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AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

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Superseding AMS 2471D

(R) 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:

This process has been used typically to increase corrosion resistance and to provide surfaces which will promote adherence of paint and other organic finishes, but usage is not limited to such applications.

1.2.1 AMS 2472 should be specified for coatings colored by dyeing. This process is not suitable for parts which contain joints or recesses in which the anodizing solution may be retained.

1.3 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2472 Anodic Treatment of Aluminum Alloys, Sulfuric Acid Process, Dyed Coating
AMS 2473 Chemical Treatment for Aluminum Alloys, General Purpose Coating
AMS 4037 Aluminum Alloy, Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn, (2024; -73 Flat Sheet, -T351 Plate), Solution Heat Treated

2.2 ASTM Publications:

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

ASTM B117 Salt Spray (Fog) Testing
ASTM B 137 Measurement of Mass of Coating on Anodically Coated Aluminum

2.3 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 Solutions:

3.1.1 Electrolyte: Shall be an aqueous solution of sulfuric acid of suitable concentration maintained within ± 2 °F (± 1 °C) of the temperature approved in 4.4.2.

3.1.1.1 The nominal concentration of the electrolyte should be 15 to 20% by weight. The temperature should be selected from within the range 64 to 75 °F (18 to 24 °C).

3.1.2 Sealer: Unless otherwise permitted, the sealer should be an aqueous solution of sodium dichromate or potassium dichromate.

3.1.2.1 Dichromate concentration should be 4.5 to 6% by weight. The pH shall be within the range 5.5 to 6.5, and may be adjusted by the addition of chromic acid. The temperature should be within the range 190 to 212 °F (88 to 100 °C) (See 8.2.8).

3.2 Procedure:

3.2.1 Preparation: All fabrication-type operations, such as forming, shot peening, brazing, welding, perforating, machining, and heat treatment, shall be completed before parts are anodized.

- 3.2.2 Cleaning and Deoxidation: Parts shall have clean surfaces, free from water break, prior to immersion in the anodizing solution. Etching to achieve metal removal is required for cast surfaces.
- 3.2.2.1 Cleaning materials or products used for surface preparation containing iron, such as steel wool, iron oxide rouge, or steel wire, which may become embedded in the metal and accelerate subsequent corrosion, are prohibited.
- 3.2.3 Tight electrical contact shall be maintained during the anodic treatment to prevent contact arcing (burning) of parts, but small irregularities of coating at points of electrical contact are acceptable.
- 3.2.4 Coating: The cleaned parts shall be made the anode(s) in the electrolyte contained in a chemical-resistant tank which may also serve as the cathode. The processing shall be adjusted to obtain the required weight and quality of the coatings. The anodizing current shall be maintained within ± 2 amperes per square foot ($\pm 21.5 \text{ A/m}^2$) of the nominal value. Alternatively, the anodizing current shall be ramped up over a five minute or other preselected period to the desired final voltage and maintained until the anodic coating reaches the desired thickness. After anodizing, parts shall be rinsed in clean water at ambient temperature.
- 3.2.5 Sealing: Parts shall be immersed in the sealant solution for a suitable time (See 8.2.8), then rinsed. The rinse shall be thorough, but slight staining resulting from the sealant solution is acceptable. Rinsing is not required if deionized water is used for sealing.
- 3.2.6 Masking: Areas where anodizing is prohibited shall be masked.
- 3.3 Properties:
- Coated parts shall conform to the following requirements:
- 3.3.1 Coating Weight: The sealed coating weight (See 4.3.2.1), determined in accordance with ASTM B 137, shall be not less than 600 mg/square foot (6.5 g/m^2).
- 3.3.1.1 If small parts, such as rivets or machine screws, are anodized in bulk in a container, the specified coating weight shall apply to not less than 75% of the parts treated together, determined by random sampling, but in no case shall any part show uncoated areas.

- 3.3.2 Corrosion Resistance: Panels (See 4.3.2.2) shall meet the following requirements, determined after exposure for not less than 336 hours to salt spray corrosion test in accordance with ASTM B 117, except that significant surface shall be inclined six degrees from vertical. Areas within 1/16 inch (1.6 mm) of identification markings or of an edge, or at electrode contact marks, shall not be included.

Fifteen scattered spots or pits, none larger than 1/32 inch (0.8 mm) diameter, on a total of 150 square inches (968 cm²) of test area from five or more test pieces.

Five scattered spots or pits, none larger than 1/32 inch (0.8 mm) diameter, on any 30 square inches (194 cm²) of test area from one or more test pieces.

- 3.4 Touch Up:

Parts on which the anodic coating has been scratched or damaged superficially may be coated using AMS 2473 or another method acceptable to the cognizant engineering organization. Touch-up, unless otherwise specified, shall not exceed 0.5 inch (13 mm) in its longest dimension, except that scratches that are essentially one dimensional (less than 0.03 inches (0.8 mm) wide) may be reworked. The total reworked area shall not exceed 5% of the total surface area.

- 3.5 Quality:

Anodic coating, as received by purchaser, 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 usage of the coating.

4. QUALITY ASSURANCE PROVISIONS:

- 4.1 Responsibility for Inspection:

The coating processor shall supply all samples for processor's tests and shall be responsible for performing all required tests. Parts, if required for tests, shall be supplied by purchaser. Processor may utilize his own or any other inspection facilities or services acceptable to purchaser. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that processing conforms to specified requirements.

- 4.2 Classification of Tests:

- 4.2.1 Acceptance Tests: Quality (3.5) is an acceptance test and shall be performed on each lot.

- 4.2.2 Periodic Tests: Coating weight (3.3.1), corrosion resistance (3.3.2), and tests of cleaning and processing solutions to ensure that the anodic coating will conform to specified requirements are periodic tests and shall be performed at a frequency selected by the processor unless frequency of testing is specified by purchaser.
- 4.2.3 Preproduction Tests: All technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of processed parts to a purchaser, when a change in material and/or processing requires approval by the cognizant engineering organization (See 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, contracting officer, or request for procurement.

4.3 Sampling and Testing:

Shall be not less than the following; a lot shall be all parts of the same part number, processed in a continuous series of operations (3.2.4 to 3.2.5, inclusive), in not longer than 24 consecutive hours, and presented for processor's inspection at one time.

- 4.3.1 For Acceptance Tests: Shall be as shown in Table 1.

TABLE 1 - Sampling for Acceptance Testing

Number of Parts in Lot		Quality
Up to	7	All
8 to	15	7
16 to	40	10
41 to	110	15
111 to	300	25
301 to	500	35
Over	500	50

- 4.3.2 For Periodic and Preproduction Tests: Sample quantity and frequency shall be selected at the discretion of the processor, unless otherwise specified, except for corrosion testing, which shall be carried out at a frequency not less than monthly.
- 4.3.2.1 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 panels 0.025 to 0.063 inch (0.64 to 1.60 mm) thick and not less than 3 inches (76 mm) square fabricated from AMS 4037 aluminum alloy.

- 4.3.2.1.1 Separate test panels, if used, shall be processed with the work they represent.
- 4.3.2.2 Corrosion Resistance: Shall be determined on separate test panels 0.025 to 0.63 inch (0.64 to 1.60 mm) thick and not less than 3 x 10 inches (76 x 254 mm) in width and length fabricated from AMS 4037 aluminum alloy.
- 4.4 Approval:
- 4.4.1 Processes, control factors, or preproduction sample part or test panel, or any combination thereof specified, shall be approved by the cognizant engineering organization before production parts are supplied.
- 4.4.2 Processor 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 parts.
- 4.4.3 Control factors for anodizing shall include, but not be limited to, the following:
- Cleaning procedure, including the compositions and temperatures of the baths used
 - Deoxidation process
 - Anodizing bath composition (including impurity limits), temperature, and agitation method
 - Rate of voltage rise, anodizing voltage, and time of anodizing
 - Sealing solution composition (including impurity limits), temperature, and pH
 - Purity of water used for sealing and rinsing
 - Periodic test plan
- 4.5 Reports:
- The processing vendor of coated parts shall furnish with each shipment a report stating that the parts have been processed and tested in accordance with specified requirements and that they conform to the acceptance test requirements. This report shall include the purchase order number, lot number, AMS 2471 E, part number, and quantity.
- 4.6 Resampling and Retesting:
- 4.6.1 If results of any acceptance test fail to meet specified test requirements, the parts in that lot may be stripped by a method acceptable to purchaser that does not roughen or pit the basis metal or adversely affect dimensional tolerances, pretreated, coated, post treated as defined herein, and tested. Alternatively, all parts in the lot may be inspected for the nonconforming attribute, and the nonconforming parts may be stripped by a method acceptable to purchaser that does not roughen or pit the basis metal or adversely affect dimensional tolerances, pretreated, coated, post treated as defined herein, and tested.