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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE RECOMMENDED PRACTICE

SAE ARP1932 | REV. A

Issued 1985-01
Cancelled 2000-10

Superseding ARP1932

Anodize Treatment of Titanium and Titanium Alloys pH 12.4 Maximum

CANCELLATION NOTICE

This ARP has been declared "CANCELLED" by the Aerospace Materials Division, SAE, as of October 2000, and has been superseded by AMS 2487. The requirements of the latest issue of AMS 2487 shall be fulfilled whenever reference is made to the cancelled ARP1932. By this action, this document will remain in the Numerical Section of the Index of Aerospace Material Specifications noting that it is superseded by AMS 2487.

If you need a copy of the previous revision of this specification, please contact SAE Headquarters at (724) 776-4970.

1. SCOPE:

1.1 Purpose:

This recommended practice describes the engineering requirements for producing a voltage-resistant, non-powdery anodic coating on titanium and titanium alloys and the properties of such coatings.

1.2 Application:

Primarily to increase resistance to galvanic and high temperature corrosion and high voltages and to form a receptive base for the application of lubricants and paints on titanium and titanium alloys.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this practice 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
AMS 3084	Solid Film Lubricant, Space Application, Minimal Outgassing
AMS 4000	Aluminum Plate and Sheet (1060-0)
AMS 4911	Titanium Alloy Sheet, Strip, and Plate, 6A1-4V, Annealed

2.2 ASTM Publications:

Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM B110	Dielectric Strength of Anodically Coated Aluminum
ASTM B117	Salt Spray (Fog) Testing
ASTM B244	Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy Current Instruments
ASTM D2714	Calibration and Operation of the Alpha Model LFW-1 Friction and Wear Testing Machine

2.3 U.S. Government Publications:

Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 141	Paint, Varnish Lacquer, and Related Materials, Methods of Inspection, Sampling, and Testing

2.3.2 Military Specifications:

MIL-L-8937	Lubricant, Solid Film, Heat Cured
MIL-L-81329	Lubricant, Solid Film, Extreme Environment

2.3.3 Military Standards:

MIL-STD-794 Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Solutions:

3.1.1 Electrolyte: Should be any suitable solution with a pH not higher than 12.4.

3.2 Equipment:

3.2.1 Tanks and Cathodes: Should be of any material suitable for the electrolyte being used.

3.2.2 Fixturing: Racks, wires, hooks, and clamps used to suspend parts in the electrolyte should be make of titanium or titanium alloys.

3.3 Preparation:

3.3.1 Parts should be cleaned to remove oil, grease, dirt, mill marks, heat scale, and discoloration or any other contaminant that will interfere with the anodize process. The cleaning process should not cause pick up of hydrogen or halogen.

3.3.2 Masking: Titanium parts containing inserts or portions of other metals should have the dissimilar metal masked off before parts are coated.

3.3.3 Attachment and Contacts: When parts are to be selectively coated, electrical contact should be made on a surface not required to be coated. When parts are not to be coated all over, the areas on which electrical contact is permissible should be indicated on the drawing or as agreed upon by purchaser and vendor.

3.3.4 Racking: Parts should be placed on clean racks and tested for electrical continuity.

3.3.5 Suspension in Electrolyte: Racks should be tightly attached to the anode bar, positioning in a manner to avoid gas entrapment.

3.4 Procedure:

3.4.1 Processing: The cleaned and racked parts should be immersed in the electrolyte. The parts should be the anode and the tank or separate electrodes serve as the cathode. Current should be applied and the voltage raised manually or automatically to maintain the required current density for the time necessary to achieve the required thickness. Air agitation may be used to minimize entrapment of air in the parts.

3.4.2 Rinsing and Drying: After anodizing, parts should be thoroughly rinsed in cold, agitated tap water, rinsed in clean, hot tap water, and dried.

3.5 Properties:

Coatings on parts should conform to the following requirements.

3.5.1 Thickness: May be specified by ARP1932 and a suffix number designating the nominal thickness in ten-thousandths of an inch (2.5 μm); thus ARP1932 designates a coating thickness of 0.0001 in. (2.5 μm) and ARP1932 designates a finished coating thickness of 0.0003 in. (7.5 μm). A tolerance of ±0.00005 in. (1.25 μm) per 0.0001 in. (2.5 μm) of nominal coating thickness will be permitted.

3.5.1.1 Thickness of coating should be determined on representative parts or on specimens as in 4.3.1.1 to the nearest 0.0001 in. (2.5 μm) by micrometer, by eddy current measurement in accordance with ASTM B244, or by other method agreed upon by purchaser and vendor. Coating thickness requirements shall not apply to blind holes or recesses with depth greater than seven times the diameter unless a specific coating thickness is specified on those areas.

3.5.2 Color: Should be substantially uniform on pieces of the same alloy processed to the same nominal coating thickness.

3.5.3 Voltage Resistance: Should be 75 V AC on a 0.0001-in. (2.5-μm) thick coat applied to AMS 4911 titanium alloy, determined in accordance with ASTM B110. Voltage resistance for other thicknesses should be as agreed upon by purchaser and vendor.

3.5.4 Galvanic Corrosion Resistance: There should be no evidence of galvanic corrosion of AMS 4911 titanium alloy anodized to a thickness of 0.0001 in. (2.5 μm) and coupled to bare AMS 4000 aluminum when tested for 168 hr in accordance with ASTM B117. The corrosion resistance for other specified thicknesses should be as agreed upon by purchaser and vendor.

3.5.5 Abrasion Resistance: Weight loss for a 0.0001 in. (2.5 µm) coat should not exceed 10 mg, determined in accordance with Federal Test Method Standard No. 141, Method 6192, using CS-17 wheels with a 1000 g load. The test shall be run for 100 cycles.

3.5.6 Abrasion Resistance of Lubricated Surfaces: Specimens of AMS 4911 titanium alloy with a 0.0001-in. (2.5-µm) thick coating lubricated with either AMS 3084, MIL-L-8937, or MIL-L-81329 should pass a straight line wear of 35,000 ft (10,700 m) determined in accordance with ASTM D2714.

3.5.7 Foil Test: There should be no evidence of burning of AMS 4911 foil, nominally 0.008 x 1 x 3 in. (0.2 x 25 x 75 mm), when anodized to a minimum coating thickness of 0.0001 in. (2.5 µm).

3.5.8 Resistivity: Should be 1 x 10^{12} ohms when tested in accordance with electrodes suggested in ASTM B110 on AMS 4911 titanium alloy anodized to a thickness of 0.0001 in. (2.5 µm). An RCA megohmmeter, type 1862-B, or equivalent, may be used for the determination.

3.5.9 Quality: Coating should be substantially uniform in thickness, texture, and appearance, adherent to basis metal, and free of scratches, chips, and burned or powdery areas. Small irregularities at points of electrical contact are permissible.

3.5.10 Tolerances: When parts are specified to be selectively coated, a tolerance of –0, +1/16 in. (+1.6 mm), unless otherwise specified, will be permitted on the extent of the anodized area.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The coating vendor should supply all samples for vendor's tests and be responsible for performing all required tests. Results of such tests should 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 the processing conforms to the requirements of this recommended practice.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for thickness (3.5.1), color (3.5.2), voltage resistance (3.5.3), resistivity (3.5.8), and quality (3.5.9) are classified as acceptance tests and should be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for corrosion resistance (3.5.4), abrasion resistance (3.5.5 and 3.5.6), and foil test (3.5.7) are classified as periodic tests and should 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 recommended practice are classified as preproduction tests and should be performed prior to or on the initial shipment of coated 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.

4.3 Sampling:

Should be as follows: a lot shall be all coated parts made from the same alloy, processed to the same coating thickness in a 24-hr period, 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.

4.3.1.1.1 When micrometer measurement is used, specimens for the thickness determination should be of the same alloy as the parts they represent and should be processed with the parts. Micrometer measurements should be calibrated against eddy current measurements on specimens of the same alloy processed to the same nominal thickness.

4.3.1.2 Color and Quality: All parts.

4.3.1.3 Voltage Resistance and Restivity: Three parts from each lot.

4.3.2 For Periodic Tests and Preproduction Tests: As agreed upon by purchaser and vendor.

4.3.2.1 Specimens for galvanic corrosion resistance should be made of AMS 4911 titanium alloy and AMS 4000 aluminum strips 0.020 - 0.062 x 1 x 6 in. (0.50 - 1.50 x 25 x 150 mm) with a 0.25-in. (6.25-mm) hole at an edge distance of 0.50 in. (12.5 mm) from one end. The AMS 4911 specimen should be fastened to the AMS 4000 specimen by means of a nylon bolt and nut.

4.4 Approval:

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

4.4.2 Vendor should 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 materials, in type of equipment, or in established composition limits and operating conditions of processing solutions, vendor should submit for reapproval of the process a statement of the proposed changes in processing and, when requested, coated parts, test panels, or both. Production parts coated by the revised procedure should not be shipped prior to receipt of reapproval.