



AEROSPACE MATERIAL SPECIFICATION

AMS2487™**REV. B**

Issued 1993-04
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Reaffirmed 2022-01

Superseding AMS2487A

Anodic Treatment of Titanium and Titanium Alloys
Solution pH 12.4 Maximum

RATIONALE

AMS2487B results from a Five-Year Review with changes made to paragraphs Ordering Information, Preparation 3.3.2, Voltage Breakdown Resistance 3.5.3.1.1 and 3.5.3.1.2, Abrasion Resistance 3.5.5, Wear Resistance 3.5.6, Electrical Resistance 3.5.8, and Periodic Test 4.2.2.

NOTICE

ORDERING INFORMATION: The following information shall be provided to the processor by the purchaser.

1. Purchase order shall specify not less than the following:

- AMS2487B
 - Basis metal to be anodized
 - Special features, geometry or processing present on parts that requires special attention by the processor
 - Quantity of pieces to be anodized
 - Part or assembly number of parts to be coated
2. Parts manufacturing operations such as heat treating, forming, joining and media finishing can affect the condition of the substrate for anodizing, or, if performed after anodizing, could adversely affect the coated part. The sequencing of these types of operations should be specified by the cognizant engineering organization or purchaser and is not controlled by this specification.

1. SCOPE

1.1 Purpose

This specification describes the engineering requirements for producing an electrically-insulating, non-powdery anodic coating on titanium and titanium alloys and the properties of such coatings.

1.2 Application

This process has been used typically to increase resistance to galvanic and high temperature corrosion and voltage breakdown and to form a receptive base for the application of lubricants and paints on titanium and titanium alloys, but usage is not limited to such applications.

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For more information on this standard, visit
<https://www.sae.org/standards/content/AMS2487B/>

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 issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS3084	Lubricant, Solid Film, Minimal Outgassing
AMS4001	Aluminum Sheet and Plate, 0.12Cu (1100-0), Annealed
AMS4911	Titanium Alloy Sheet, Strip, and Plate, 6Al - 4V, Annealed
AMS4928	Titanium Alloy Bars, Wire, Forgings, and Rings, 6Al - 4V, Annealed
ARP4992	Periodic Test Plan for Process Solutions
AS5272	Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting, Procurement Specification

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B117	Operating Salt Spray (Fog) Apparatus
ASTM B244	Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments
ASTM D257	DC Resistance or Conductance of Insulating Materials
ASTM D2714	Calibration and Operation of the Falex Block-on-Ring Friction and Wear Testing Machine
ASTM D 4060	Abrasion Resistance of Organic Coatings by the Taber Abraser

2.3 U.S. Government Publications

Copies of these documents are available online at <http://quicksearch.dla.mil>.

MIL-PRF-46010	Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting
MIL-PRF-81329	Lubricant, Solid Film, Extreme Environment

3. TECHNICAL REQUIREMENTS

3.1 Solutions

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

3.2 Equipment

3.2.1 Tanks and Cathodes: Processing tanks shall be fabricated from a material which is suitable for containment of the electrolyte being used. Cathode materials shall be insoluble in the electrolyte.

3.2.2 Fixturing: Racks, wires, hooks, and clamps, in contact with the parts or the electrolyte, which are used to suspend parts in the electrolyte shall be made of titanium or titanium alloys.

3.3 Preparation

3.3.1 Cleaned parts shall be free of water break. The use of halogenated solvents is prohibited.

3.3.2 Anodic cleaning of titanium parts shall be prohibited.

3.3.3 Electrical contact points shall be in areas acceptable to the purchaser.

3.3.4 Suspension in Electrolyte: Parts shall be positioned in a manner to avoid gas entrapment.

3.4 Procedure

The cleaned and racked parts shall be immersed in the electrolyte. Current shall be applied and the voltage raised manually or automatically to maintain the required current density for the time necessary to achieve the required coating thickness. Air agitation shall be used to minimize entrapment of gas in the coated surface. After anodizing, parts shall be thoroughly rinsed and dried.

3.5 Properties

Coatings on parts shall conform to the following requirements:

3.5.1 Thickness

May be specified by AMS2487 and a suffix number designating the nominal thickness in ten-thousandths of an inch (2.5 μm); thus, AMS2487-1 designates a coating thickness of 0.0001 inch (2.5 μm) and AMS2487-3 designates a finished coating thickness of 0.0003 inch (7.6 μm). A tolerance of ± 0.00005 inch (1.27 μm) per 0.0001 inch (2.5 μm) of nominal coating thickness will be permitted. If thickness is not specified, coating thickness shall be 0.0001 inch (2.5 μm).

3.5.1.1 Thickness of coating shall be determined on representative parts or on specimens to the nearest 0.0001 inch (2.5 μm) by direct micrometer measurement, by eddy current measurement in accordance with ASTM B244, or by other method acceptable to purchaser. Specimens, if used, shall be fabricated from the same alloy as the parts they represent and shall be processed with the parts represented. In case of dispute, eddy current method shall govern. 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

Shall be substantially uniform on anodized parts of the same alloy, with a similar surface finish, processed to the same nominal coating thickness.

3.5.3 Voltage Breakdown Resistance

Shall be not less than 75 volts, alternating current on a 0.0001-inch (2.5- μm) thick coat applied to specimens fabricated from AMS4911 titanium alloy, determined in accordance with the procedure in 3.5.3.1 through 3.5.3.2. Specimens shall be processed with the parts they represent. Voltage breakdown resistance for other thicknesses shall be as agreed upon by purchaser and processor.

3.5.3.1 Equipment

- 3.5.3.1.1 Voltage source for testing shall be supplied by an alternating current power source capable of supplying a voltage from 0 to 300 VAC; voltage shall be controlled so that it can be increased at a rate of 25 V/s $\pm$ 2 v/s until breakdown occurs.
- 3.5.3.1.2 Electrode(s) shall be made of brass, bronze, or copper and shall have smooth contact surfaces. The electrode used for contacting the coated surface shall have a spherical apex of an approximately 0.125-inch (3.18-mm) radius. Electrodes shall be insulated to ensure that personnel are protected from electrical shock. Electrodes shall be examined for damage or roughness prior to use and shall be repolished if necessary.

3.5.3.2 Test Procedure

- 3.5.3.2.1 Attach one probe to the specimen to be tested; this probe must make contact with the base substrate. Contact with the base substrate shall be made by scratching through the finish on an area which is not a functional area, or by making contact with an area not coated.
- 3.5.3.2.2 Bring the conical shaped electrode in contact with the coated surface, (care should be taken not to damage the coating) to maintain a uniform pressure to ensure an accurate reading.
- 3.5.3.2.3 Raise applied voltage at a rate of 25 $\pm$ 2 V/s until specified voltage is attained or until breakdown occurs.

3.5.4 Galvanic Corrosion Resistance

There shall be no evidence of galvanic corrosion of bare AMS4001 aluminum specimens when coupled to AMS4911 titanium alloy specimens anodized to a thickness of 0.0001 inch (2.5 μ m) after exposure for not less than 168 hours to salt spray corrosion test in accordance with ASTM B117. After exposure, aluminum specimens shall show no evidence of galvanic corrosion. Specimens shall be prepared in accordance with 4.3.2.1.

3.5.5 Abrasion Resistance

Weight loss for a 0.0001 inch (2.5 μ m) coating shall not exceed 10 mg, determined in accordance with ASTM D 4060, using CS-17 wheels with a 1000 g load. The test shall be run for 100 cycles. Specimens may be placed in a desiccator prior to and following test to establish constant weight in lieu of conditioning specified in ASMT D 4060..

3.5.6 Wear Resistance of Lubricated Surfaces

Test rings and blocks made of AMS4928 titanium alloy, anodized as specified herein (AMS2481-1) and coated with 0.0003 to 0.0005 inch (7.6 to 12.7 μ m) of AMS3084, AS5272, MIL-PRF-46010 or MIL-PRF-81329 solid film lubricant shall have an average life of 75000 oscillatory cycles, determined in accordance with 3.5.6.1.

- 3.5.6.1 Using a block-on-ring test machine calibrated and operated in accordance with ASTM D2714, mount an anodized and dry-film lubricated test ring on the test machine in accordance with manufacturers' instructions. Place sufficient weight on the bale rod to achieve 630 pounds normal force (2802 N) when load is applied. Start machine. After 1 minute, gently apply load to the lever system. Terminate the test when the coefficient of friction equals 0.20. Repeat the room temperature test twice using new anodized and lubricated test blocks and rings in each test.

3.5.7 Foil Test

There shall be no evidence of burning of AMS4911 foil, nominally 0.008 x 1 x 3 inches (0.20 x 25 x 76 mm), when anodized to a minimum coating thickness of 0.0001 inch (2.5 μ m).

3.5.8 Electrical Resistance

Shall be not less than $1 \times 10^{12} \Omega$ determined in accordance with ASTM D257 on AMS4911 titanium alloy anodized to the thickness callout of AMS 2478-1 The resistance of coatings with other thicknesses or on other materials shall be agreed upon by purchaser and processor.

3.6 Quality

Coating, as received by purchaser, shall be essentially 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.

3.7 Tolerances

When parts are specified to be selectively coated, a tolerance of -0, +1/16 inch (+1.6 mm) will be permitted on the extent of the anodized area.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The processor shall supply all samples for processor's tests and shall be responsible for performance of all required tests. When parts are to be tested, such parts shall be supplied by the purchaser. 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 specification.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Thickness (3.5.1), color (3.5.2), voltage breakdown resistance (3.5.3), electrical resistance (3.5.8), and quality (3.6) are acceptance tests and shall be performed on each lot. The voltage breakdown resistance of coatings with other thicknesses or on other materials may be agreed upon by purchaser and processor, or, where not specified or agreed upon, the results of tests on AMS4911 coated as in AMS2487-1 in the same manner at the same time shall be acceptable.

4.2.2 Periodic Tests

Galvanic corrosion resistance (3.5.4), abrasion resistance (3.5.5) wear resistance (3.5.6), and foil test (3.5.7) and tests of cleaning and processing solutions to ensure that the anodic coating will conform to specified requirements (see 8.3) 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 coated parts to a purchaser and when purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing

Shall be as follows; a lot shall be all coated parts of the same part number made from the same alloy, processed to the same coating thickness in the same set of solutions in a 24-hour period, and presented for processor's inspection at one time.

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