AEROSPACE MATERIAL SPECIFICATION

AMS2479™	REV. E

Issued 1966-09
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Revised 2024-02

Superseding AMS2479D

Anodic Treatment of Magnesium Alloys Acid Type, Thin coat

RATIONALE

AMS2479E results from a Five-Year Review and update of this specification with the addition of Ordering Information notice, change to Electrolyte (see 3.1.1), addition of Fixture/Electrical Contact Locations (see 3.3.3) per GA, clarification of Coating Thickness (see 3.5.1), change to Quality (see 3.6), and changing lot definition per GA (see 4.3).

NOTICE

ORDERING INFORMATION: The following information shall be provided to the plating processor by the cognizant engineering organization:

1. Purchase order shall specify not less than the following:
   - AMS2479E
   - Quantity of pieces to be plated
   - Magnesium alloy to be plated
   - Optional: fixture/electrical contact locations, when not specified (see 3.3.3)
2. Parts manufacturing operations such as heat treating, forming, joining, and media finishing can affect the condition of the substrate for treatment, or, if performed after treatment, could adversely affect the treated 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 establishes the engineering requirements for producing an acid-type, anodic coating on magnesium alloys and the properties of the coating.

1.2 Application

This process has been used typically to increase corrosion and abrasion resistance and to provide surfaces which will ensure maximum paint adhesion, but usage is not limited to such applications.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

For more information on this standard, visit
https://www.sae.org/standards/content/AMS2479E

1.2.1 This process is applicable to all magnesium alloys provided proper allowance is made for dimensional change. It should not be used for parts flexed in service. Abrasion resistance is not as high as is provided with the alkaline electrolytic treatment of AMS2476 or the full-coat, acid treatment of AMS2478 but, when similarly painted or resin-coated, other properties are equivalent.

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.

AMS2476 Electrolytic Treatment for Magnesium Alloys, Alkaline Type, Full Coat

AMS2478 Anodic Treatment of Magnesium Alloys, Acid Type, Full Coat

AMS4352 Magnesium Alloy, Extrusions, 5.5Zn - 0.45Zr (ZK60A-T5), Precipitation Heat Treated

ARP4992 Periodic Test for Processing Solutions

AS7766 Terms Used in Aerospace Metals Specifications

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 B244 Measurement of Thickness of Anodic Coatings on Aluminum and Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments

ASTM B487 Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section

2.3 Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Solutions

3.1.1 Electrolyte

Shall be an aqueous solution of one of the compositions shown in Table 1, maintained within the range 160 to 180 °F (71 to 82 °C). If neither alternating nor direct current is specified, either may be used. Alternative processing solutions (see 4.4.1) may be used if acceptable to the cognizant engineering organization.

Table 1A - Bath composition, inch/pound units

Ingredient	AC Process Quantity	DC Process Quantity
Ammonium Bifluoride, ounces (Avdp) per gallon ($NH_4F{\cdot}HF$)	30.0 to 60.0	40.0 to 60.0
Sodium Dichromate, ounces (Avdp) per gallon ($Na_2Cr_2O_7{\cdot}2H_2O$)	6.7 to 16.0	6.7 to 16.0
Phosphoric Acid, fluid ounces per gallon (85% H_3PO_4)	6.5 to 14.0	6.5 to 14.0

Table 1B - Bath composition, SI units

Ingredient	AC Process Quantity	DC Process Quantity
Ammonium Bifluoride, grams/L ($NH_4F{\cdot}HF$)	225 to 449	300 to 449
Sodium Dichromate, grams/L ($Na_2Cr_2O_7{\cdot}2H_2O$)	50 to 120	50 to 120
Phosphoric Acid, mL/L (85% H_3PO_4)	51 to 109	51 to 109

3.1.2 Sealer

Shall be an aqueous solution containing 6 to 8 ounces/gallon (45 to 60 g/L) of sodium tetrasilicate ($Na_2Si_4O_9$) maintained at a temperature within the range 200 to 212 °F (93 to 100 °C).

3.2 Equipment

3.2.1 Tanks

Shall be fabricated from materials which are compatible with the solutions and temperature required for processing parts and shall be equipped with facilities for maintaining the solutions within the operating temperature ranges specified.

3.2.2 Fixtures

Wire, hooks, clamps, and racks used to suspend parts in the electrolyte, and which are in contact with the electrolyte, shall be of magnesium or magnesium alloys, or from aluminum alloys containing magnesium (5000 or 6000 series). Such fixtures shall be protected with a suitable maskant at the electrolyte-air interface.

3.3 Preparation

3.3.1 Masking

Parts which contain inserts other than 5000 or 6000 series aluminum alloys and parts not to be anodized all over shall be masked to seal off the non-magnesium or non-aluminum materials and the surfaces not to be anodized.

3.3.2 Cleaning

Parts shall be pickled and cleaned as necessary to ensure that surfaces are free of water break.

3.3.3 Fixture/Electrical Contact Locations

Tight fixture/electrical contact shall be maintained during the anodic treatment/conversion coating process, in order to prevent damage or contact arcing (burning) of parts, but small irregularities of coating at points of fixture/electrical contact, are acceptable. Parts shall, insofar as practicable, be hung to avoid gas entrapment during processing.

3.3.3.1 For parts that are to be anodized all over, and contact locations are not specified, contact locations shall be at the discretion of the processor.

3.3.3.2 For parts that are not to be anodized all over, and contact locations are not specified, locations shall be in areas on which coating is not required.

3.3.3.3 AC Processing

Parts shall be distributed on both electrodes so that the surface areas of the parts on each electrode are approximately equal.

3.3.3.4 DC Processing

Parts shall be distributed on one electrode with the other electrode being separate steel plates except as noted in 3.4.1.

3.4 Procedure

3.4.1 Processing

The cleaned and racked parts shall be immersed in the electrolyte (see 8.2.1). The parts shall be made the anode in the DC process, and, for this process, the tank may serve as the cathode if it is made of unlined steel. Alternating or direct current, as applicable, shall be applied and the voltage raised manually or automatically during processing to maintain the required current density. Current density shall be maintained so that, in a processing time of not more than 30 minutes, the total power input shall be as shown in Table 2.

Table 2 - Power input

Type of Current	Total Power Input
AC Process	80 to 100 ampere minutes/square foot (14.3 to 18.0 A·second/m^2)
DC Process	50 to 60 ampere minutes/square foot (9.0 to 10.8 A·second/m^2)

3.4.1.1 Completion of processing is indicated by a uniform, light green to gray color, free from definite bare or light colored areas except as permitted in 3.6, examined, while wet, after rinsing in cold water.

3.4.2 Sealing

When specified, immediately after coating and rinsing, parts which will not be painted, or which are to be partially painted shall be immersed in the sealer solution (see 3.1.2) for approximately 15 minutes immediately after coating.

3.4.3 Rinsing and Drying

After anodizing, or after sealing, when specified, parts shall be rinsed thoroughly in cold, running tap water, rinsed in clean hot water, and dried.

3.5 Properties

Coatings shall conform to the following requirements:

3.5.1 Coating Thickness

Shall be such that the dimensional increase will be 0.0001 to 0.0005 inch (2.5 to 12.7 µm) per surface. Anodize thickness shall be determined on representative parts or specimens (see 4.3.3) in accordance with ASTM B244, ASTM B487, by direct micrometer measurements, or by other method acceptable to the cognizant quality organization.

3.5.2 Coating Weight

If the size or shape of parts is such that coating thickness cannot be determined accurately, determination of coating weight may be substituted for determination of thickness. Coating weight shall be 0.400 to 2.000 grams/square foot (4.30 to 21.50 g/m^2), determined as in 3.5.2.1.

3.5.2.1 Weigh an oven-dried coated part or a coated test specimen as in 4.3.3. Strip the coating in a fresh, sulfate-free solution containing approximately 40 ounces/gallon (300 g/L) of chromic acid until the weight difference between successive weighings is less than 1.0 milligram/square inch (0.155 mg/cm^2). After each stripping operation, wash the part or test specimen with distilled water and oven dry thoroughly before weighing. Determine coating weight by subtracting the weight of the stripped specimen from the weight prior to stripping and dividing by the surface area. Oven drying temperature shall not be higher than 250 °F (121 °C).

3.6 Quality

3.6.1 Anodic coating, as received by the purchaser, shall be continuous, smooth, adherent to base metal, uniform in texture and appearance, and free from burned or 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.

3.6.2 Differences in the coating texture or appearance on castings or wrought components attributed to base metal conditions such as, between cast and machined surface textures, between welds and adjacent areas, between shot peened and non-shot peened surfaces, variations to grain size or grain flow, or due to variations in alloy composition from part to part, or from lot to lot, are acceptable (see 8.8).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The processor shall supply all samples for the processor's tests and shall be responsible for the performance of all required tests. Where parts are to be tested, such parts shall be supplied by the purchaser. The purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the coating conforms to the requirements of this specification.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Coating thickness (see 3.5.1) or coating weight (see 3.5.2), as applicable, and quality (see 3.6) are acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests

Cleaning and processing solution tests (see 8.4) to ensure that the deposited coating will conform to the requirements of this specification are periodic tests and shall be performed at a frequency selected by the processor unless frequency of testing is specified by the cognizant quality organization.

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, when a change in material and/or processing requires approval by the cognizant engineering organization (see 4.4.2), and when the cognizant engineering organization and/or the purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing

Shall be not less than the following: a lot is a group of parts, all of the same part number, processed through the same chemical solutions in the same tanks under the same conditions, which have completed the chemical processing within a period of 24 hours of each other, and are presented for inspection at the same time.

4.3.1 For Acceptance Tests

Shall be as shown in Table 3.

Table 3 - Sampling for acceptance testing

Number of Parts in Lot	Quantity	Coating Weight or Coating Thickness As Applicable
Up to 7	All	3
8 to 15	7	4
16 to 40	10	4
41 to 110	15	5
111 to 300	25	6
301 to 500	35	7
Over 500	50	8

4.3.2 For Periodic Tests

Sample quantity and frequency of testing shall be selected at the discretion of the processor, unless otherwise specified.

4.3.3 Coating Thickness and Coating Weight

Shall be determined on representative parts when size and shape permit accurate determinations. If parts are of such size and shape that accurate determinations cannot be made, coating thickness, and coating weight tests shall be made on separate specimens, having surface area not less than 24 square inches (155 cm^2), made of the same generic class of alloy as the parts represented. Separate specimens, if used, shall be processed with the work they represent. In case of dispute, results of tests on actual parts shall govern.

4.4 Approval

4.4.1 The process and control factors, a preproduction sample, or both, whichever is specified, shall be approved by the cognizant engineering organization before production parts are supplied.

4.4.2 The 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.

4.4.2.1 Control factors for the process shall include, but not be limited to, the following:

Cleaning procedure
Racking set-up
Composition limits for electrolyte
Current and/or voltage control
Frequency of solution(s) analysis
Precleaning process
Periodic test plan

4.5 Reports

The processor 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, AMS2479E, part number, type of current used, and quantity.