Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS2479A
Superseding 2479

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ANODIC TREATMENT OF MAGNESIUM ALLOYS
Acid Type, Thin Coat

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: Primarily to increase corrosion and abrasion resistance and to provide surfaces which will ensure maximum paint adherence. 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 AMS 2476 or the full-coat, acid, anodic treatment of AMS 2478 but, when similarly painted or resin-coated, other properties are equivalent. Coating thickness is approximately 0.0003 in. (0.008 mm), of which approximately 0.0002 in. (0.005 mm) is build-up.

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.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pennsylvania 15096.

2.1.1 Aerospace Material Specifications:

AMS 2476 - Electrolytic Treatment for Magnesium Base Alloys, Alkaline Type, Full Coat
AMS 2478 - Anodic Treatment of Magnesium Alloys, Acid Type, Full Coat
AMS 4352 - Magnesium Alloy Extrusions, 5.5Zn - 0.45Zr (ZK60A-T5)

3. TECHNICAL REQUIREMENTS:

3.1 Solutions:

3.1.1 Electrolyte: Shall be an aqueous solution of one of the compositions of Table I, maintained at a temperature within the range 160° - 180°F (71.1° - 82.2°C).

TABLE I

	AC Process	DC Process
Ammonium Bifluoride, oz (Avoir) per gal ($NH_4F \cdot HF$)	30.0 - 60.0	40.0 - 60.0
Sodium Dichromate, oz (Avoir) per gal ($Na_2Cr_2O_7 \cdot 2H_2O$)	6.7 - 16.0	6.7 - 16.0
Phosphoric Acid, oz (Fluid) per gal (85% H_3PO_4)	6.5 - 14.0	6.5 - 14.0

TABLE I (SI)

	AC Process	DC Process
Ammonium Bifluoride, g/m^3 ($NH_4F \cdot HF$)	225 - 449	300 - 449
Sodium Dichromate, g/m^3 ($Na_2Cr_2O_7 \cdot 2H_2O$)	50 - 120	50 - 120
Phosphoric Acid, l/m^3 (85% H_3PO_4)	51 - 109	51 - 109

3.1.2 Sealer: Shall be an aqueous solution containing 6 - 8 oz per gal (45 - 60 kg/m^3) of sodium tetrasilicate ($Na_2Si_4O_9$) maintained at a temperature within the range 200° - 212°F (93.3° - 100°C).

3.2 Equipment:

3.2.1 Tanks: Shall be of steel, either lined or unlined, or shall be of other materials lined with synthetic rubber or vinyl-base materials and shall be equipped with adequate 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 vinyl-type electroplater's tape at the electrolyte-air interface.

3.3 Preparation:

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

3.3.2 Cleaning: Parts shall be pickled and cleaned as necessary to assure that surfaces are free from grease, oil, soap, alkali, and other contaminants which could cause unacceptable coatings.

3.3.3 Racking:

3.3.3.1 AC Processing: Parts shall be suspended on both electrodes so that the surface areas of the parts on each electrode are approximately equal.

3.3.3.2 DC Processing: Parts shall be suspended on one electrode with the other electrode being separate steel plates except as noted in 3.4.1.

3.3.3.3 Attachment and Contact: Parts shall be firmly attached to the racks. Contact areas shall be kept as small as possible and, when practicable, shall be on surfaces not required to be coated. When parts are to be coated all over, contacts shall be located in areas indicated on the drawing. Parts shall, insofar as practicable, be hung so as to avoid gas entrapment during processing.

3.4 Procedure:

3.4.1 Processing: The cleaned and racked parts shall be immersed in the electrolyte. 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 denisty shall be maintained so that, in a processing time of not more than 30 min., the total power input will be as follows:

AC Process	80 - 100 amp-min. per sq ft (14.4 - 17.9 A·sec/m^2)
DC Process	50 - 60 amp-min. per sq ft (9.0 - 10.8 A·sec/m^2)

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

3.4.2 Sealing: When specified, parts not to be painted or which are to be only partly painted shall be immersed in the sealer solution for approximately 15 minutes.

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:

3.5.1 Coating Thickness: Shall be such that the dimensional increase will be 0.0001 - 0.0005 in. (0.003 - 0.013 mm) per surface, determined by measuring at the same locations with micrometers accurate to 0.0001 in. (0.003 mm) before and after anodizing, dividing by two if opposite faces are anodized, and multiplying by 1.3.

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 - 2.000 g per sq ft (4.31 - 21.53 g/m^2), determined as in 3.2.5.1.

3.5.2.1 Weigh a coated part, or a coated test specimen, and strip the coating in a fresh, sulfate-free solution containing approximately 40 oz per gal (300 kg/m^3) of chromic acid until the weight difference between successive weighings is less than 1.0 mg per sq in. (0.155 mg/cm^2). After each stripping operation wash the part or test specimen with distilled water and 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.

3.5.3 Adhesion: Coatings on parts or on test panels shall show no damage or removal when subjected to the following tape test:

3.5.3.1 Press a piece of 1-in. (25-mm) wide masking tape (See 8.2) tightly against the coated surface by passing a 4-1/2 lb (2.04 kg) rubber covered roller over the tape two times. Remove the tape in one quick perpendicular motion and examine the coating for damage.

3.6 Quality: Surfaces of coated parts shall be uniform in texture and appearance except that dark striations on parts made of extruded ZK60A alloy (AMS 4352) will be acceptable if no pitting is present. Powdery areas, laminations, excessive buildup, and darkening of corners and edges are not acceptable. There shall be no bare or definite light-colored areas except in pockets where gas was trapped during processing and at fixture-contact areas.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The coating vendor shall supply all samples and shall be reponsible 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 perform such confirmatory testing as he deems necessary to assure that deposits conform to the requirements of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classifed as acceptance or routine control tests except that determination of both coating thickness and coating weight on any one lot will not be required.

4.3 Sampling: Sufficient parts or test specimens shall be prepared to permit duplicate determinations of coating thickness or coating weight and of adhesion for each lot. Test specimens shall have surface area not less than 24 sq in. (155 cm^2), shall be of the same alloy as the parts they represent, and shall be coated with the lot of parts they represent. A lot of parts shall be all parts made of the same material, processed in the same solutions under the same conditions, and presented for inspection at one time.

4.4 Approval:

4.4.1 Parts coated in accordance with this specification shall be approved by purchaser before parts for production use are supplied, unless such approval be waived.

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 any change is necessary 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. No production parts coated by the revised procedure shall be shipped prior to receipt of approval.

4.5 Reports: The vendor of coated parts shall furnish with each shipment three copies of a report showing the purchase order number, this specification number and its revision letter, material specification number and its revision letter if any, contractor or other direct supplier of part and coating materials, part number, and quantity. When material for making parts or the coating material is produced or purchased by the coated parts vendor, that vendor shall inspect each lot of material to determine conformance to the applicable material specification, and shall include in the report a statement that the materials conform, or shall include copies of laboratory reports showing the results of tests to determine conformance. This report shall also include the results of tests to determine that the coating conforms to the requirements of this specification.

4.6 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the parts may be based on the results of testing three additional specimen for each original nonconforming specimen. Except as specified in 4.6.1, failure of any retest 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.

4.6.1 If any part fails to meet the specified requirements, either on the original sampling or upon resampling as in 4.6, the parts in that lot may be stripped by a method approved by purchaser which does not roughen, pit, or embrittle the basis metal, reprocessed, and retested.

5. PREPARATION FOR DELIVERY:

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

5.2 Packages of parts shall be prepared for shipment in accordance with commercial practice to assure carrier acceptance and safe transportation to the point of delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.