The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2466

Issued SEP 1997

Submitted for recognition as an American National Standard

HARD ANODIC COATING OF MAGNESIUM ALLOYS
Alkaline Type, High Voltage

1. SCOPE:

1.1 Purpose:

This specification establishes the procedures used to produce a hard anodic coating on magnesium alloys and the properties of the coating.

1.2 Application:

This coating has been used typically to provide corrosion resistance and abrasion resistance to cast magnesium alloys, but usage is not limited to such applications.

1.3 Classification:

Anodic finishes are classified by coating thickness as follows:

Class 1 Thin Coating: Coating thickness in the range of 0.0002 to 0.0004 inch (5 to 10 µm).

Class 2 Thick Coating: Coating thickness in the range of 0.0008 to 0.0010 inch (20 to 25 µm).

1.3.1 If a class is not specified, Class 1 shall be supplied.

1.4 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.

QUESTIONS REGARDING THIS DOCUMENT: (412) 772-7154 FAX: (412) 776-0243
TO PLACE A DOCUMENT ORDER: (412) 776-4970 FAX: (412) 776-0790

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.

2.1 SAE Publications:

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

AMS 4439 Magnesium Alloy Castings, Sand, 4.2Zn - 1.2Ce - 0.7Zr, (ZE41A-T5), Precipitation Heat Treated

AMS 4446 Magnesium Alloy Castings, Sand, 8.7Al - 0.70Zn - 0.26Mn, (AZ91 E - T6), Solution and Precipitation Heat Treated

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 117 Operating Salt Spray (Fog) Testing Apparatus

ASTM B 244 Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Meals With Eddy-Current Instruments

ASTM B 487 Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section

ASTM D 1193 Reagent Water

ASTM D 1654 Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ASTM D 4060 Abrasion Resistance of Organic Coatings by the Taber Abraser

3. TECHNICAL REQUIREMENTS:

3.1 Equipment:

3.1.1 Tanks: Shall be fabricated from, or lined with, a material that is compatible with the baths used for cleaning, pretreatment, anodizing, or post-treatment solutions and shall be equipped with temperature controls capable of controlling the bath temperatures within specified limits.

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

3.2 Preparation:

3.2.1 Electrical contacts between the parts and the power source shall be made to ensure an uninterrupted current flow without local overheating. Contact points shall be located where specified or in locations where coating is not required or is optional. Parts shall, insofar as practicable, be hung to avoid gas entrapment during processing.

3.2.2 Parts shall be cleaned free of greases, oils, or other contaminants prior to immersion in the anodizing solution. An alkaline bath is suggested as the final cleaning medium (See 8.2). Cleaned parts shall have a water-break-free surface.

3.3 Procedure:

3.3.1 Pretreatment: The cleaned part shall be pretreated, prior to anodization, by immersion for 30 to 90 minutes in an aqueous solution of 83 to 102 grams per liter ammonium fluoride solution, with a pH of 6.0 to 6.8, and operated at 160 to 180 ºF (71 to 82 ºC) followed by a water rinse.

3.3.2 Anodizing: Shall be done in an aqueous chromate-free, alkaline electrolyte with the parts made the anode and using voltage and current densities which will develop coatings conforming to specified properties.

3.3.3 After coating, part shall be thoroughly rinsed in cold running water and dried.

3.3.4 Post-Treatment: When post-treatment is specified, parts shall be treated for 30 to 60 seconds for Class 1 coatings and one to two minutes for Class 2 coatings at 115 to 125 ºF (46 to 52 ºC) in a bath containing 108 to 132 grams per liter sodium dihydrogen phosphate (NaH_2P0_4) in ASTM D 1193, Type IV, water maintained at a pH of 4.3 to 4.5 followed by rinsing in cold water, hot deionized water, and drying.

3.4 Properties:

3.4.1 Coating Thickness: Shall be 0.0002 to 0.0004 inch (5 to 10 pm) for Class 1 coatings, and 0.0008 to 0.0010 inch (20 to 25 pm) for Class 2 coatings, determined in accordance with ASTM B 244, ASTM B 487, or other method acceptable to purchaser.

3.4.2 Corrosion Resistance: When the hard coat is applied to AMS 4439 and AMS 4446 magnesium alloy parts, coated panels of the same alloy, representing the parts which have been machined to a minimum of 4 x 5 inches (102 x 127 mm), shall be tested for corrosion resistance. The coated panels shall withstand exposure to salt spray corrosion testing for times shown in Table 1 when tested in accordance with ASTM B 117. The exposed surfaces of the panels shall show a rating of nine or greater after exposure, determined in accordance with ASTM D 1654, procedure B. Corrosion resistance of coatings applied to other alloys may be specified by purchaser.

TABLE 1 - Corrosion Resistance Requirements

Panel Material	Coating Class	Salt Spray Resistance Hours
AMS 4439	1	24
AMS 4439	2	72
AMS 4446	1	168
AMS 4446	2	336

3.4.3 Wear Resistance: Coated panels of AMS 4439 and AMS 4446 shall exhibit a wear index value less than 30 and a wear cycle rating greater than 5000 cycles per mil when tested in accordance with ASTM D 4060 except that the CS-17 wheel shall be resurfaced after every 1000 cycles by running it for 25 cycles against the resurfacing medium, S-11 abrasive disk. Wear resistance test is applicable to both Class 1 and Class 2 coatings. Wear resistance requirements for coatings on other alloys may be specified by purchaser.

3.5 Quality:

Surfaces of coated parts, as received by purchaser, shall be uniform in texture and appearance except at the points of electrical contact and in pockets where gas was unavoidably trapped during processing. Powdery areas, laminations, pits, and other evidence of burning are not acceptable. Darkened comers or edges and excessive buildup are not acceptable.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The processor shall supply all test panels when required for processor's tests, and shall be responsible for the performance of all required tests. Parts, if required for tests, shall be supplied by 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: Coating thickness (3.4.1) and quality (3.5) are acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Corrosion resistance (3.4.2), wear resistance (3.4.3), and tests of the cleaning and processing solutions to ensure that the coating will conform to specified requirements are periodic tests and shall be performed at a frequency selected by the processor, but not less than monthly for corrosion testing (3.4.2).

4.2.3 Preproduction Tests: All technical requirements are preproduction tests and shall be performed prior to 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 purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing:

Sampling shall be not less than the following; a lot shall be all parts of the same part number, coated in the same baths in not longer than eight consecutive hours, and presented for processors inspection at one time:

4.3.1 Acceptance Tests: Frequency of tests shall be in accordance with Table 2.

TABLE 2 - Sampling for Acceptance Tests

Number of Parts in Lot	Quality (Visual)	Thickness	Test Panels If Required
1 to 6	all	3 (when available)	1
7 to 15	7	4	1
16 to 40	10	4	2
41 to 110	15	5	3
111 to 300	25	6	4
301 to 500	35	7	4
501 to 700	50	8	5
701 to1200	75	10	6
Over 1200	125	15	6

4.3.2 Periodic and Preproduction Tests: Sample quantity and frequency of sampling shall be selected at the discretion of the processor, except for corrosion testing which shall be carried out at a frequency not less than monthly.

4.3.3 When coated parts are of a configuration or size not readily adaptable to the specified tests, separate test specimens of the same generic class of alloy as the parts represented, cleaned, coated, and post treated, as required, with parts represented may be used.

4.4 Approval:

4.4.1 Process and control factors, a preproduction sample, or both, whichever is specified by purchaser, 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 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 coating.

4.4.3 Control factors shall include, but not be limited to, the following:

Precleaning procedures
Concentration limits of the anodizing bath
Temperature limits of the anodizing bath
Anodizing current limits
Initial and final voltage
Composition limits of the sealant
Method of drying parts
Periodic test plan

4.5 Reports:

The processor of coated parts shall furnish with each shipment a report stating that parts have been processed and tested in accordance with specified requirements and that they conform to the technical requirements. This report shall include the purchase order number, lot number, AMS 2466, coating class, and quantity.

4.6 Resampling and Retesting:

4.6.1 If results of any acceptance test fail to meet specified requirements, the parts in that lot may be stripped, if approved by the cognizant engineering organization, by a method that does not roughen, pit, or adversely affect part dimensions, pretreated, coated, post treated if specified, 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, pit, or adversely affect part dimensions, pretreated, coated, post treated if specified, and tested. (See 8.3).

4.6.2 If results of any periodic test fail to meet specified requirements, the process is nonconforming. No additional parts shall be coated until the process is corrected and new specimens coated and tested. Results of all tests shall be recorded and, when requested, reported. Purchaser shall be notified of all parts coated since the last acceptable test.

5. PREPARATION FOR DELIVERY:

5.1 Coated parts shall be handled and packaged to ensure that the required physical characteristics and properties of the coating are preserved.

5.2 Packages of coated parts shall be prepared for shipment in accordance with commercial practice and in compliance with the applicable rules and regulations pertaining to the handling, packaging, and transportation of the parts to ensure carrier acceptance and safe delivery.