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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2469F

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Superseding AMS 2469E

Submitted for recognition as an American National Standard

(R)

Hard Anodic Coating Treatment of Aluminum and Aluminum Alloys Processing and Performance Requirements

1. SCOPE:

1.1 Purpose:

This specification establishes the engineering requirements for producing a hard anodic coating on aluminum and aluminum alloys and the properties of such coating.

1.2 Application:

This process has been used typically to increase, by formation of a dense aluminum oxide, surface hardness and resistance to abrasion and corrosion of aluminum and aluminum-alloy parts containing, in general, less than 5% copper or 8% silicon or a total of 8% of both, but usage is not limited to such applications. Alloys with higher alloy content can be coated satisfactorily with proper precautions in processing. Careful consideration should be given when using this process on highly-stressed parts because of the resultant marked lowering of fatigue performance and on parts with sharp corners and edges where chipping may result.

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 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.

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7161 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS: http://www.sae.org

2.1 SAE Publications:

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

AMS 4037 Aluminum Alloy, Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn, 2024-T3 Sheet 2024-T351 Plate

2.2 ASTM Publications:

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

ASTM B 117 Operating Salt Spray (Fog) Apparatus
ASTM B 137 Measurement of Weight of Coating on Anodically Coated Aluminum
ASTM B 244 Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals With Eddy-Current Instruments
ASTM B 487 Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

FED-STD-141 Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling and Testing

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

3.1.1 Parts, prior to being coated, shall have clean surfaces free from waterbreaks.

3.1.2 When not otherwise specified by purchaser, the location of electrical contact points shall be as follows:

3.1.2.1 For parts which are not to be coated all over, locations shall be acceptable to purchaser.

3.1.2.2 For parts which are not to be coated all over, locations shall be in areas on which coating is not required or is optional.

3.1.3 Aluminum parts having faying surfaces, which may trap electrolyte or inserts of other metal shall have those surfaces masked before parts are coated.

3.2 Procedure:

3.2.1 Shall consist of the formation of aluminum oxide on surfaces of parts made the anode in a suitable electrolyte. After coating, parts shall be thoroughly rinsed in cold, clean water, and dried.

3.2.2 Sealing of parts for improved corrosion resistance may be accomplished at the sacrifice of wear resistance when permitted by purchaser.

3.3 Properties:

Coating on parts shall conform to the following requirements:

3.3.1 Thickness: AMS 2469 designates finished coating thickness of 0.0020 inch ± 0.0005 (0.051 mm ± 0.013). Other coating thicknesses may be specified by this specification number and a suffix number designating the nominal thickness in thousandths of an inch (25 µm). A tolerance of ±0.0005 inch (± 0.013 mm) in thickness of coating will be allowed, unless otherwise specified. Thus, AMS 2469-3 designates a finished coating thickness of 0.0030 inch ± 0.0005 (0.076 mm ± 0.013).

3.3.1.1 Thickness of coating shall be determined on representative parts or specimens by microscopic method, micrometer measurement, ASTM B 244 or ASTM B 487, or other method acceptable to purchaser. When used, micrometer measurements shall be calibrated against microscopic measurements on specimens processed to the same nominal coating thickness. Coating thickness requirements shall not apply to blind holes or recesses with depth greater than twice the diameter or in open holes with depth greater than seven times the diameter unless a specific coating thickness is specified in those areas.

3.3.1.2 When specimens are used for thickness determination, they shall be of the same alloy as the parts they represent, and shall be processed with the parts.

3.3.2 Coating Weight: Shall be not less than 0.030 grams/square inch per 0.001 inch (0.18 g/cm^2/mm) of coating thickness, determined on unsealed coatings in accordance with ASTM B 137.

3.3.3 Color: Shall be substantially uniform on pieces of the same alloy processed to the same nominal coating thickness. Coated surfaces shall not have a sooty appearance or the presence of a moire pattern.

3.3.4 Abrasion Resistance: Unsealed, coated specimen (See 4.3.2.2) shall have a maximum wear index of 3.5 mg/1000 cycles on aluminum alloys having a copper content of two percent or higher and a wear index not greater than 1.5 mg/1000 cycles for all other alloys, determined as follows; two test specimens weighed to the nearest milligram shall be tested in accordance with method 6192.1 of FED-STD-141 using CS-17 wheels with a 1000 gram load. Specimens may be placed in a desiccator prior to and following test to establish constant weight. The wheels shall revolve on the anodic coating at a speed of 70 revolutions per minute (RPM) for 10,000 cycles. The abrasive wheels shall be resurfaced prior to the start of any individual test, and at least once every 10,000 cycles. The wear index is determined at the end of 10,000 cycles by dividing the weight loss by ten.

3.3.5 Corrosion Resistance: Coating that has been given a supplementary sealing treatment shall show no evidence of corrosion after exposure for 336 hours ± 1 to salt spray corrosion test in accordance with ASTM B 117, with the test panel inclined approximately 6 degrees from the vertical.

3.4 Quality:

Coating on parts, as received by purchaser, shall be substantially uniform in thickness except in small holes unless a specific coating thickness is specified, and in fillets, radii, and deep recesses, and shall be free from scratches, chips, and burned or powdery areas. Small irregularities at points of electrical contact are permissible.

3.5 Tolerances:

When a limited area to be hard coated is specified, a tolerance of -0, +1/16 inch (+1.6 mm) will be permitted on the extent of the hard coated area except when such area ends at a corner; in such cases, the area shall not extent beyond the corner by more than the projected thickness of the coating.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The processor shall supply all samples for processor's tests and shall be responsible for the performance of all required tests. Parts, when required for test shall be supplied by the purchaser. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that processing conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Thickness (3.3.1), or coating weight (3.3.2), color (3.3.3), and quality (3.4) are acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Coating weight (3.3.2) unless determined in lieu of thickness testing for acceptance, abrasion resistance (3.3.4), and corrosion resistance (3.3.5) are periodic tests and shall be performed at a frequency selected by the vendor 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, 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:

Shall be as follows; a lot shall be all coated parts of the same part number, processed to the same coating thickness, and presented for processor's inspection at one time:

4.3.1 For Acceptance Tests: The number of parts sampled shall not be less than shown in Table 1.

TABLE 1 - Minimum Sampling for Acceptance Tests

Number of Parts in Lot	Color and Quality	Thickness or Coating Weight
Up to 7	all	3 if available
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: Frequency of sampling shall be at the discretion of the processor unless otherwise specified by purchaser.

4.3.2.1 Samples for determination of coating weight shall be actual coated parts when size and shape permit accurate determination of surface area. If parts are of such size and shape that surface area cannot be determined readily, coating weight determinations shall be made on test panels approximately 0.025 to 0.063 inch (0.64 to 1.60 mm) in nominal thickness and not less than 3 inches (76 mm) square and, except as specified in 4.3.2.1.1, made of the same alloy as the parts and processed with the parts they represent.

4.3.2.1.1 If test panels of an alloy different from that of the parts they represent are used, panels shall be processed under conditions, previously established, which will produce the same coating thickness as that on the parts they represent.

4.3.2.2 Abrasion resistance shall be determined on production parts provided they can be adapted to the test. If parts are of a configuration or size not readily adaptable to the specified test or when destructive testing is not practical or it is not economically acceptable to perform destructive tests on actual production parts, separate panels may be used.

4.3.2.2.1 Specimens, for abrasion and wear resistance test (3.3.4) shall be either 4-inch (102-mm) diameter round or 4-inch (102-mm) square panel fabricated from AMS 4037, aluminum alloy sheet, or the predominant alloy being processed, when the periodic test specimen is selected, not less than 0.063 inch (1.60 mm) thick with a 0.250-inch (6.35-mm) diameter hole in the center and shall not have been given a supplementary sealing treatment.

4.3.2.3 Specimens for corrosion resistance test (3.3.5) shall be approximately 0.063 x 3 x 10 inches (1.60 x 76 x 254 mm) made from the same alloy and processed with the parts they represent.

4.4 Approval:

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

4.4.2 The processor shall make no significant changes 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, would affect the properties or performance of the part.

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

Surface preparation methods
Composition limits and temperature limits of anodizing bath
Frequency of test of anodizing bath composition
Method for determining coating thickness, and, if micrometer measurements are used, correlation between measurement and actual thickness
Type and control on sealer, when used
Anodizing voltage limits, and voltage ramp rates where voltage is not constant
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 the specified requirements and that the parts conform to the acceptance test requirements. This report shall include the purchase order number, lot number, AMS 2469F, part number, and quantity.

4.6 Resampling and Retesting:

4.6.1 If results of any acceptance test fails to meet specified requirements, the parts may be stripped with the approval of the cognizant engineering organization, by a method that does not roughen, pit, or adversely affect part dimension, pretreated, coated, sealed if specified and tested. Alternatively, all parts in the lot may be inspected for the nonconforming attribute, and the nonconforming parts may be stripped with the approval of the cognizant engineering organization, by a method that does not roughen, pit, or adversely affect part dimensions, pretreated, coated, sealed if specified, and tested.