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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2469E

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Superseding AMS 2469D

HARD 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 coating on aluminum and aluminum alloys and the properties of such coating.

1.2 Application:

This process has been used typically to increase, by the 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 referenced publications shall be the issue in effect on the date of the purchase order.

2.1 ASTM Publications:
(R)

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM B 117 Salt Spray (Fog) Testing
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

2.2 U.S. Government Publications:
(R)

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
MIL-STD-2073-1 DOD Materiel, Procedures for Development and Application of Packaging Requirements

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

3.1.1 (R) All fabrication-type operations, such as heat treatment, machining, forming, brazing, welding, and perforating operations shall, insofar as practicable, be completed before parts are hard coated. Post process machining to remove hard anodic coatings from areas where it is not required is permitted.

3.1.2 Parts, prior to being coated, shall have clean surfaces free from water-breaks.

3.2 Procedure:

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.

3.2.1 (R) Coated surfaces may be honed or lapped as necessary to meet specified surface finish requirements.

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

3.2.3 (R) Electrical contact areas on parts that are not completely hard anodic coated shall be located on areas not required to be hard coated.

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 (R) Thickness of coating shall be determined on representative parts or specimens by direct micrometer measurement, or in accordance with ASTM B 487, ASTM B 244, or other method acceptable to purchaser. Micrometer measurements shall be calibrated against microscopic measurements on specimens of the same alloy processed to the same nominal coating thickness.

3.3.1.2 (R) 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.

3.3.1.3 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.

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

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 (R) Abrasion and Wear Resistance: Anodic coating weight loss shall be not greater than 35 milligrams for 2024 and other 2000 series aluminum alloys and not greater than 15 milligrams for aluminum and aluminum alloys other than the 2000 series, determined on specimens as in 4.3.2.2 in accordance with FED-STD-141, Method 6192, using CS-17 wheels, a load of 1000 grams, and a speed of 70 rpm for 10,000 cycles. Specimens shall be conditioned for 48 hours ± 1 at 23 °C ± 1 (73 °F ± 2) and relative humidity of 50% ± 5 prior to testing. Specimens shall be weighed and tested under these conditions. Specimens shall be weighed to the nearest milligram prior to and after test and the average weight loss of the panels reported.

3.3.5 (R) 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 (R) Quality:

Coating 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), unless otherwise specified, 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 extend beyond the corner by more than the projected thickness of the coating.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The coating vendor shall supply all samples for vendor's tests and shall be responsible for performing all required tests. 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 (R) Acceptance Tests: Tests for thickness (3.3.1), color (3.3.3), and quality (3.4) are acceptance tests and shall be performed on each lot.

4.2.2 (R) Periodic Tests: Tests for coating weight (3.3.2), 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: Tests for 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.

4.2.3.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, contracting officer, or request for procurement.

4.3 Sampling:

(R)

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 vendor's inspection at one time:

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

TABLE 1 - Minimum Sampling for Acceptance Tests

Number of Parts in Lot	Visual Examination	Thickness
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 vendor unless otherwise agreed upon between purchaser and vendor.

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 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 panels of the alloy being processed, 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 (R) The process and control procedures, a preproduction sample part, or both, whichever is specified, shall be approved by the cognizant engineering organization before production parts are supplied.

4.4.2 (R) The supplier 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 (R) 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
Control on sealer, when used
Anodizing voltage limits, and voltage ramp rates where voltage is not constant
Frequency of periodic tests

4.5 (R) Reports:

The vendor of coated parts shall furnish with each shipment a report stating that the parts have been processed and tested in accordance with the requirements of this specification and that the parts conform to the acceptance test requirements. This report shall include the purchase order number, lot number, AMS 2469E, part number, and quantity.

4.6 (R) Resampling and Retesting:

If any specimen fails to meet the specified requirements, disposition of the parts may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the parts represented. In the case of periodic test specimens, the process shall be declared nonconforming, and no additional parts shall be processed until corrections are made and test specimens meet specified requirements. All parts processed with or after processing periodic test specimens shall be considered suspect, and results shall be reported to purchaser. If any part fails to meet specified requirements, all parts shall be inspected for that nonconformance.

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.