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AEROSPACE MATERIAL SPECIFICATION

AMS 2469D
Superseding AMS 2469C

Issued 6-30-62
Revised 1-1-85

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: Primarily 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. Alloys with higher silicon content alone can be coated satisfactorily with proper precautions in processing. Careful consideration should be given to the use of 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.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM B117 - Salt Spray (Fog) Testing
ASTM B137 - Measurement of Weight of Coating on Anodically Coated Aluminum

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2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 141 - Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling and Testing

2.3.2 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

3.1.1 All heat treatment, machining, forming, brazing, welding, and perforating operations shall, insofar as practicable, be completed before parts are hard coated.

3.1.2 Parts, prior to being coated, shall have clean surfaces, free from water-breaks, prepared with minimum abrasion, erosion, or pitting.

3.2 Procedure: Consists 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 Coated surfaces shall 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.

3.3 Properties: Coating on parts shall conform to the following requirements:

3.3.1 Thickness: AMS 2469 designates finished coating thickness of 0.002 in. ± 0.0005 (0.05 mm ± 0.012). 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 in. (±0.012 mm) in thickness of coating will be allowed, unless otherwise specified. Thus, AMS 2469-3 designates a finished coating thickness of 0.003 in. ± 0.0005 (0.08 mm ± 0.012).

3.3.1.1 Thickness of coating shall be determined on representative parts or specimens by microscopic method, micrometer measurement, or other method agreed upon by purchaser and vendor. When micrometer measurement is used, specimens for thickness determination shall be of the same alloy as the parts they represent and shall be processed with the parts. Micrometer measurements shall be calibrated against microscopic measurements on specimens of the same alloy 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.

3.3.2 Coating Weight: Shall be not less than 0.030 g/sq in. per 0.001 in. (0.18 g/cm^2 per mm) of coating thickness, determined in accordance with ASTM B137 on unsealed coatings. Ø

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. Ø

3.3.4 Abrasion and Wear Resistance: Shall be not greater than 40 mg for 2024 and other 2000 series aluminum alloys and not greater than 20 mg for aluminum and aluminum alloys other than the 2000 series, determined on specimens as in 4.3.2.2 in accordance with Federal Test Method Standard No. 141, Method 6192, using CS-17 wheels, a load of 1000 g, and a speed of 70 rpm for 10,000 cycles. Specimens shall be conditioned for 48 hr ± 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.

3.3.4.1 Anodic coating loss of 2024 alloy or other 2000 series aluminum alloy shall not exceed 40 mg and that of any other aluminum alloy shall not exceed 20 mg when tested as in 3.3.4.

3.3.5 Adhesion: Coatings shall show no evidence of delamination, peeling, or flaking on the tension side when submitted to the following bend test: Specimens 0.063 in. (1.6 mm) thick x 10 in. (250 mm) long x 1 in. (25 mm) wide, with the long dimension transverse to the direction of rolling, shall be coated and then bent 90 deg around a 0.5 in. (12.5 mm) diameter. Delamination or spalling on the compression side and crazing on the tension side are permissible.

3.3.6 Corrosion Resistance: Coating that has been given a supplementary sealing treatment shall show no evidence of corrosion after exposure for 240 hr ± 1 to salt spray corrosion test in accordance with ASTM B117, with the test panel inclined approximately 6 deg from the vertical.

3.4 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 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 in. (+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
Ø for vendor's tests and shall be responsible 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 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: Tests to determine conformance to requirements for
Ø thickness (3.3.1) or coating weight (3.3.2), color (3.3.3), and quality (3.4) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for coating weight (3.3.2), unless determined in lieu of thickness for acceptance and for abrasion resistance (3.3.4), adhesion (3.3.5), and corrosion resistance (3.3.6) are classified as 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 to determine conformance to all technical
Ø requirements of this specification are classified as preproduction tests and shall be performed prior to or on the initial shipment of coated parts to a purchaser, when a change in material or processing, or both, requires reapproval as in 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
Ø requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be as follows; a lot shall be all coated parts made from the same alloy, processed to the same coating thickness, and presented for vendor's inspection at one time:

4.3.1 For Acceptance Tests:

4.3.1.1 Thickness: Three parts from each lot.
Ø

4.3.1.2 Color and Quality: All parts.
Ø

4.3.2 For Periodic Tests and Preproduction Tests: As agreed upon by purchaser and vendor.

4.3.2.1 Samples for determination of coating weight shall be actual coated parts
Ø 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 0.025 - 0.063 in. (0.60 - 1.60 mm) in nominal thickness and not less than 3 in. (75 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
Ø 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-in. (100-mm) diameter round or 4-in. (100-mm) square panels of the alloy being processed, not less than 0.063 in. (1.60 mm) thick with a 0.250-in. (6.25-mm) diameter hole in the center and shall not have been given a supplementary sealing treatment.

4.3.2.3 Specimens for adhesion test (3.3.5) shall be approximately 0.063 x 1 x 10 in. (1.60 x 25 x 250 mm) with the long dimension transverse to the direction of rolling.

4.4 Approval:

4.4.1 Sample coated parts shall be approved by purchaser before parts for
Ø production use are supplied, unless such approval be waived by purchaser. Results of tests on production parts shall be essentially equivalent to those on the approved sample parts.

4.4.2 Vendor shall use manufacturing procedures, processes, and methods of
Ø inspection on production parts which are essentially the same as those used on the approved sample parts. If necessary to make any change 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. Production parts coated by the revised procedure shall not be shipped prior to receipt of reapproval.