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

AEROSPACE MATERIAL SPECIFICATION

AMS 2470G
Superseding AMS 2470F
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ANODIC TREATMENT OF ALUMINUM ALLOYS
Chromic Acid Process

1. SCOPE:

1.1 Purpose: This specification establishes the engineering requirements for producing anodic coatings on aluminum alloys and the properties of such coatings.

1.2 Application: To increase corrosion resistance and provide surfaces which will ensure satisfactory adherence of paint and other organic finishes. This process is primarily applicable to aluminum and aluminum alloy parts which do not have nominal copper content greater than 5% or total nominal alloy content greater than 7.5%. Coating may be dyed if specified but AMS 2472 is recommended where a colored finish is required.

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. The applicable issue of other documents shall be as specified in AMS 2350.

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

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 4037 - Aluminum Alloy Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn (2024; -T3 Flat Sheet, -T351 Plate)

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

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

3. TECHNICAL REQUIREMENTS:

3.1 Solutions:

3.1.1 Electrolyte: Shall be an aqueous solution of technical grade chromic acid (99.5% min CrO_3) of suitable concentration. A chloride content in the solution of the equivalent of 0.2 g of NaCl per liter or a sulfate content equivalent to 0.5 g of H_2SO_4 per liter may result in unsatisfactory operation of the process. The temperature of the solution shall be maintained within the range 91° - 99° F (32.8° - 37.2° C).

ø 3.1.2 Dye: Shall be as required to produce the specified color.

3.1.3 Sealer: Except as specified in 3.1.3.1 and 3.1.3.2, the sealer shall be water maintained at a temperature of 170° - 210° F (76.7° - 98.9° C). The pH value shall not exceed 6.8. Chromic acid may be used to maintain acidity.

3.1.3.1 A sodium dichromate sealing solution is acceptable when approved by the purchaser.

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3.1.3.2 If the anodic coating is to be used to prevent subsequent hard coating of certain areas (i.e., coating in accordance with AMS 2468 or AMS 2469), a nickel acetate sealing solution may be used when permitted by purchaser.

3.2 Preparation:

3.2.1 All heat treatment, machining, forming, brazing, welding, and perforating operations shall, insofar as practicable, be completed before parts are anodized, unless otherwise specified.

3.2.2 Parts prior to being coated shall have clean surfaces, free from water breaks, prepared with minimum abrasion, erosion, or pitting. Cleaning by a process giving a slightly etched surface is desirable.

3.3 Procedure:

3.3.1 Coating: The cleaned parts shall be made the anode in the electrolyte contained in a suitable metal tank which may also serve as the cathode. Direct current shall be applied and the voltage raised to 40 V and held for 20 - 60 minutes. A rate of increase of 8 V per min. is recommended but is not a requirement. Alloys containing not over 5% copper, with total silicon plus copper of 7.5% or more, shall be treated for not less than 20 min. as required to produce at least 600 volt-minutes. Other conditions of time, temperature, and voltage may be used when approved. After anodizing, all parts shall be rinsed thoroughly in cold, running tap water.

3.3.2 Dyeing: Parts shall be dyed when required, to the color specified, by immersing in appropriate dye solution. The temperature of the solution and the time of immersion shall be as necessary to produce the specified color. Either the parts or solution shall be agitated during immersion. Parts shall then be rinsed in cold running tap water. Dyed parts shall not be sealed in sodium dichromate solution.

3.3.3 Sealing: Parts shall be immersed in the sealer solution for not less than 20 min. at a temperature not lower than 170° F (77° C), or for not less than 10 min. at a temperature not lower than 200° F (93° C). The rinse should be as thorough as practicable but slight chromic acid stains are not considered objectionable.

3.4 Properties:

3.4.1 Coating Weight: Shall be not less than 200 mg per sq ft (2.153 g/m^2) on parts which are not to be dyed and not less than 500 mg per sq ft (5.382 g/m^2) on parts which are to be dyed. Coating weight shall be determined in accordance with ASTM B137 on parts or specimens which have been anodized and rinsed but not dyed or sealed.

3.4.1.1 If small parts such as rivets and machine screws are anodized in bulk in a container, the specified coating weight shall apply to not less than 75% of the parts treated together, determined by random sampling, but in no case shall any part show uncoated areas except at contact points.

3.4.2 Corrosion Resistance:

3.4.2.1 For control purposes, samples of AMS 4037 aluminum alloy sheet treated in accordance with 3.3 shall withstand exposure for 336 hr to salt spray without showing more than a total of 15 scattered spots or pits, none larger than 1/32 in. (0.8 mm) in diameter, in a total of 150 sq in. (968 cm^2) of test area grouped from five or more test pieces; nor more than 5 scattered spots or pits, none larger than 1/32 in. (0.8 mm) in diameter, in a total of 30 sq in. (194 cm^2) from one or more test pieces; except those areas within 1/16 in. (1.6 mm) from identification markings and at electrode contact marks remaining after processing. Salt spray corrosion tests shall be conducted in accordance with ASTM B117 except that the significant surface shall be inclined approximately 6 deg (0.105 rad) from the vertical.

3.4.2.2 Ø Each part that is anodized and not subsequently painted shall be capable of withstanding exposure for 336 hr to salt spray test conducted in accordance with ASTM B117 without showing more than a few scattered corrosion pits visible without magnification.

3.4.2.2.1 Ø Corrosion resistance test is not required when material or parts, treated in accordance with 3.3, are subsequently to be painted.

3.5 Ø Quality: Anodic coating shall be continuous, smooth, adherent, and uniform in appearance and shall be free from powdery areas, loose films, discontinuities such as breaks or scratches, except at contact points, or other damage or imperfections detrimental to appearance or to performance of parts. Parts sealed in sodium dichromate solution may have the characteristic yellow color.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Ø Responsibility for Inspection: The coating vendor shall supply all samples and shall be responsible for performing all required tests. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to assure that processing conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Ø Acceptance Tests: Tests to determine conformance to coating weight (3.4.1) and corrosion resistance (3.4.2.1) requirements are classified as acceptance or routine control tests.

4.2.2 Ø Qualification Tests: Tests to determine corrosion resistance of finished parts which are not subsequently to be painted (3.4.2.2) are classified as qualification or periodic control tests.

4.3 Sampling:

4.3.1 Coating Weight: Determinations shall be made on representative 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 separate specimens not less than 3 x 3 in. (76 x 76 mm) in length and width and 0.025 - 0.063 in. (0.64 - 1.60 mm) thick made of an alloy of the same class as the parts represented, as follows:

Class 1. Alloys of Aluminum Association designations 1100, 3003, 3004, 5052, 6053, 6061, 6063, and all alclad alloys.

Class 2. All wrought alloys not listed as Class 1 and all casting alloys.

4.3.1.1 Ø Separate specimens of Class 1 or Class 2 alloys shall be processed with the work they represent. Any alloy of the same class as the work it represents may be used for the test specimens.

4.3.2 Corrosion Resistance: Determinations shall be made on representative parts or on separate panels not less than 3 x 10 in. (76 x 254 mm), the 10 in. (254 mm) direction being perpendicular to the direction of rolling, and 0.025 - 0.063 in. (0.64 - 1.60 mm) thick.

4.4 Approval:

4.4.1 Ø Sample coated parts and panels shall be approved by purchaser before parts for production use are supplied, unless such approval be waived.

4.4.2 Ø 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 detailed statement of the revised operations and, when requested, sample coated parts, test panels, or both. No production parts processed by the revised procedure shall be shipped prior to receipt of reapproval.

4.5 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 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 and no additional testing shall be permitted.

5. PREPARATION FOR DELIVERY:

5.1 Packaging:

5.1.1 Anodized parts shall be packaged in such a manner as will ensure that the parts, during shipment and storage, will be protected against damage from exposure to weather or any normal hazard.

5.1.2 Anodized 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.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Parts on which the coating does not conform to this specification or to authorized modifications will be subject to rejection.

8. NOTES:

8.1 Marginal Indicia: The phi (Ø) symbol is used to indicate technical changes from the previous issue of this specification.

8.2 Precautions:

8.2.1 Surfaces to be painted should be handled with care after anodizing to prevent rupture of the film and contamination by dirt or oil. Painting should be performed as soon after treatment as practicable.

8.2.2 Good, tight electrical contact should be maintained during the anodic treatment to prevent burning of parts but small irregularities of coating at points of electrical contact will be permitted.

8.2.3 Anodizing baths should be provided with an exhaust system as a protection for the operators and prevention of corrosion of metal equipment in the vicinity.

8.2.4 Subassemblies may be anodized provided the surfaces which are exposed after complete assembly are anodized. Surfaces exposed to fuels, intake air, and coolants should not be machined after anodizing, but surfaces continually protected by oil films may be machined after anodizing.

8.2.5 Anodic films have high electrical resistance. Aluminum parts, therefore, which are to be used for electrical bonding and radio shielding, should have the anodic film removed at any area of electrical contact.

8.2.6 Aluminum parts which contain inserts of other metals should be properly masked during anodizing to seal off the non-aluminum material.

8.2.7 Hooks or racks should have anodic film removed from the contact areas prior to reuse.

8.2.8 Alloys containing over 5% nominal copper content or over 7.5% nominal total alloy content may be treated by this process but may require special conditions such as agitation and cooling of the solution.