Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE MATERIAL SPECIFICATION

AMS 2472B
Superseding AMS 2472A
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ANODIC TREATMENT OF ALUMINUM BASE ALLOYS
Sulfuric Acid Process, Dyed Coating

1. SCOPE:

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

1.2 Application: To increase corrosion resistance and produce colored surfaces on aluminum-base alloy parts. For coatings to be used as a base for paint or other organic finishes, AMS 2470 or AMS 2471 should be specified. This process is not suited to parts or assemblies which contain joints or recesses in which the anodizing solution may be retained.

1.3 Classification: This specification covers two types of coating, designated as follows:

AMS 2472 - Coatings for Identification
AMS 2472-1 - Coatings for Decorative Purposes

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., Two Pennsylvania Plaza, New York, New York 10001.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2355 - Quality Assurance Sampling and Testing of Aluminum and Magnesium Alloys, Wrought Products Except Forgings
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 - Weight of Coating on Anodically Coated Aluminum

3. TECHNICAL REQUIREMENTS:

3.1 Solutions:

3.1.1 Electrolyte: Shall be an aqueous solution of sulfuric acid of suitable concentration (nominal concentration is 15% by weight). The temperature of the anodizing solution shall be maintained within the range 64 - 85 F (17.8 - 29.4 C); the selected temperature shall be maintained within ± 2 F (± 1.1 C) and within the range above during the anodizing cycle.

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

3.1.3 Sealer: Shall be a solution of nickel acetate or cobalt acetate in deionized water and shall be maintained at a pH value of 5.6 - 5.8 and a temperature of 190 - 210 F (87.8 - 98.9 C). Adjustments in the pH value of the solution shall be made by addition of acetic acid or sodium hydroxide as required.

3.1.3.1 For alloys of Class 2 (See 4.3.1) anodized to the requirements of AMS 2472-1, a second sealer shall be used unless otherwise specified (See 3.2.5.1); this shall consist of a 1% aqueous solution of sodium or potassium dichromate maintained at a pH value of 5.0 - 6.0 and a temperature not lower than 208 F (98 C). Adjustments in the pH value of this solution shall be made by addition of chromic acid or sodium hydroxide as required.

3.2 Procedure:

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

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

3.2.3 Coating: The cleaned parts shall be made the anode in the electrolyte contained in a suitable tank which, if made of a metal resistant to the electrolyte or if lined with lead, may also serve as the cathode. Direct current shall be applied as required to produce an anode current density of 10 - 15 amp per sq ft (107.6 - 161.5 A/m^2) when AMS 2472 is specified or 15 - 20 amp per sq ft (161.5 - 215.2 A/m^2) when AMS 2472-1 is specified, for such time as required to produce an anodic coating conforming to the requirements of 3.3. Other conditions of temperature and amperage may be used when approved by purchaser. After anodizing, all parts shall be rinsed thoroughly in cold running tap water.

3.2.4 Dyeing: Parts shall be dyed, 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 the solution shall be agitated during immersion. Parts shall then be rinsed in cold running tap water.

3.2.5 Sealing: Parts shall be immersed in the acetate sealer solution for not less than 10 minutes. Parts made of Class 2 alloys (See 4.3.1) anodized to the requirements of AMS 2472-1 shall, unless otherwise specified (See 3.2.5.1), then be immersed in the dichromate sealer solution for 10 - 12 minutes. After sealing, all parts shall be rinsed thoroughly in clean cold running tap water, then in clean hot water, and dried.

3.2.5.1 The corrosion resistance of dyed parts may be enhanced by duplex sealing as in 3.2.5 but the second sealing in dichromate solution can cause color changes in the dye. Where any change in dye coloration is undesirable, the second sealing operation should be omitted.

3.3 Properties:

3.3.1 Coating Weight: Shall be not less than 600 mg per sq ft (6.458 g/m^2) when AMS 2472 is specified and not less than 2500 mg per sq ft (26.900 g/m^2) when AMS 2472-1 is specified, except that for wrought alloys of the 2000 series where copper is the major alloying element and for casting alloys with a nominal copper content of 1.0% or higher, the coating weight when AMS 2472-1 is specified shall be not less than 1400 mg per sq ft (15.070 g/m^2). Coating weight shall be determined in accordance with ASTM B137 on parts which have been anodized and rinsed but not dyed or sealed.

3.3.1.1 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 anodized together, determined by random sampling, but in no case shall any part show uncoated areas.

3.3.2 Corrosion Resistance:

3.3.2.1 For control purposes, samples of AMS 4037 aluminum alloy sheet treated in accordance with 3.2 shall withstand exposure for 240 hr to salt spray without showing more than five scattered corrosion spots or pits, none larger than 1/32 in. (0.8 mm) in diameter, in a 30 sq in. (196 cm^2) area and without corroding to the extent that would cause more than 5% decrease in tensile strength and 10% decrease in elongation from those of duplicate treated but unexposed panels. Salt spray corrosion tests shall be conducted in accordance with ASTM B117. Tensile tests shall be conducted in accordance with AMS 2355, the results being reported as the average of three specimens each from the exposed and unexposed panels.

3.3.2.1.1 Each part that is anodized shall be capable of withstanding exposure for 240 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 Quality: Anodic coating shall be uniform in color, quality, and condition and free from foreign materials and from imperfections detrimental to appearance or performance of parts.

4. QUALITY ASSURANCE PROVISIONS:

4.1 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: Tests to determine conformance to all technical requirements of this specification are classified as acceptance or routine control tests.

4.3 Sampling:

4.3.1 Coating Weight: Shall be determined for original qualification and thereafter at least monthly 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 Separate specimens shall be processed with the work they represent.

4.3.2 Corrosion Resistance: Shall be determined for original qualification and at least monthly thereafter on representative parts and 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. Panels for determination of tensile properties in the exposed and unexposed condition shall be cut from adjacent areas of the same sheet.

4.4 Approval:

4.4.1 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 Vendor shall use the same manufacturing procedures, processes, and methods of inspection on production parts to determine conformance to this specification 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 coated 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: Not applicable.

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 the requirements of this specification or to authorized modifications will be subject to rejection.

8. NOTES:

8.1 Precautions:

8.1.1 Wire, hooks, racks, and clamps used to suspend the parts in the electrolyte, if they are also in contact with the electrolyte, should be of aluminum, aluminum alloy, or unalloyed titanium. 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.

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

8.1.3 Subassemblies may be anodized provided the surfaces which are exposed after assembly are anodized and provided there is no possibility of entrapping the anodizing solution. Surfaces exposed to fuels, intake air, and coolants should not be machined after anodizing, but surfaces continually protected by an oil film may be machined after anodizing.

8.1.4 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.

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

8.1.6 Hooks or racks, except those of titanium, should have the anodic film removed from the contact areas prior to reuse.

8.1.7 Deionized or distilled water may be necessary for the dye solution of 3.1.2 and for rinsing between each step where local tap water contains appreciable dissolved mineral matter.

8.2 Marginal Indicia: No phi (ø) symbol is used to indicate where technical changes have been made in this specification because of the extensive nature of all changes.