

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 SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods

AMS 2468 - Hard Coating Treatment of Aluminum Alloys

AMS 2469 - Process and Performance Requirements for Hard Coating of Aluminum Alloys

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, PA 19103.

ASTM B117 - Salt Spray (Fog) Testing

ASTM B137 - Measurement of Weight of Coating on Anodically Coated Aluminum

SAE Technical Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

AMS 2470H

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

2.3.1 Military Standards:

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

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 litre or a sulfate content equivalent to 0.5 g of H_2SO_4 per litre may result in unsatisfactory operation of the process. The solution shall be maintained within the range $91^\circ - 99^\circ\text{F}$ ($33^\circ - 37^\circ\text{C}$).

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 (See 8.2.9) maintained at $170^\circ - 210^\circ\text{F}$ ($75^\circ - 100^\circ\text{C}$). 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 purchaser.

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 Procedure:

3.2.1 Preparation: 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 Cleaning: 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.

3.2.3 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.

3.2.4 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.

3.2.5 Sealing: Parts shall be immersed in the sealer solution for not less than 20 min. at a temperature not lower than 170°F (75°C), or for not less than 10 min. at a temperature not lower than 200°F (90°C). The rinse should be as thorough as practicable but slight chromic acid stains are not considered objectionable.

3.3 Properties: Coated parts shall conform to the following requirements:

3.3.1 Coating Weight: Shall be not less than 200 mg per sq ft (2 g/m²) on parts which are not to be dyed and not less than 500 mg per sq ft (5 g/m²) on parts which are to be dyed. Coating weight shall be determined in accordance with ASTM B137 on parts or specimens as in 4.3.1 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 treated together, determined by random sampling, but in no case shall any part show uncoated areas except at contact points.

3.3.2 Corrosion Resistance:

3.3.2.1 For control purposes, samples as in 4.3.2 of AMS 4037 aluminum alloy sheet treated in accordance with 3.2 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. (1 mm) in diameter, in a total of 150 sq in. (1000 cm²) of test area grouped from five or more test pieces, or more than 5 scattered spots or pits, none larger than 1/32 in. (1 mm) in diameter, in a total of 30 sq in. (200 cm²) from one or more test pieces, except those areas within 1/16 in. (2 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 from the vertical.

3.3.2.2 Parts that are anodized and not subsequently painted shall withstand 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.

3.3.2.2.1 Corrosion resistance test is not required when parts, treated in accordance with 3.2, are subsequently to be painted.

AMS 2470H

3.4 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 the coating. Parts sealed in sodium dichromate solution may have the characteristic yellow color.

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. 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 coating weight (3.3.1), quality (3.4), and color if specified, are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for corrosion resistance of representative parts and separate panels (3.3.2) and of cleaning and processing solutions to ensure that the anodic coating will conform to the requirements of this specification are classified as periodic tests and, except as specified in 4.3.2 and 4.3.3, 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 requirements of this specification are classified as preproduction tests and shall be performed prior to or on the initial shipment of processed 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 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 not less than the following; a lot shall be all parts of the same part number processed in a continuous series of operations and presented for vendor's inspection at one time:

4.3.1 Coating Weight: Shall be determined 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 test specimens 0.025 - 0.063 in. (0.6 - 1.6 mm) thick and not less than 3 x 3 in. (75 x 75 mm) in length and width made of any 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 clad alloys.

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

4.3.1.1 Separate specimens, if used, shall be processed with the work they represent.

4.3.2 Corrosion Resistance: Shall be determined at least monthly on
∅ representative parts and on separate panels 0.025 - 0.063 in. (0.6 - 1.6 mm) thick and not less than 3 x 10 in. (75 x 250 mm) in width and length.

4.3.3 Process Solution Control: Shall be performed at least weekly.
∅

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 by purchaser. Results of tests on production parts and panels shall be essentially equivalent to those on the approved sample parts and panels.

4.4.2 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 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.

4.5 Reports: The vendor of coated parts shall furnish with each shipment three
∅ copies of a report stating that the parts have been processed and tested in accordance with the requirements of this specification and that they conform to the acceptance test requirements. This report shall include the purchase order number, AMS 2470H, part number, and quantity.