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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2470L

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Superseding AMS 2470K

Anodic Treatment of Aluminum Alloys
Chrome 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:

This process has been used typically to increase corrosion resistance and to provide surfaces which will promote adherence of paint and other organic finishes, and has been found useful for assemblies which have faying surfaces and/or which may trap electrolyte, but usage is not limited to such applications.

1.2.1 This process is primarily applicable to aluminum and aluminum alloy parts which have nominal copper content not greater than 5% by weight or total nominal alloy content not greater than 7.5% by weight, AMS 2471 being recommended for parts having higher alloy content. Coating may be dyed if specified, but AMS 2472 is recommended where a colored finish is required.

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 measure to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS:

The issue of the following documents in effect on the date of the purchase order form a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been canceled and no superseding document has been specified, the last published issue of that document shall apply.

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2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2471	Anodic Treatment of Aluminum Alloys, Sulfuric Acid Process, Undyed Coating
AMS 2472	Anodic Treatment of Aluminum Alloys, Sulfuric Acid Process, Dyed Coating
AMS 2473	Chemical Film Treatment for Aluminum Alloys, General Purpose Coating
AMS 4037	Aluminum Alloy Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn, (2024; -T3 Flat Sheet, -T351 Plate), Solution Heat Treated

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 117	Operating Salt Spray (Fog) Testing Apparatus
ASTM B 137	Measurement of Mass of Coating on Anodically Coated Aluminum
ASTM D 3762	Adhesive Bonded Surface Durability of Aluminum (Wedge Test)

3. TECHNICAL REQUIREMENTS:

3.1 Solutions:

3.1.1 Electrolyte: Should be an aqueous solution of chromic acid of suitable concentration (See 8.2.9) maintained within ±4 °F (±2 °C) of the temperature approved as in 4.4.2.

3.1.1.1 Use of surfactants (anti-misting additives) to minimize airborne emission of chromium into the environment may be made only when approved by the cognizant engineering organization as in 4.4.

3.1.1.1.1 If surfactants have been approved for use and if anodized parts are to be subsequently adhesively bonded, purchaser shall notify processor of the need to perform the adhesive bond verification test of 3.3.3.

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

3.1.3 Sealer: Unless otherwise permitted, the sealer shall be water of suitable purity and controlled pH (See 8.2.10) maintained at a suitable temperature (See 8.2.12).

3.2 Procedure:

3.2.1 Cleaning and Deoxidation: Parts shall have clean surfaces, free from water break, prior to immersion in the anodizing bath.

3.2.1.1 Cleaning materials or products used for surface preparation containing iron, such as steel wool, iron oxide rouge, or steel wire, which may become embedded in the metal and accelerate subsequent corrosion, are prohibited.

3.2.2 Tight electrical contact shall be maintained during the anodic treatment, to prevent contact arcing (burning) of parts, but small irregularities of coating at points of electrical contact are acceptable.

3.2.3 Coating: The cleaned parts shall be made the anode(s) in the electrolyte contained in a suitable chemical-resistant tank which may also serve as the cathode. The processing shall be adjusted to obtain the required weight and quality of the coatings. The rate of increase of the voltage shall be maintained within a range of two volts per minute of the nominal value, and the anodizing voltage shall be maintained within two volts of the nominal value. After anodizing, parts shall be rinsed thoroughly in water at ambient temperature and sealed (See 3.2.5) unless dyeing (See 3.2.4) or other treatment is specified.

3.2.4 Dyeing: Parts shall be dyed, when specified, to the color required by immersing in an appropriate dye solution. The anodic coating shall not be allowed to dry before dyeing. 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 clean water at ambient temperature.

3.2.5 Sealing: Parts shall be immersed in the sealant solution for a suitable time and temperature (See 8.2.12), then rinsed. The rinse shall be thorough, but slight staining resulting from the sealant solution is acceptable. Rinsing is not required if deionized water is used for sealing.

3.2.6 Masking: Areas where anodizing is prohibited shall be masked.

3.3 Properties:

Coated parts shall conform to the following requirements:

3.3.1 Coating Weight: The coating weight (See 4.3.2.1), determined in accordance with ASTM B 137, shall be not less than 200 mg/square foot (2 g/m^2) on parts which are not to be dyed, and not less than 500 mg/square foot (5 g/m^2) on parts which are to be dyed.

3.3.1.1 If small parts, such as rivets or 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.

3.3.2 Corrosion Resistance: Panels (See 4.3.2.2) shall meet the following requirements, determined after exposure for not less than 336 hours to salt spray corrosion test in accordance with ASTM B 117, except that the significant surface shall be inclined 6 degrees from the vertical. Areas within 1/16 inch (1.6 mm) of identification markings or of an edge, or at electrode contact marks, shall not be included.

Fifteen scattered spots or pits, none larger than 1/32 inch (0.8 mm) diameter, on a total of 150 square inches (968 cm^2) of test area from five or more test pieces.

Five scattered spots or pits, none larger than 1/32 inch (0.8 mm) diameter, on any 30 square inches (194 cm^2) of test area from one or more test pieces.

3.3.2.1 Panels which are acceptable to the criteria of 3.3.2 but which exhibit patchy dark gray areas (spots, streaks, or marks) with a white chalky film on the surface shall be examined at 10X magnification. Pits, if discovered, shall be added to those found with the unaided eye and the acceptance criteria reapplied.

3.3.3 Adhesive Bond Verification Test: When anti-misting agents are used as in 3.1.1.1 and in 3.1.1.1.1, the effect of such agents on adhesive bond strength shall be determined in accordance with ASTM D 3762, using panels primed and adhesively bonded using materials and procedures acceptable to purchaser. Test panels shall be conditioned by exposure to 100% RH at a temperature of 100 °F ± 5 (49 °C ± 3) for 60 minutes, minimum. Crack growth in excess of 0.25 inch (6.4 mm) or any evidence of adhesion failure at the anodize/primer interface shall be cause for failure.

3.4 Touch Up:

Parts on which the anodic coating has been scratched or damaged superficially may be coated using AMS 2473 or another method acceptable to the cognizant engineering organization. Touch-up, unless otherwise specified, shall not exceed 0.5 inches (13 mm) in its longest dimension, except that scratches that are essentially one dimensional (less than 0.03 inch (0.8 mm) wide) may be reworked. The total reworked area shall not exceed 5% of the total surface area.

3.5 Quality:

Anodic coating, as received by purchaser, 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 usage of the coating.

3.5.1 Parts sealed in sodium dichromate solution may have a characteristic yellow color, and those sealed in nickel acetate solution may have a characteristic gray-green color. Slight variations in color between cast and machined surfaces, between welds and adjacent areas, due to grain size or grain flow variations, or due to variation in alloy composition from lot to lot, are acceptable.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The processor shall supply all samples for processor's tests and shall be responsible for performance of all required tests. Parts, if required for tests, shall be supplied by purchaser. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that processing conforms to specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Quality (3.5) and color (3.1.2), if specified, are acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Coating weight (3.3.1), corrosion resistance (3.3.2), adhesive bond verification (3.3.3) when required by purchaser, and tests of cleaning and processing solutions to ensure that the anodic coating will conform to the specified requirements are periodic tests and shall be performed at a frequency selected by the processor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: All technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of processed 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 the purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing:

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 (3.2.4 to 3.2.6, inclusive), in not longer than 24 consecutive hours, and presented for the processor's inspection at one time.

4.3.1 For Acceptance and Preproduction Tests: Shall be as shown in Table 1, and as follows. For preproduction tests for coating weight and corrosion resistance, sample quantity shall be selected by the processor unless quantity is specified by purchaser.

4.3.1.1 Adhesive Bond Verification Tests (3.3.3): Shall be determined on three samples fabricated from AMS 4037 aluminum alloy, using dimensions in ASTM D 3762.

TABLE 1 - Sampling for Acceptance Tests

Number of Parts In Lot	Quality and Color
Up to 7	All
8 to 15	7
16 to 40	10
41 to 110	15
111 to 300	25
301 to 500	35
Over 500	50

4.3.2 For Periodic Tests: Sample quantity shall be selected at the discretion of the processor, unless otherwise specified, except for corrosion testing, which shall be carried out at a frequency not less than monthly.

4.3.2.1 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 panels 0.025 to 0.063 inch (0.64 to 1.60 mm) thick and not less than 3 inches (76 mm) square fabricated from AMS 4037 aluminum alloy.

4.3.2.1.1 Separate test panels, if used, shall be processed with the work they represent.

4.3.2.2 Corrosion Resistance: Shall be determined on separate test panels 0.025 to 0.063 inch (0.64 to 1.60 mm) thick and not less than 3 x 10 inches (76 x 254 mm) in width and length fabricated from AMS 4037 aluminum alloy.

4.4 Approval:

4.4.1 Processes, control factors, or preproduction sample part or test panel, or any combination thereof specified, shall be approved by the cognizant engineering organization before production parts are supplied.

4.4.2 The processor shall make no significant change 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, could affect the properties or performance of the parts.

4.4.3 Control factors for anodizing shall include, but not be limited to, the following:

Cleaning procedure, including the compositions and temperatures of the baths used
Deoxidation process
Anodizing bath composition (including impurity limits), temperature, and agitation method
Anti-misting agents (including composition and concentration), if used
Rate of voltage rise, anodizing voltage, and time of anodizing
Sealing solution composition (including impurity limits), temperature, and pH
Touch up method, if used
Purity of water used for sealing and rinsing
Periodic test plan

4.5 Reports:

The processor of coated parts shall furnish with each shipment a report stating that the parts have been processed and tested in accordance with specified requirements and that they conform to the acceptance test requirements. This report shall include the purchase order number, lot number, AMS 2470L, part number, and quantity.

4.6 Resampling and Retesting:

4.6.1 If results of any acceptance test fail to meet specified requirements, the parts in that lot may be stripped by a method acceptable to purchaser that does not roughen or pit the basis metal or adversely affect dimensional tolerances, pretreated, coated, post treated as defined herein, and tested. Alternatively, all parts in the lot may be inspected for the nonconforming attribute, and the nonconforming parts may be stripped by a method acceptable to purchaser that does not roughen or pit the basis metal or adversely affect dimensional tolerances, pretreated, coated, post treated as defined herein, and tested.

4.6.2 If results of any periodic test fail to meet specified requirements, the process is nonconforming. No additional parts shall be coated until the process is corrected and new specimens are coated and tested. Results of all tests shall be recorded and, when requested, reported. Purchaser shall be notified of all parts coated since the last acceptable test.