AEROSPACE MATERIAL SPECIFICATION

AMS2471™	REV. K

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Revised 2022-01

Superseding AMS2471J

Anodic Treatment of Aluminum Alloys Sulfuric Acid Process, Undyed Coating

RATIONALE

AMS2471K results from adding non-hexavalent chromium or non-chromium sealing solution (3.1.2) when specified or approved by the cognizant engineering organization.

NOTICE

ORDERING INFORMATION: The following information shall be provided to the processor by the purchaser.

1. Purchase order shall specify not less than the following:

   - AMS2471K
   - Basis metal to be anodized
   - Special features, geometry or processing present on parts that requires special attention by the processor
   - Electrical contact locations, when specified (3.2.3)
   - Optional: Alternative sealing solution (3.1.2)
   - Quantity of pieces to be anodized

2. Parts manufacturing operations such as heat treating, shot peening, media finishing, forming, joining, brazing, welding, perforating, and machining performed prior to anodizing, can affect the condition of the substrate and if performed after anodizing, can adversely affect the finished coating. The sequencing of these types of operations should be specified by the cognizant engineering organization or purchaser and is not controlled by this specification.

1. SCOPE

1.1 Purpose

This specification establishes the requirements for undyed anodic coatings on aluminum alloys.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS2471K/

1.2 Application

This process has been used typically to increase corrosion resistance and to provide surfaces that will promote adherence of paint and other organic finishes, but usage is not limited to such applications.

1.2.1 AMS2472 should be specified for coatings colored by dyeing. This process is not suitable for parts that contain joints or recesses in which the anodizing solution may be retained.

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 measures 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 forms 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 cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2472 Anodic Treatment of Aluminum Alloys, Sulfuric Acid Process, Dyed Coating

AMS2473 Chemical Film Treatment for Aluminum Alloys, General Purpose Coating

AMS4037 Aluminum Alloy, Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn (2024; -T3 Flat Sheet, -T351 Plate), Solution Heat Treated

ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

ARP4992 Periodic Test Plan for Processing Solutions

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B117 Operating Salt Spray (Fog) Apparatus

ASTM B137 Measurement of Coating Mass Per Unit Area on Anodically Coated Aluminum

2.3 Definitions

Terms used in AMS are clarified in ARP1917 and as follows.

2.3.1 PIT

A pit, as used in 3.4.2, is defined as an area of localized corrosion having a depth greater than its width. Pit size may be determined by either direct dimensional measurement or by comparison to known references. A superficial pit or discontinuity in the anodize surface itself, not penetrating thru to the base metal and not showing the presence of white corrosion products is not rejectable. As a general rule, a rejectable pit usually displays a characteristic tail or line of white aluminum corrosion products.

3. TECHNICAL REQUIREMENTS

3.1 Solutions

3.1.1 Electrolyte shall be an aqueous solution of sulfuric acid of suitable concentration maintained within ±2 °F (±1 °C) of the temperature approved in 4.4.3 (see 8.2.10).

3.1.2 Sealer

The sealer shall be an aqueous solution of sodium dichromate or potassium dichromate. When specified or approved by the cognizant engineering organization (see 4.4), other sealing solutions including non-hexavalent chromium, or non-chromium sealers (see 8.2.8) may be used.

3.2 Preparation

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 Masking

Areas where anodizing is prohibited shall be masked.

3.2.3 Electrical Contact Points

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. For parts that are to be anodized all over, and contact locations are not specified, contact locations shall be at the discretion of the processor. For parts that are not to be anodized all over, and contact locations are not specified, locations shall be in areas on which coating is not required. When required, contact locations shall be approved by the cognizant engineering organization.

3.3 Procedure

3.3.1 Anodizing

3.3.1.1 The cleaned parts shall be made the anode(s) in the electrolyte contained in a chemical-resistant tank which may also serve as the cathode. The processing shall be adjusted to obtain the required weight and quality of the coating. The anodizing current shall be maintained within ±2 amperes per square foot (±21.5 A/m^2) of the nominal value.

3.3.1.2 Alternatively, the anodizing current shall be ramped up over a 5 minute or other preselected period to the desired final voltage and maintained until the anodic coating reaches the desired coating weight.

3.3.1.3 After anodizing, parts shall be rinsed in water at ambient temperature.

3.3.2 Sealing

Parts shall be immersed in the sealer solution (8.2.8) for a suitable time (8.2.9), 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.

3.3.3 Touch Up

Damaged areas of parts on which the anodic coating has been scratched or damaged superficially may be coated using AMS2473 or another method acceptable to the cognizant engineering organization. Touch-up, unless otherwise specified, shall not exceed 0.5 inch (13 mm) in its longest dimension, except that scratches that are essentially one dimensional (less than 0.03 inches (0.8 mm) wide) may be reworked. The total reworked area shall not exceed 5% of the total anodized surface.

3.4 Properties

Coated parts shall conform to the following requirements:

3.4.1 Coating Weight

The unsealed coating weight (4.3.3.2), determined in accordance with ASTM B137, shall be not less than 600 mg/square foot (6.5 g/m^2).

3.4.1.1 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.

3.4.2 Corrosion Resistance

Specimens in accordance with 4.3.3.3 shall meet the following requirements, determined after exposure for not less than 336 hours to salt spray corrosion test in accordance with ASTM B117, except that significant surface shall be inclined back approximately 6 degrees from vertical. The five test specimens shall show not more than a total of 15 isolated pits, as defined in 2.3.1, none larger than 1/32 inch (0.8 mm) in diameter, in a total of 150 square inches (968 cm^2) of test area. Areas within 1/16 inch (1.6 mm) of identification markings or of an edge, or at electrode contact marks, shall not be included. Individual test specimens shall show no more than five isolated pits none larger than 1/32 inch (0.8 mm) in a total of 30 square inch (194 cm^2). See 2.3.1 for pit morphology definition.

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. Differences in the anodic coating appearance on castings or wrought components due to welds, or cast versus machined surface textures, or macro grain size and other inherent metallurgical artifacts shall not be cause for rejection of the anodic coating (see 8.5).

3.5.1 The transition zone between the masked and anodize surfaces may not be uniform. Some anodize leakage onto the previously masked surfaces can be expected, however, this transition zone should not exceed 0.050 inch (1.3 mm) wide. To the extent this anodize leakage may extend beyond a 0.050 inch (1.3 mm) wide, transition zone, the extent of leakage should be agreed upon with the cognizant engineering organization.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The coating processor shall supply all samples for processor's tests and shall be responsible for the performance of all required tests. Parts, if required for tests, shall be supplied by purchaser. Processor may utilize his own or any other inspection facilities or services acceptable to the cognizant engineering organization. The cognizant engineering organization 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) is an acceptance test and shall be performed on parts, or samples representing parts when permitted, from each lot.

4.2.2 Periodic Tests

Coating weight (3.4.1) and corrosion resistance (3.4.2) are periodic tests and shall be performed at least monthly in any month that parts are processed unless frequency of testing is specified by the cognizant engineering organization. Tests of cleaning and processing solutions are periodic tests and shall be performed at a frequency established by the processor unless frequency of testing is specified by the cognizant engineering organization (see 8.3 and 4.4.3).

4.2.2.1 Periodic testing may be suspended in any test period when parts are not processed but shall be performed before or at the time such processing is resumed. Preproduction testing may be required by the cognizant engineering organization, upon resumption of processing.

4.2.3 Preproduction Tests

All property verification tests (see 3.4) are preproduction tests and shall be performed prior to or on the initial shipment of processed parts to a purchaser and when the cognizant engineering organization requires confirmatory testing.

4.3 Sampling for Testing

4.3.1 Acceptance Tests

Acceptance test samples shall be randomly selected from all parts in the lot. A lot is a group of parts, all of the same part number, processed through the same chemical solutions in the same tanks under the same conditions, which have completed the chemical processing within a period of 24 hours of each other and are presented to inspection at the same time. Unless the cognizant engineering organization provides a sampling plan, the minimum number of samples shall be as shown in Table 1.

Table 1 - Sampling for acceptance testing

Number of Parts in Lot	Quality
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 Periodic and Preproduction Tests

Sample quantities shall be three for coating weight and five for corrosion resistance unless otherwise specified by the cognizant engineering organization.

4.3.3 Sample Configuration

4.3.3.1 Separate test specimens may be used under any one of the following circumstances: The parts are of such configuration or size as to be not readily adaptable to specified tests, nondestructive testing is not practical on actual parts, or it is not economically acceptable to perform destructive tests on actual parts. Acceptance test specimens shall be distributed within the lot, cleaned, anodized, and sealed with the parts represented.

4.3.3.2 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 to 0.063 inch (0.64 to 1.60 mm) thick and not less than 3 inches (76 mm) square fabricated from 2024-T3 aluminum alloy in accordance with AMS4037.

4.3.3.3 Corrosion resistance test specimens shall be 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 2024-T3 aluminum alloy in accordance with AMS4037.

4.4 Approval

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

4.4.2 If the processor makes a significant change to any material, process, or control factor from that which was used for process approval, all preproduction tests shall be performed, and the results submitted to the cognizant engineering organization for process reapproval 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
Rate of voltage rise, anodizing voltage, and time of anodizing
Sealing solution composition (including impurity limits), temperature, and pH
Purity of water used for sealing and rinsing
Stripping procedure, when applicable
Periodic test plan for cleaning and processing solutions (see 8.3)

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, AMS2471K, part number, and quantity.

4.6 Resampling and Retesting

4.6.1 If any lot acceptance test fails to meet specified requirements, parts in that lot may be stripped, pretreated, coated, post-treated as defined herein and retested. Alternatively, all parts in the lot may be inspected for the nonconforming attribute, and the nonconforming parts may be stripped, pretreated, recoated, post-treated as defined herein, and retested. After any stripping and recoating, parts shall meet the dimensional requirements of the drawing.

4.6.1.1 When stripping is performed, the method shall be acceptable to the cognizant engineering organization and shall not roughen, pit, or embrittle the basis metal or adversely affect part dimensions. When parts have been stripped and re-anodized, the cognizant engineering organization shall be informed.

4.6.2 If any periodic test fails to meet specified test requirements, the process is nonconforming. No additional parts shall be plated 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.

5. PREPARATION FOR DELIVERY

5.1 Coated parts shall be handled and packaged to ensure that the required physical characteristics and properties of the coating are preserved.