

Hard Anodic Coating on Aluminum and Aluminum Alloys

RATIONALE

AMS2469H results from a Five Year Review and update of this specification.

1. SCOPE

1.1 Purpose

This specification establishes the requirements for a hard anodic coating on aluminum and aluminum alloys.

1.2 Application

This process has been used typically to increase, by formation of a dense aluminum oxide, surface hardness and resistance to abrasion and corrosion of aluminum and aluminum-alloy parts containing, in general, less than 5% copper or 8% silicon or a total of 8% of both, but usage is not limited to such applications. Alloys with higher alloy content can be coated satisfactorily with proper precautions in processing. Careful consideration should be given when using this process on highly-stressed parts because of the resultant marked lowering of fatigue performance and on parts with sharp corners and edges where chipping may result.

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.

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2.1 SAE Publications

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

AMS4037 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 International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B 117 Operating Salt Spray (Fog) Apparatus
ASTM B 137 Measurement of Coating Mass Per Unit Area on Anodically Coated Aluminum
ASTM B 244 Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments
ASTM B 487 Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section
ASTM D 4060 Abrasion Resistance of Organic Coatings by the Taber Abraser

3. TECHNICAL REQUIREMENTS

3.1 Preparation

- 3.1.1 The coating shall be applied over a surface free from water breaks. The cleaning procedure shall not produce pitting or intergranular attack of the basis metal and shall preserve dimensional requirements.
- 3.1.2 When not otherwise specified by purchaser, the location of electrical contact points shall be as follows. For parts which are to be coated all over, locations shall be acceptable to purchaser. For parts which are not to be coated all over, locations shall be in areas on which coating is not required or is optional.
- 3.1.3 A suitable maskant shall be applied to any area or areas where solution entrapment may occur such as faying surfaces or where there is another metal such as a thread insert.

3.2 Procedure

- 3.2.1 An anodic potential shall be impressed on the parts while immersed in a suitable electrolyte to produce an aluminum oxide coating. Tight electrical contact shall be maintained during the anodic treatment to prevent arcing (burning) of parts. After coating, parts shall be thoroughly rinsed in cold, clean water, and dried.
- 3.2.2 Sealing of parts for improved corrosion resistance shall be accomplished only when specified by the cognizant engineering organization.

3.3 Properties

Coating on parts shall conform to the following requirements:

3.3.1 Thickness

AMS2469 designates finished coating thickness of 0.0020 inch \pm 0.0005 (0.051 mm \pm 0.013). Coating thickness may be specified by use of AMS2469 followed by a suffix number to designate the nominal thickness in thousandths of an inch (25 μ m). A tolerance of \pm 0.0005 inch (\pm 0.013 mm) in thickness of coating will be allowed, unless otherwise specified. For example, AMS2469-3 designates a finished coating thickness of 0.0030 inch \pm 0.0005 (0.076 mm \pm 0.013).

3.3.1.1 Thickness of coating shall be as specified on the drawing, determined in accordance with any of the following methods: microscopic method, micrometer measurement, ASTM B 244 or ASTM B 487, or other method acceptable to the cognizant engineering organization. When used, micrometer measurements shall be calibrated against microscopic measurements on specimens processed to the same nominal coating thickness. Coating thickness requirements shall not apply to blind holes or recesses with depth greater than twice the diameter or in open holes with depth greater than seven times the diameter unless a specific coating thickness is specified in those areas.

3.3.2 Coating weight shall be not less than 0.030 grams/square inch per 0.001 inch (0.18 grams/cm²/mm) of coating thickness, determined on unsealed coatings in accordance with ASTM B 137.

3.3.3 Color shall be substantially uniform on pieces of the same alloy processed to the same nominal coating thickness. Coated surfaces shall not have a sooty appearance or the presence of a moiré pattern.

3.3.4 Abrasion Resistance

Unsealed, coated specimen (4.3.3.3) shall have a maximum wear index of 3.5 mg/1000 cycles on aluminum alloys having a copper content of two percent or higher and a wear index not greater than 1.5 mg/1000 cycles for all other alloys, determined as follows; two test specimens weighed to the nearest milligram shall be tested in accordance with ASTM D 4060 using CS-17 wheels with a 1000 gram load for 10 000 cycles. Specimens may be placed in a desiccator prior to and following testing to establish constant weight in lieu of conditioning specified in ASTM D 4060. The wheels shall revolve on the anodic coating at a speed of 70 revolutions per minute (RPM) for 10 000 cycles. The abrasive wheels shall be resurfaced prior to the start of any individual test, and at least once every 10 000 cycles. The wear index is determined at the end of 10 000 cycles by dividing the weight loss by ten.

3.3.5 Corrosion Resistance

Coated specimens that have been given a supplementary sealing treatment 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 significant surface shall be inclined approximately six degrees from 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 cm²) 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 cm²) of test area from one or more test pieces.

3.4 Quality

Coating on parts, as received by purchaser, shall be substantially uniform in thickness except in small holes unless a specific coating thickness is specified, and in fillets, radii, and deep recesses, and shall be free from scratches, chips, and burned or powdery areas. Small irregularities at points of electrical contact are permissible.

3.5 Tolerances

When a limited area to be hard coated is specified, a tolerance of $-0, +1/16$ inch ($+1.6$ mm) will be permitted on the extent of the hard coated area except when such area ends at a corner; in such cases, the area shall not extend beyond the corner by more than the projected thickness of the coating.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The processor shall supply all samples for processor's tests and shall be responsible for the performance of all required tests. Parts, when required for test shall be supplied by the purchaser. 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

Thickness (3.3.1) or coating weight (3.3.2), color (3.3.3), and quality (3.4) are acceptance tests and shall be performed on parts, or specimens representing parts when permitted herein, from each lot.

4.2.2 Periodic Tests

Coating weight (3.3.2) unless determined for acceptance testing, abrasion resistance (3.3.4), and corrosion resistance (3.3.5) are periodic tests and shall be performed at least monthly 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 8.4 and 4.4.3).

4.2.3 Preproduction Tests

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

4.3 Sampling for testing shall not be less than the following:

A lot shall be all coated parts of the same part number, processed to the same coating thickness, and presented for processor's inspection at one time.

4.3.1 Acceptance Tests

Test samples shall be randomly selected from all parts in the lot. Unless the cognizant engineering organization provides a sampling plan, the minimum number of parts sampled shall be as shown in Table 1.

TABLE 1 - MINIMUM SAMPLING FOR ACCEPTANCE TESTS

Number of Parts in Lot	Color and Quality	Thickness or Coating Weight
Up to 7	All	3 or all*
8 to 15	7	4
16 to 40	10	4
41 to 110	15	5
111 to 300	25	6
301 to 500	35	7
Over 500	50	8

*Whichever is less

4.3.2 Periodic Tests

Sample quantities shall be two for abrasion resistance (3.3.4), five for corrosion resistance (3.3.5) and three for coating weight (3.3.2) 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 coated 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. Except as specified below, acceptance test specimens shall be made of the same alloy as the parts represented and periodic test specimens shall be fabricated from the predominant alloy anodized since the last periodic test. Whenever possible, specimens shall be anodized with an actual production lot.

4.3.3.2 If parts are of such size and shape that surface area cannot be determined readily, coating weight determinations shall be made on test panels approximately 0.025 to 0.063 inch (0.64 to 1.60 mm) in nominal thickness and not less than 3 inches (76 mm) square.

4.3.3.3 Specimens for abrasion resistance test (3.3.4) shall be either 4-inch (102-mm) diameter round or 4 inches (102 mm) square panel fabricated from AMS4037 (2024-T3), aluminum alloy sheet, or the predominant alloy (as defined above) anodized measuring not less than 0.063 inch (1.60 mm) thick with a 0.250-inch (6.35-mm) diameter hole in the center and shall not have been given a supplementary sealing treatment.

4.3.3.4 Corrosion resistance (3.3.5) shall be determined on test panels approximately 0.025 to 0.063 inch (0.64 to 1.6 mm) thick and not less than 3 x 10 inches (76 x 254 mm) fabricated from alloy AMS4037 (2024-T3) or the predominant alloy (as defined above) anodized.

4.4 Approval

4.4.1 The process and control procedures, a preproduction sample part, or both, whichever is specified by purchaser, 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, would affect the properties or performance of the part.