

Submitted for recognition as an American National Standard

EPOXY PRIMER PLATING
Electrodeposition

1. SCOPE:

- 1.1 Purpose: This specification covers the engineering requirements for electrodeposition of AMS 3109 epoxy primer on aluminum alloy surfaces and the properties of the deposit.
- 1.2 Application: Primarily for use as a primer for structural adhesive bonding of aluminum alloys and honeycomb panels.
- 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 following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

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

2.1.1 Aerospace Material Specifications:

AMS 2825 - Material Safety Data Sheets

AMS 3109 - Primer, Adhesive, Electrodeposited, -55° - 82°C (-67° - 180°F)

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2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM D 1193 - Reagent Water

ASTM D 3933 - Preparation of Aluminum Surfaces of Structural Adhesives Bonding (Phosphoric Acid Anodizing)

2.3 U.S. Government Publications: Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

2.3.1 Military Specifications:

MIL-P-17667 - Paper, Wrapping, Chemically Neutral (Non corrosive)

2.3.2 Military Standards:

MIL-STD-2073-1 - DOD Material Procedures for Development and Application of Packaging Requirements

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

3.1.1 All machining, brazing, welding, forming, and heat treating shall be completed before parts are plated.

3.1.2 Parts shall have chemically clean surfaces, prepared with minimum abrasion, erosion, or pitting, prior to immersion in the plating solution.

3.1.3 Electrical contacts between the parts and power source shall be made to ensure that neither chemical or immersion deposition nor electric arcing or overheating will occur. If parts are to be plated all over, contact points shall be located as specified on the part drawing or as agreed upon by purchaser and vendor. If parts are not required to be plated all over, contact points shall be located in areas on which plating is not required or is optional.

3.2 Procedure: Parts shall be plated in the following sequence, using the AMS 3109 epoxy primer solution.

1. Degrease
2. Alkaline clean
3. Rinse in ASTM D 1193, Type III, water (3 to 5 minutes)
4. Anodize in accordance with ASTM D 3933
5. Rinse in ASTM D 1193, Type III, water (5 to 7 minutes)
- 5a. Alternately, oven dry at $54^{\circ}\text{C} \pm 6$ ($130^{\circ}\text{F} \pm 10$) for 30 - 40 minutes
6. Epoxy primer plate

3.2.1 Epoxy Primer Plate: Shall be electrodeposited from AMS 3109 epoxy primer solution on an anodized aluminum surface.

3.2.1.1 Parts to be electrodeposited in the dry condition shall be oven dried at 49° - 60°C (120° - 140°F), handled with clean cotton gloves, and covered with MIL-P-17667 paper.

3.2.2 Rinsing: The plated part shall be removed from the plating solution and shall be thoroughly rinsed by immersion for not less than 15 minutes in water at not lower than 80°C (176°F) and dried.

3.2.3 Curing: Parts shall be oven cured at 121°C ± 3 (250°F ± 5) for 30 to 35 minutes.

3.3 Properties:

3.3.1 Epoxy Primer Solution: Shall conform to the following requirements, determined by the specified test methods:

3.3.1.1	Temperature	21° - 27°C (70° - 81°F)	4.5.1
3.3.1.2	Solids content	8.0 to 10.0% by weight	4.5.2
3.3.1.3	Acidity (pH)	4.8 - 6.5	4.5.3
3.3.1.4	Solvent content	As specified by supplier	4.5.4
3.3.1.5	Resistance	1000 - 2000 ohm-cm	4.5.5
3.3.1.6	Milliequivalence of solubilizer	0.25 - 0.30 meq/g	4.5.6

3.3.2 Cured Epoxy Primer Plate: The following properties shall be determined each day that adherends are processed:

3.3.2.1 Thickness shall be 0.0001 - 0.0004 inch (2.54 - 10.16 μm), determined by eddy current or other method acceptable to purchaser.

3.3.2.2 Adhesion properties (tensile shear, sandwich peel, and wedge crack propagation) shall meet the requirements of AMS 3109.

3.3.2.3 Completeness of cure shall meet the requirements of AMS 3109.

3.4 Quality: Plated epoxy primer, as received by purchaser, shall be continuous, adherent to the basis metal, uniform in appearance, and essentially free from pinholes, porosity, blisters, nodules, pits, and other imperfections detrimental to usage of the plating.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The processing vendor shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform 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 for thickness (3.3.2.1) and quality (3.4) are acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests for all technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of plated parts to a purchaser, when a change in material and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 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, contracting officer, or request for procurement.

4.3 Sampling and Testing: Shall be as follows; a lot shall be all parts of the same part number plated in one set of baths to the same specified thickness range, processed in a continuous operation or within one 24-hour period, and presented for vendor's inspection at one time.

4.3.1 For Acceptance Tests: Three parts from each lot.

4.3.2 For Preproduction Tests: As agreed upon by purchaser and vendor.

4.4 Approval:

4.4.1 Sample plated parts 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 shall be essentially equivalent to those on the approved sample parts.

4.4.2 Vendor shall use manufacturing procedures, processes, and methods of inspection for 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 a statement of the proposed changes in processing and, when requested, sample plated parts, test panels, or both. Production parts plated by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Temperature: Shall be determined continuously, using a suitable measuring device.

4.5.2 Solids Content: Shall be determined daily as follows:

4.5.2.1 Weigh an aluminum dish to an accuracy of ± 2 milligrams. Stir the primer sample well. Transfer approximately one mL of primer from a filled and tared one-mL syringe, completely emptying the syringe onto the tared dish. Reweigh the empty syringe. Calculate weight of sample transferred to the dish.

- 4.5.2.2 Add approximately one mL of acetone and swirl the dish to uniformly distribute the sample. Bake the dish and its contents in a circulating air oven for 15 to 30 minutes at $120^{\circ}\text{C} \pm 6$ ($248^{\circ}\text{F} \pm 11$). Allow dish to cool for 2 to 3 minutes. Reweigh dish and solid residue. Calculate results as follows:

$$\% \text{ Solids Content} = \frac{\text{Wt of dish and dried film} - \text{wt of dish}}{\text{Wt of full syringe} - \text{wt of empty syringe}} \times 100$$

- 4.5.3 Acidity (pH): Determine daily as follows: Adjust the temperature of the buffer solution to $25^{\circ}\text{C} \pm 1$ ($77^{\circ}\text{F} \pm 2$). Use the buffer which is closest to the expected pH of the primer. Standardize the pH meter daily using the buffer closest to the anticipated value. Standardize the pH meter weekly using buffers pH 4.0 and 1.0 to recalibrate the slope and intercept point. Rinse electrodes with distilled water. Allow primer temperature to stabilize to $24^{\circ}\text{C} \pm 3$ ($75^{\circ}\text{F} \pm 5$). Stir the sample well. Immerse the electrodes in the primer sample and read the pH value.
- 4.5.4 Solvent Content: Determine solvent content on a monthly basis using gas chromatography analysis. Method shall be as agreed upon by purchaser and vendor.
- 4.5.5 Resistance: Shall be determined daily using a conductance bridge meter with the temperature of the field stabilized at $24^{\circ}\text{C} \pm 3$ ($75^{\circ}\text{F} \pm 5$).
- 4.5.6 Milliequivalence (meq) of Solubilizer: Shall be determined daily as follows:
- 4.5.6.1 Standardize 0.1N potassium hydroxide (KOH) in methanol to the nearest 0.0002N, using acid potassium phthalate. Draw about 5 mL of homogeneously disbursed primer into a 5-mL syringe. Wipe the tip of the syringe clean; cover the tip and weigh the full syringe to the nearest 0.0001 gram. Transfer the full syringe load into a 100-mL beaker and reweigh the empty syringe. Calculate the weight of the sample transferred to the beaker. A full syringe shall be used for each sample as electrodeposition baths tend to settle rapidly, and due to settling on the side of the syringe, a representative sample may not be obtained if the syringe is only partially emptied.

- 4.5.6.2 Add reagent grade acetone to the sample to a depth sufficient to make pH measurements while it is being agitated and titrate with a 0.01N KOH in methanol solution. While constantly stirring the sample, titrate with the standardized KOH in methanol and record the titration curve. Calculate the milliequivalents per gram of bath solids as follows:

$$\frac{\text{meq acid}}{\text{grams bath solid}} = \frac{\text{mL KOH} \times \text{Normality KOH} \times 100}{\text{wt. of sample} \times \% \text{ Solids Content}}$$

- 4.6 Reports: The vendor of plated parts shall furnish with each shipment 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, lot number, AMS 2443, part number, and quantity.
- 4.6.1 A material safety data sheet conforming to AMS 2825, or equivalent, shall be supplied to each purchaser prior to, or concurrent with, the report of preproduction test results or, if preproduction testing be waived by purchaser, concurrent with the first shipment of plated parts for production use. Each request for modification of product formulation shall be accompanied by a revised data sheet for the proposed formulation.
- 4.7 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. Except as specified in 4.7.1, failure of any retest specimen to meet the specified requirements shall be cause for rejection of the parts represented. Results of all tests shall be reported.
- 4.7.1 If any part fails to meet the specified requirements, either on the original sampling as in 4.3 or upon resampling as in 4.7, the parts in that lot may be stripped, with purchaser's approval, by a method which does not roughen or pit the basis metal, replated, and retested.

5. PREPARATION FOR DELIVERY:

- 5.1 Parts shall be handled and packaged to ensure that the required physical characteristics and properties of the plating are preserved.
- 5.2 Packages of plated parts shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the plated parts to ensure carrier acceptance and safe delivery.
- 5.3 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-2073-1, Commercial Level, unless Level A is specified in the request for procurement.
6. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.