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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 3107

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Revised

PRIMER, ADHESIVE, CORROSION-INHIBITING
For High Durability Structural Adhesive Bonding

1. SCOPE:

1.1 Form: This specification and its supplementary detail specifications cover corrosion-inhibiting, modified epoxy primers in the form of ready-to-use sprayable liquids.

1.2 Application: Primarily for use as a primer on metal surfaces in preparation for high-durability, structural, adhesive bonding of sandwich panels and for metal-to-metal attachments or as a primer in preparation for final paint-type finishing. The primers are useful over the temperature range specified in the applicable detail specification.

1.3 Classification: The requirements specified herein and in the applicable detail specification define each primer on the basis of anticipated maximum service temperature, which temperature is shown in the title of each detail specification.

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) and Aerospace Recommended Practices (ARP) 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 1425 - Deicing/Anti-Icing Fluid, Aircraft, Ethylene-Glycol Base
AMS 2350 - Standards and Test Methods
AMS 2825 - Material Safety Data Sheets
AMS 3020 - Oil, Reference, For "L" Stock Rubber Testing
AMS 3021 - Reference Fluid for Testing Di-Ester (Polyol) Resistant Materials
AMS 3695/1 - Adhesive Film, Epoxy-Base, High Durability, For 95°C (200°F) Service
AMS 3595/2 - Adhesive Film, Epoxy-Base, High Durability, For 120°C (250°F) Service
AMS 3695/3 - Adhesive Film, Epoxy-Base, High Durability, For 175°C (350°F) Service
AMS 3695/4 - Adhesive Film, Epoxy-Base, High Durability, For 215°C (420°F) Service
AMS 4037 - Aluminum Alloy Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn (2024; -T3 Flat Sheet, -T351 Plate)
AMS 4041 - Aluminum Alloy Sheet and Plate, Alclad, 4.4Cu - 1.5Mg - 0.60Mn (Alclad 2024 and 1-1/2% Alclad 2024 -T3 Flat Sheet; 1-1/2% Alclad 2024 -T351 Plate)

2.1.2 Aerospace Recommended Practices:

ARP 1524 - Surface Preparation and Priming of Aluminum Alloy Parts for High Durability Structural Adhesive Bonding, Phosphoric Acid Anodizing

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 D471 - Rubber Property - Effect of Liquids
ASTM D522 - Elongation of Attached Organic Coatings with Conical Mandrel Apparatus
ASTM D1200 - Viscosity of Paints, Varnishes, and Lacquers by Ford Viscosity Cup
ASTM D1475 - Density of Paint, Varnish, Lacquer, and Related Products
ASTM D1655 - Aviation Turbine Fuels
ASTM D2794 - Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3359 - Measuring Adhesion by Tape Test

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

2.3.1 Federal Specifications:

QQ-A-250/4 - Aluminum Alloy 2024, Plate and Sheet
QQ-A-250/5 - Aluminum Alloy Alclad 2024, Plate and Sheet
TT-P-28 - Paint, Aluminum, Heat Resisting, (1200 Deg. F)
TT-S-735 - Standard Test Fluids, Hydrocarbon
PPP-P-1892 - Paint, Varnish, Lacquer, and Related Materials, Packaging, Packing, and Marking of

2.3.2 Military Specifications:

MIL-T-5624 - Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-P-14105 - Paint, Heat-resisting (For Steel Surfaces)
MIL-L-23699 - Lubricating Oil, Aircraft Turbine Engines, Synthetic Base
MIL-A-46106 - Adhesive Sealants, Silicone, RTV, General Purpose
MIL-C-83286 - Coating, Urethane, Aliphatic Isocyanate, for Aerospace Applications
MIL-S-83430 - Sealing Compound, Integral Fuel Tanks and Fuel Cell Cavities, Intermittent Use to 360 Degrees F

3. TECHNICAL REQUIREMENTS:

3.1 Detail Specifications: The requirements for a specific primer shall consist of all the requirements specified herein in addition to the requirements specified in the applicable detail specification. In case of any conflict between the requirements of this basic specification and an applicable detail specification, the requirements of the detail specification shall govern.

3.2 Material: The primer shall be a sprayable liquid composed of a resin or resin mixture, pigmented and compounded to be compatible with epoxy-base film or paste adhesives. The primer shall impart corrosion resistance and shall contribute to the adhesive properties of the primer-and-adhesive system.

3.2.1 Storage Life: The primer, stored in the original closed containers, shall meet the requirements of this specification and the applicable detail specification when tested at any time up to the time and temperature conditions specified in the applicable detail specification.

3.3 Properties: Primer shall conform to the following requirements:

3.3.1 Uncured Primer: Primer, as-received, shall conform to the requirements of this specification and the applicable detail specification; tests shall be performed on the product supplied and in accordance with specified test methods.

3.3.1.1 Color: The primer shall be pigmented with a readily visible color, as specified in the applicable detail specification, and, after spraying, shall produce a uniform coat, determined in accordance with 4.5.2.

3.3.1.2 Solids Content: Shall be as specified in the applicable detail specification, determined in accordance with 4.5.3.

3.3.1.3 Inhibitor Content: The quantity of corrosion inhibitor shall be as specified in the applicable detail specification, expressed as a percentage of the solids content, determined in accordance with 4.5.3.

3.3.1.4 Weight Per Volume: Shall be as specified in the applicable detail specification, determined in accordance with ASTM D1475.

3.3.1.5 Viscosity: Shall be as specified in the applicable detail specification, determined in accordance with ASTM D1200.

3.3.1.6 Sprayability: The primer shall be sprayable in accordance with manufacturer's instructions to a dry film thickness of 0.0003 to 0.0006 in. (8.0 to 15.0 m), determined in accordance with 4.5.2. The use of solvents for sprayability shall be as specified in the applicable detail specification. The final sprayed coat shall be continuous, smooth, and uniform in thickness and color, determined by any suitable thickness measuring instrument and visual examination of the spray pattern.

3.3.1.7 Pot Life: The pot life or "working life" of the primer shall not be less than the time period specified in the applicable detail specification, determined in accordance with 4.5.2. Pot life is defined as that period of time at a specified temperature wherein the viscosity changes by increasing not more than 100% of the original value and the primer is still in a condition that it can be used to produce films meeting the other property requirements of this specification and the applicable detail specification.

3.3.2 Curing: The primer shall cure within the times and temperatures specified in the applicable detail specification. Primer curing at different time and temperature combinations will be acceptable at the option of the purchaser provided that the primer, in conjunction with adhesive film specified in the applicable detail specification, meets the requirements for that primer-adhesive combination; such primer shall be identified with the curing parameters required to produce satisfactory bonds.

3.3.3 Primer Film: The primer, applied to panels prepared as specified in 4.5.1.2 and cured in accordance with the applicable detail specification, shall meet the requirements specified in the applicable detail specification, determined as specified below:

Requirement	Test Method
Adhesion	4.5.4
Flexibility	ASTM D522
Impact Resistance	ASTM D2794
Hardness	4.5.5
Fluid Resistance	4.5.6
Corrosion Resistance	4.5.7
Humidity Resistance	4.5.8
Heat Resistance	4.5.9
Low-Temperature Shock	4.5.10
Compatibility with Sealant	4.5.11
Compatibility with Topcoat	4.5.12

3.3.4 Cured Primer/Adhesive System: The cured primer, used in conjunction with the film adhesive specified in the applicable detail specification, shall meet the room-temperature lap shear and metal-to-metal peel requirements for that primer/adhesive system specified in the applicable adhesive detail specification.

3.4 Quality: The primer, as received by purchaser, shall be uniform in quality and condition, homogenous, and free from contamination or foreign material that would alter its use or function and, when sprayed, shall yield a smooth, continuous, uniform coat possessing a uniformly pigmented color.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the primer 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 4.6. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the primer conforms to the requirements of this specification and the applicable detail specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Shall be as specified in the applicable detail specification and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification and the applicable detail specification are classified as preproduction tests and shall be performed prior to or on the initial shipment of primer 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.

4.2.2.1 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, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be as follows:

4.3.1 For Acceptance Tests: Each lot of primer shall be sampled at random to provide sufficient material to perform all required tests. The number of specimens for each test shall be as specified in the applicable test procedure or, if not specified therein, not less than three.

4.3.1.1 A lot shall be all primer produced in a single production run from the same batches of raw materials under the same fixed conditions, or all primer subjected to the same unit chemical and physical process intended to make the final product homogeneous, and submitted for vendor's inspection at one time. A lot shall not exceed 1000 gal (3800 L) and may be packaged in small containers under a basic lot approval provided the lot identification is maintained.

4.3.1.2 When a statistical sampling plan and acceptance quality level (AQL) have been agreed upon by purchaser and vendor, sampling shall be in accordance with such plan in lieu of sampling as in 4.3.1 and the report of 4.6.1 shall reference the plan used.

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

4.4 Approval:

4.4.1 Sample primer shall be approved by purchaser before primer for production use is supplied, unless such approval be waived by purchaser. Results of tests on production primer shall be essentially equivalent to those on the approved sample.

4.4.2 Vendor shall use ingredients, manufacturing procedures, processes, and methods of inspection on production primer which are essentially the same as those used on the approved sample primer. If necessary to make any change in ingredients, in type of equipment for processing, or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in material or processing, or both, and, when requested, sample primer. Production primer made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Specimen Preparation:

4.5.1.1 Uncured Primer Tests: Each container to be sampled shall be well-mixed immediately prior to obtaining the test material.

4.5.1.2 Cured Primer Film Tests: Panels shall be fabricated from 2024-T3 and alclad 2024-T3 aluminum alloy sheet conforming to AMS 4037 or QQ-A-250/4 and AMS 4041 or QQ-A-250/5. For sealant compatability tests, panels shall be approximately 0.040 x 6 x 3 in. (1 x 150 x 75 mm); all others shall be approximately 0.020 x 2 x 6 in. (0.5 x 50 x 150 mm). All panels shall be cleaned, treated, and primed in accordance with the procedure specified in ARP 1524, with primer applied and cured in accordance with manufacturer's instructions. When approved by purchaser, preproduction testing and subsequent acceptance testing may be based on specimens prepared as agreed upon by purchaser and vendor.

4.5.1.3 Cured Primer/Adhesive System Tests: Test specimens shall be cut from panels specified in the applicable adhesive specification. All panel components shall be cleaned, treated, and primed in accordance with the procedures specified in ARP 1524, with the primer and adhesive applied and cured in accordance with manufacturer's instructions. When approved by purchaser, preproduction and subsequent acceptance testing may be based on specimens prepared as agreed upon by purchaser and vendor.

4.5.2 Color, Sprayability, and Pot Life: Examine the primer for color, pot life, sprayability, uniformity of coat and thickness during preparation of test panels.

4.5.3 Solids Content and Inhibitor Content:

4.5.3.1 Determine weight per mL of sample by pipetting 10 mL of well-mixed primer into a weighed dropping bottle, or equivalent. Re-weigh and compute weight per millilitre. Report the average of three measurements.

4.5.3.1.1 It is optional to determine weight per mL by weighing each 2 mL portion added to the ignition-loss crucibles, prior to the addition of the methyl ethyl ketone in accordance with 4.5.3.3.

4.5.3.2 Tare four ignition-loss crucibles with covers.

4.5.3.3 Stir a well-mixed sample continuously and pipette 2 mL portions into each crucible. Add approximately 2 mL of methyl ethyl ketone for each crucible, and devolatilize primer at 120°C ± 2 (250°F ± 4) for 60 min. ± 5. Crucible covers may be required to prevent spattering and loss of solvent and solids.

4.5.3.4 Cool to room temperature in a desiccator, weigh, and compute average weight of the four samples. Compute percent solids content:

$$\text{Solids Content, \%} = \frac{\text{Total weight of non-volatile residue}}{\text{Weight of 2-mL sample (original sample)}} \times 100$$

4.5.3.5 Place the crucibles (with covers and residue) in a furnace at 590°C ± 10 (1095°F ± 18) for 60 min. ± 5.

4.5.3.6 Cool to room temperature in a desiccator, weigh, and compute average weight of the four samples. Compute percent inhibitor of the non-volatile residue.

$$\text{Inhibitor, \%} = \frac{\text{Weight of inhibitor residue}}{\text{Weight of non-volatile residue}} \times 100$$

4.5.3.7 If results of the 2-mL sample size tests do not fall within the required range for either the solids or inhibitor content, a 10-mL sample shall be used as a referee test.

4.5.4 Adhesion: Shall be determined in accordance with ASTM D3359, Method A (See 8.1), using panels prepared in accordance with 4.5.1.2 and also on panels exposed to various conditions as required by other tests. All panels shall be thoroughly dried, as applicable, by wiping with clean, dry cheese cloth. The test shall be conducted at 20° to 30°C (68° to 86°F).

4.5.5 Hardness:

4.5.5.1 Preparation of Pencils: A set of drawing pencils (KOH-I-NOOR 1500), Venus Drawing Pencils, A. W. Faber-Castell, Eagle Turquoise, or equivalent), ranging in hardness from 6B to 9H shall be prepared by stripping the wood away from the end approximately 3/8 in. (10 mm) without damaging the lead. The tip of the lead shall be squared by holding the pencil in a vertical position and moving the lead back and forth over 400 (38 m) grit or finer abrasive paper. The tip of the lead shall be squared after each trial. Alternatively, drafting leads held in a clutch-type holder may be used.

4.5.5.2 Procedure: Test panels with the applied film shall be placed in a horizontal position. Pencils of increasing hardness shall be pushed across the coated surface of the panel at approximately a 45-deg angle until one is found which will cut or scratch the coating. The number of this pencil shall be used to express the pencil hardness.

4.5.6 Fluid Resistance:

4.5.6.1 Use a set of 3 or more primed panels for each fluid specified in the applicable detail specification.

4.5.6.2 Immerse the primed panels in each fluid at the exposure temperature and for the exposure time specified in the applicable detail specification.

4.5.6.3 Remove panels at the end of the exposure period and wipe dry.

4.5.6.4 Conduct hardness test in accordance with 4.5.5.

4.5.6.5 Examine primer film for blistering, cracking, peeling, or loss of adhesion.

4.5.7 Corrosion Resistance:

4.5.7.1 Determine salt spray corrosion resistance in accordance with ASTM B117.

4.5.7.2 For filiform corrosion testing, a set of 3 primed AMS 4037 or QQ-A-250/4 aluminum alloy panels shall be overcoated with the topcoat specified in the applicable detail specification, scribed, and exposed to 12 normal hydrochloric acid (HCl) vapor for 60 min. ± 5 at 25°C ± 2 (77°F ± 4). Immediately expose the panels to 80% ± 5 relative humidity at 35°C ± 2 (95°F ± 4) for not less than 30 days.

4.5.8 Humidity Resistance:

4.5.8.1 Use a humidity cabinet with the exposure zone maintained at 95 to 100% relative humidity and 50°C ± 2 (122°F ± 4). Record the temperature in the test chamber at least twice each working day. Distilled water or water containing not more than 200 ppm of total solids shall be used to maintain the humidity.

4.5.8.2 Suspend the primed specimens in such a manner that they do not contact the water used to maintain the humidity, each other, any metallic material, or any material that acts as a wick. The condensate from one specimen shall not drip on any other specimen.

4.5.8.3 Expose the specimens for not less than 30 days, with the cabinet closed and the humidity and temperature maintained as specified in 4.5.8.1, except for short interruptions necessary for inspection, rearrangement, or removal of test panels.

4.5.8.4 Remove panels at the end of the exposure period and carefully wipe dry with dry, clean cheese cloth or other soft absorbent material. Examine immediately for blistering, loss of adhesion, or any other deterioration of the primer film. Evaluate the loss of adhesion by performing the adhesion test in accordance with 4.5.4.

4.5.9 Heat Resistance: Expose primed panels in a mechanical convection oven at the temperature and for the time specified in the applicable detail specification. Remove panels, cool to room temperature, and immediately bend rapidly 180 deg over a 1-in. (25-mm) diameter mandrel. Panel evaluation after exposure shall include visual examination and adhesion test in accordance with 4.5.4.

4.5.10 Low-Temperature Shock: Test the panels through 24 cycles as follows:

25 min. ± 1 at the temperature specified in the applicable detail specification; then, within 5 sec,

5 min. +1, -0, at -55°C ± 1 (-67°F ± 2).

On completion of the last cycle, expose the panels to -55°C ± 1 (-67°F ± 2) for not less than 5 hr, and bend rapidly 180 deg over a 4-in. (100-mm) diameter mandrel maintained at the test temperature. Evaluate the panels visually and by the adhesion test in accordance with 4.5.4.

4.5.11 Compatibility with Sealant: Shall be determined using three AMS 4037 or QQ-A-250/4 aluminum alloy panels prepared in accordance with 4.5.1.2. The panels shall be cleaned within 8 hr of coating with primer.

4.5.11.1 Apply a continuous layer of properly mixed sealant as specified in the applicable detail specification approximately 1/8 in. (3 mm) thick by 5 in. (125 mm) long across the full width of one side of each panel.

4.5.11.2 Impregnate a 3 x 12 in. (75 x 300 mm) strip of cotton duck, cotton drill, Monel screen, or equivalent (exhibiting not less than 80 lb/in. (14 kN/m) breaking strength) with the same sealant mix used in 4.5.11.1 for approximately 5 in. (125 mm) on one end, completely covering both sides and edges, and working the sealant into the weave of the cloth or screen.

4.5.11.3 Place the sealant impregnated end of the cloth or screen strip on the panel, leaving a loose, unimpregnated end approximately 7 in. (175 mm) long (See Fig. 1). Smooth the reinforcement down on the sealant, taking care not to trap air under the strip. Apply an additional layer of sealant approximately 1/8 in. (3 mm) thick from the same mix over the impregnated reinforcement and smooth to uniform thickness. Cure the specimen panels for 7 days ± 0.1 at 25°C ± 1 (77°F ± 2) and 50% ± 5 relative humidity.

4.5.11.4 Completely immerse one panel in aromatic test fluid, ASTM Fuel B (See ASTM D471) or TT-S-735, Type III, for 7 days ± 0.1 at 50°C ± 2 (122°F ± 4). Completely immerse the remaining two panels in a 3% aqueous sodium chloride solution which is covered with a layer of aromatic test fluid, ASTM Fuel B (See ASTM D471) or TT-S-735, Type III, for 7 days ± 0.1 at 50°C ± 2 (122°F ± 4). Seal all immersion jars with a layer of aluminum foil placed inside the lids. At the completion of the immersion period, remove the jars from the heat source and allow to return to room temperature prior to removing the specimens. Test the specimens within 20 hr after removal of the jars from the heat source, and within 1 hr after removal of panels from the test fluids.

4.5.11.5 Prepare the specimens by blotting dry of test fluid and cutting two 1.0 in. (25-mm) wide strips the entire length of the reinforcement and along the sealant impregnated portion of the panel, cutting through the reinforcement and sealant to the base metal. Clamp the loose end of each strip in one jaw of a suitable recording tensile test machine and the adjacent end of the panel in the other jaw, as shown in Fig. 1. Make cuts through the sealant under the reinforcement, as shown in Fig. 1, so that the initial separation of sealant from the metal panel is promoted. Test the assembly by pulling the reinforcement at 180 deg and at a rate of 2 in. (50 mm) per minute of jaw separation.

4.5.11.6 On one strip of each panel, make cuts in the sealant to the metal panel at the junction of separation at an angle of approximately 45 deg towards the direction of separation at approximately 3/8 in. (10 mm) increments (approximately every 24 sec) as shown in Fig. 1. No cuts are required on 100% adhesive failure.

4.5.11.7 On the other strip on each panel, except for the initial cut to promote separation, make cuts only as necessary to prevent the reinforcement from peeling from the sealant.

4.5.11.8 For each test, calculate the percent cohesive failure from the ratio of area of cohesive separation to total area of cohesive and adhesive separation from the metal panel. Determine the cohesive strength from the recorded load during cohesive tear failure, excluding the load recorded during cutting.

4.5.11.9 Report the average cohesive strength value, the individual lowest cohesive strength value, and the percent cohesive failure for each strip of each specimen.

4.5.12 Compatability with Topcoat: Apply the topcoat specified in the applicable detail specification in accordance with the topcoat manufacturer's instructions to 4 sets of primed panels prepared in accordance with 4.5.1.2. Conduct flexibility (ASTM D522), impact resistance (ASTM D2794), fluid resistance (distilled water only) (4.5.6), and low-temperature shock (4.5.10), using one set of panels in each test.

4.6 Reports:

4.6.1 The vendor of primer shall furnish with each shipment three copies of a report showing the results of tests to determine conformance to the acceptance test requirements and stating that the primer conforms to the other technical requirements of this specification and the applicable detail specification. This report shall include the purchase order number, AMS 3107 and its applicable detail specification number, vendor's product identification, lot number, and quantity.