SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3116

Issued JUL 1998

Submitted for recognition as an American National Standard

Primer Coating; Epoxy, Chemical and Solvent Resistant Non-Chromated, Corrosion Preventive

1. SCOPE:

1.1 Form:

This specification covers two types of two-component, epoxy, chemical and solvent resistant primer coatings formulated primarily for spray application. Coatings shall be compatible with epoxy and polyurethane topcoats.

1.2 Application:

Coatings covered in this specification have been used typically on metal surfaces of commercial and general aviation aircraft where chromates are prohibited but usage is not limited to such applications.

1.3 Classification:

Coating shall be furnished in the following classes:

Class 1: High-Solids (340 grams/L maximum volatile organic content (VOC))
Class 2: Waterborne (340 grams/L maximum VOC)

1.4 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.

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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.

AMS 2629	Fluid, Jet Reference
AMS 2825	Material Safety Data Sheets
AMS 3819	Cloth Cleaning for Aircraft Interior and Exterior Surfaces
AMS 4035	Aluminum Alloy Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn (20240), Annealed
AMS 4036	Aluminum Alloy Sheet and Plate, Alclad One Side, 4.4Cu - 1.5Mg - 0.60Mn, (Alclad One Side 2024 and 1-1/2% Alclad One Side 2024-T3 Sheet; 1-1/2% Alclad One Side 2024-T351 Plate), Solution Heat Treated
AMS 4037	Aluminum Alloy Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn (2024; -T3 Flat Sheet, -T351 Plate), Solution Heat Treated
AS1241	Fire Resistant Hydraulic Fluid for Aircraft

2.2 ASTM Publications:

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

ASTM B 117	Salt Spray (Fog) Testing
ASTM D 1200	Viscosity of Paints, Varnishes and Lacquers by Ford Viscosity Cup
ASTM D 1210	Fineness of Dispersion of Pigment - Vehicle Systems
ASTM D 1296	Odor of Volatile Solvents and Diluents
ASTM D 1544	Color of Transparent Liquids (Gardner Color Scale)
ASTM D 1640	Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
ASTM D 2803	Filiform Corrosion Resistance of Organic Coatings on Metal
ASTM D 3335	Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
ASTM F 151	Residual Solvents in Flexible Barrier Materials

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

QQ-A-250/12	Aluminum Alloy Alclad 7075, Plate and Sheet
CCC-C-419	Cloth, Duck, Cotton, Unbleached, Plied Yarns, Army and Numbered
MIL-C-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-A-8625	Anodic Coatings for Aluminum and Aluminum Alloys

2.3 (Continued):

MIL-S-8802	Sealing compound, Temperature Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High-Adhesion
MIL-C-38736	Compound Solvent; for Use in Integral Fuel Tanks
MIL-L-23699	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-R-81294	Remover, Paint, Epoxy, Polysulfide and Polyurethane Systems
MIL-C-81706	Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys
MIL-T-81772	Thinner, Aircraft Coating
MIL-C-85285	Coating, Polyurethane, High Solids
FED-STD-595	Colors

3. TECHNICAL REQUIREMENTS:

3.1 Materials:

The primers shall consist of two components. The primers shall contain no lead, chromates, or ozone depleting chemicals.

3.1.1 These primers shall be suitable for air, airless, high volume low pressure (HVLP), or electrostatic spray application.

3.2 Volatile Content:

The solvents used in manufacturing and thinning prior to application shall conform to the following requirements when tested as specified in 4.5. Class 1 primers shall meet a maximum volatile organic compounds (VOC) content of 340 grams/L when tested as in 4.5. Class 2 primers shall be capable of water dilution to an admixed VOC of 340 grams/L, maximum.

3.3 Pigment Requirements:

The fineness of grind shall be 5, minimum, on the Hegman scale.

3.3.1 Condition in Container: Individual components that have been allowed to stand without agitation for at least two weeks in closed containers, shall be capable of being mixed to a smooth, homogeneous, pourable condition. Components shall be free from grit, seeds, lumps, abnormal thickening, or livering and shall not show pigment flotation or excessive settling, which cannot be reincorporated by mixing, when tested in accordance with 4.5. There shall be no trace of particulate matter, either suspended in solution or settled on the inner surface of the container (which cannot be dispersed readily by agitation), when tested in accordance with 4.5.

3.4 Properties:

3.4.1 Color Optional: It is suggested that the color of the admixed primers shall be beige similar to FED-STD-595, Federal Color No. 30475, but other colors may be specified.

3.4.2 Odor: The odor of the epoxy primers, as packaged components or as a film after application, shall be characteristic of the thinners used and shall not be obnoxious when tested in accordance with 4.5.

3.4.3 Viscosity: Class 1 and Class 2 primers (immediately after mixing) shall have a maximum viscosity of 30 seconds through a No. 4 Ford cup.

3.4.4 Pot Life: The viscosity of the admixed primers, when stored in a closed container, at room temperature, shall not exceed 40 seconds after four hours, through a No. 4 Ford cup. The primer shall meet specification requirements of 3.5, 3.6, and 3.7 at the end of pot life.

3.4.5 Storage Stability: The product, as packaged by the manufacturer, shall meet requirements specified herein for a period of two years when tested in accordance with Table 2 of 4.5.

3.4.6 Accelerated Storage Stability: The product, as packaged by the manufacturer, shall meet all requirements specified herein after seven days at 60 °C ± 1 (140 °F ± 2).

3.5 Properties:

3.5.1 Surface Appearance: The admixed primer, when reduced with any thinner meeting MIL-T-81772, Type II, shall spray satisfactorily with no sagging, running, or streaking. The dried film shall be free from grit, seeds, craters, blisters, and other surface irregularities (See 4.5.3).

3.5.2 Drying Time: Class 2 primers shall be tack-free within one hour and dry hard within six hours. The Class 1 primer shall be tack-free within four hours and dry hard within eight hours.

3.5.3 Lifting: There shall be no evidence of lifting or any other film irregularity upon applying a polyurethane topcoat after the primer has air dried for five hours when tested as in 4.5.4.

3.5.4 Adhesion: When tested as specified in Table 2 of 4.5, the primer film shall not peel away from the substrate after 168 hours immersion in water.

3.5.5 Flexibility: The primer film shall exhibit a minimum impact elongation of 10% at room temperature when tested as in 4.5.5.

3.5.6 Strippability: At least 90% of the primer film shall be stripped with the use of MIL-R-81294, Type I, Class 1 paint remover in 60 minutes at room temperature when tested as specified in 4.5.6.

3.6 Fluid Resistance Properties:

3.6.1 Water Resistance: The primer film, when topcoated and tested as specified in 4.5.6, shall withstand four days immersion in distilled water at a temperature of 49 °C ± 3 (120 °F ± 5) without showing any softening, wrinkling, blistering, or any other coating deficiency.

3.6.2 Corrosion Resistance:

3.6.2.1 Salt Spray Test: When the primer film is tested as specified in 4.5.7, it shall exhibit no blistering, lifting of the coating system, or substrate corrosion except in the scribe line after exposure to salt spray. In addition, the aluminum in the aluminum/graphite/epoxy test specimen shall exhibit no pitting greater than 1.0 mm in depth after exposure to salt spray.

3.6.2.2 Filiform Test: The primer film shall be topcoated and tested as in 4.5.8. Most filiform corrosion shall extend not more than 1/8 inch (3.2 mm) from the scribe lines and none shall extend more than 1/4 inch (6.4 mm).

3.6.3 Solvent Resistance: The primer film shall withstand repeated rubbing by a cloth rag soaked in methyl ethyl ketone solvent without removal when tested as in 4.5.9. Some color transfer to the cloth is permissible.

3.6.4 Oil, Hydraulic Fluid and Fuel Resistance: The primer film shall withstand 24 hours immersion in MIL-L-23699 lubricating oil at 121 °C ± 3 (250 °F ± 5); 30 days in AS1241 Type IV Class 1 Grade A hydraulic fluid (Example: Skydrol LD-4) at 25 °C ± 1 (77 °F ± 2); and 24 hours immersion in AMS 2629 Type I jet reference fluid at 60 °C ± 1 (140 °F ± 2) without allowing any blistering, loss of adhesion, or softening four hours after removal. Discoloration of the coating is acceptable and shall not be cause for rejection (See 4.5.10). Note that these are separate immersions and shall not be run consecutively.

3.6.5 Low Temperature Flexibility: When tested as specified in 4.5.11 the primer shall show no loss of adhesion or other evidence of film failure.

3.6.6 Sealing Compound Compatibility: Sealing compound conforming to MIL-S-8802 Type II Class B-2 applied to the cured primer shall have a peel strength of not less than 20 pounds per inch (3503 N/m) when tested as specified in 4.5.12. The sealing compound shall exhibit not less than 75% cohesive failure, except for bubbles, knife cuts, and other causes that are obviously not the fault of the sealing compound or the primer.

3.7 Working Properties:

3.7.1 Mixing: Component A and Component B shall easily blend together to a smooth homogeneous product (See 4.5.13).

3.7.2 Application: When admixed and reduced for spraying, the primer shall be homogeneous; and, when sprayed using conventional, airless, high volume low pressure, or electrostatic equipment, shall yield a smooth, uniform film with no runs or sags at a dry-film thickness of 0.0006 to 0.0012 inches (0.015 to 0.030 mm).

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The manufacturer of the primer shall supply all samples for required tests and shall be responsible for all required tests. The 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.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for requirements shown in Table 1 are acceptance tests and shall be performed on each batch of primer.

TABLE 1 - Acceptance Tests

Property	Paragraph Reference
Viscosity	3.4.3
Pot Life	3.4.4
Surface Appearance	3.5.1
Drying Time	3.5.2
Lifting	3.5.3
Adhesion	3.5.4
Water Resistance	3.6.1
Solvent Resistance	3.6.3

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 product by the manufacturer, when a change in ingredients and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing:

Shall be as follows:

4.3.1 For Acceptance Tests: Sufficient product shall be taken at random from each batch to perform the required tests. Except as specified in 4.5, the number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three.

4.3.1.1 A batch shall consist of all coating material manufactured during one continuous operation and forming one component of the primer. Tests shall be conducted on matched batches of the primer components.

4.3.1.2 When a statistical sampling plan acceptable to purchaser has been agreed upon, sampling shall be in accordance with such plan and the report of 4.6 shall state that such plan was used.

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

4.4 Approval:

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

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

4.5 Test Methods:

Tests to determine conformance to the requirements of this specification shall be conducted as shown in Table 2 and 4.5.1 to 4.5.13 inclusive.

TABLE 2 - Test Methods

Paragraph	Property	FED-STD-141 Method	ASTM Method No.	Test Panels (See Table 3)
3.1	Lead Content		ASTM D 3335	
3.2	Volatile Organic Compound		Environmental Protection Agency Method 24	
3.3	Total Pigment[1]	4021		
3.3	Fineness of Grind		ASTM D 1210	
3.3.1	Condition in Container[2]	3011		
3.3	Color (Gardner)		ASTM D 1544	
3.4.2	Odor		ASTM D 1296	
3.4.3	Viscosity		ASTM D 1200	
3.4.4	Pot Life		ASTM D 1200	
3.4.6	Storage Stability[3]	3022		
3.4.7	Accelerated Storage Stability[4]	3019		
3.5.2	Drying Time		ASTM D 1640	A
3.5.4	Adhesion (Tape Test)	6301		C

[1]For Component A, see 4.5.1

[2]Method A for Components A and B

[3]The daily temperature of the ambient air at the storage location shall fall within the range of 1.7 to 46 °C (35 to 115 °F)

[4]Store at 60 °C ± 1 (140 °F ± 2) for seven days

4.5.1 Panel Preparation: Except for the composite test specimens used in the salt spray test (See 4.5.7), test panels shall be 0.020 x 3 x 6 inches (0.52 x 76 x 152 mm), fabricated from alloys and pretreated as shown in Table 3.

TABLE 3 - Test Panels

Panel Designation	Substrate Alloy	Pretreatment
A	AMS 4037	MIL-C-5541, Class 1A Conversion Coat[1]
B	AMS 4035	MIL-A-8625, Type I Anodize
C	AMS 4036	Deoxidized[2]
D	AMS 4036	MIL-C-5541, Class 1A Conversion Coat[1]

[1]Use materials meeting Class 1A, Form I, Method C of MIL-C-81706.

[2]Immerse panel for 15 seconds in solution made by dissolving one pound (454 g) of Allied-Kelite ISOPREP 188, or equivalent, in one gallon (3.8 L) of distilled water.

4.5.1.1 Primer Application: The epoxy primer shall be prepared by thoroughly mixing each of the components separately. The components shall be combined with constant stirring until the volume ratio specified by the manufacturer is attained. Thin the admixed Class 2 primer with water, if required. Mix thoroughly and allow Class 1 and Class 2 to stand 30 minutes before using. Spray the panels with one cross-coat of the primer and air dry for at least one hour for Class 2 or 5 hours for Class 1. The dry-film thickness shall be 0.0006 to 0.0009 inch (0.015 to 0.023 mm). When specified, apply the polyurethane topcoat between 5 and 24 hours after primer application as directed in 4.5.1.2. Allow at least seven days air-dry or 24 hours at 60 °C ± 3 (140 °F ± 5) after topcoat application before testing. Air-dry for one hour before exposure to elevated temperatures.

4.5.1.2 Topcoat Application: Admix polyurethane topcoat, either MIL-C-85285 Type I or Type II (FED-STD-595 Color 17925 - gloss white). Apply two full coats to a total dry film topcoat thickness of 0.0017 to 0.0023 inch (0.043 to 0.058 mm). Allow at least seven days air-dry or 24 hours at 50 °C ± 3 (122 °F ± 5) before testing. Air-dry for one hour before exposure to elevated temperatures.

4.5.2 Surface Appearance: The primer film, on an “A” panel (See Table 3) prepared as directed in 4.5.1, shall be examined for conformance to 3.5.1.

4.5.3 Lifting: “A” panels shall be primed as in 4.5.1.1 air dried for five hours and then topcoated as directed in 4.5.1.2. Examine the panels for conformance to 3.5.3.

4.5.4 Flexibility: “B” panels (See Table 3), primed as directed in 4.5.1.1, shall be tested with a GE Impact-Flexibility Tester, or equivalent. Place the coated panel, film downward, on the rubber pad at the bottom of the impacter guide. Drop the impacter on the panel so that the impression of the entire rim of the impacter is made in the panel. Reverse the impacter ends; and drop it on the panel adjacent to the first area of impact. Use 10-X magnification to detect fine surface cracking. Report the percent elongation corresponding to the largest spherical impression at which no cracking occurs.

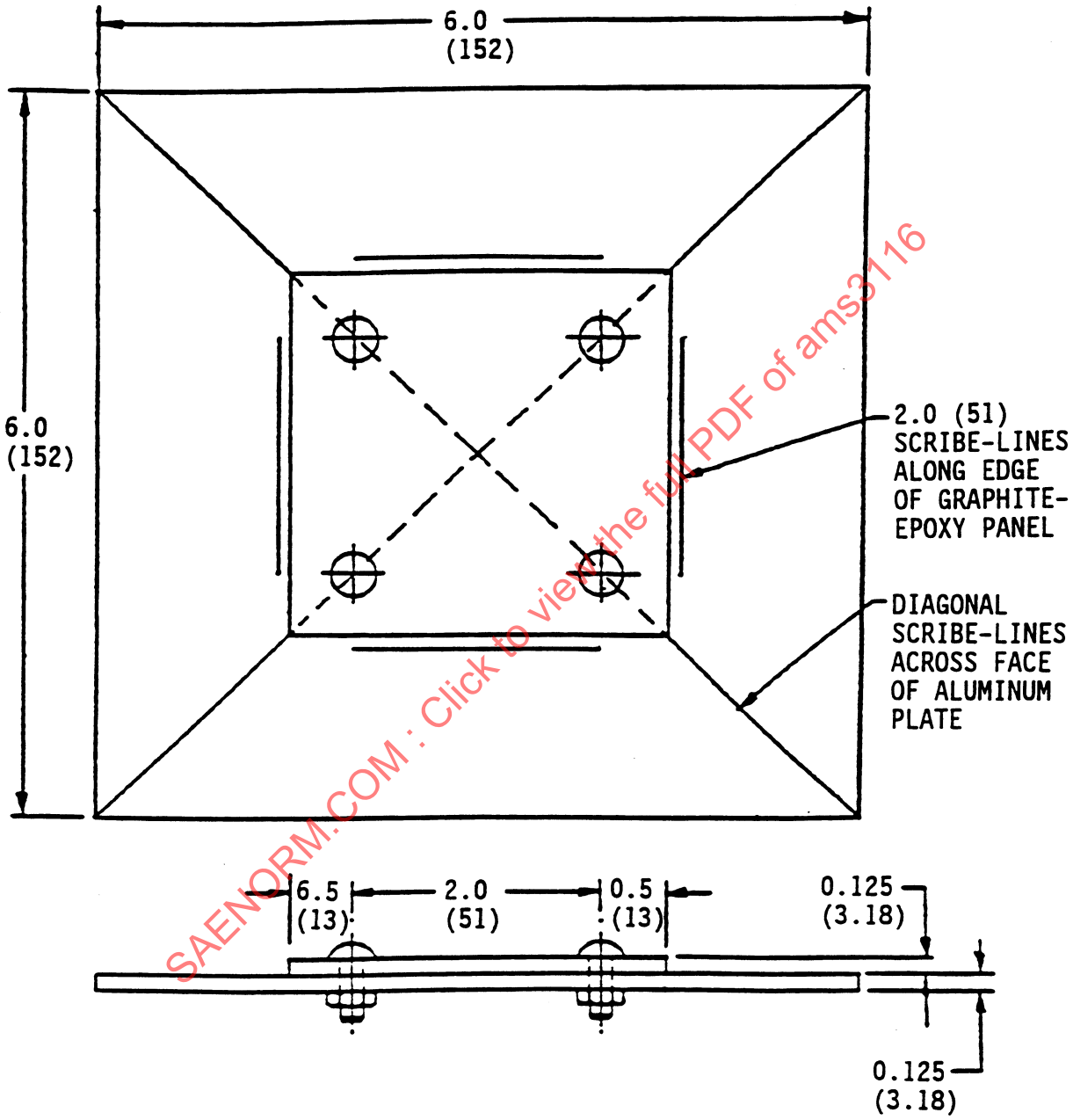
4.5.5 Strippability: “A” panels, primed as directed in 4.5.1.1 shall be artificially aged at a temperature of 99 °C ± 3 (210 °F ± 5) for four days. Panels shall then be placed on a rack at a 60-degree angle with the horizontal. The test shall be performed in a well ventilated area maintained at room temperature. Just enough of MIL-R-81294, Type I, Class 1 paint remover shall be poured along the upper edge of each panel to completely cover the primer surface. After 60 minutes exposure, the loosened film shall be gently brushed off and the panels rinsed while brushing under a steady stream of cool water. The amount of primer removed in this manner is determined by the percentage of substrate surface area exposed.

4.5.6 Water Resistance: “A” panels, primed and topcoated as directed in 4.5.1.1 and 4.5.1.2, shall be immersed in distilled water for four days at a temperature of 49 °C ± 3 (120 °F ± 5). Two hours after removal from the water, panels shall be examined for conformance to 3.6.1.

4.5.7 Corrosion Resistance (Salt Spray): “A” panels shall be primed as directed in 4.5.1.1. Two intersecting lines shall be scribed diagonally across the surface of each panel, so that the bare substrate is exposed. The panels shall then be placed in a 5% salt spray cabinet for not less than 2000 hours as described in ASTM B 117 and examined for conformance to 3.6.2.1. In addition, the aluminum graphite-epoxy test specimen shown in Figure 1 shall be prepared as follows: An aluminum alloy plate conforming to QQ-A-250/12 (T6 temper), 0.125 x 6 x 6 inches (3.18 x 152 x 152 mm), shall be anodized in accordance with MIL-A-8625, Type II and primed as directed in 4.5.1.1. Two intersecting lines shall be scribed diagonally across the surface of the plate, so that the bare substrate is exposed. A graphite-epoxy panel (Hercules AS4/3501-6, or equivalent) with a 0°, 90° orientation of approximately 16 plies, 0.094 x 3 x 3 inches (2.381 x 76 x 76 mm), shall be joined to the center of the primed plate with four aluminum fasteners. Four additional lines of two-inch (51 mm) length shall be scribed along the edge of the panel, so that the bare substrate of the plate is exposed. The assembled specimen shall then be placed in a 5% salt-spray cabinet not less than 500 hours as described in ASTM B 117 and examined for conformance to 3.6.2.1.

4.5.8 Corrosion Resistance (Filiform): “D” panels (See Table 3) shall be primed and topcoated as directed in 4.5.1.1 and 4.5.1.2. Two intersecting lines shall be scribed diagonally across the surface of each panel so that bare substrate is exposed. The panels shall then be exposed to acid vapor for one hour by placing vertically in a desiccator containing 12N hydrochloric acid. This is equivalent to concentrated hydrochloric acid (A.C.S. reagent grade). Remove the panels from the acid vapor and within five minutes place the panels in a humidity cabinet or desiccator/oven combination maintained at 40 °C ± 2 (104 °F ± 4) and 80 ± 5% RH for 720 hours. The panels shall be approximately 6 degrees from vertical with the small dimension horizontal and the scribed surface facing up in the humidity chamber. The panels shall be removed from the humidity cabinet and be examined for filiform corrosion, as described in ASTM D 2803. Determine conformance with 3.6.2.2. Filiform corrosion appears as threadlike filaments initiating from the exposed substrate and spreading underneath the coating.

4.5.9 Solvent Resistance: “A” panels shall be primed as directed in 4.5.1.1. An AMS 3819 cleaning cloth shall be soaked in methyl ethyl ketone solvent and rubbed back and forth 25 times (50 passes) over the primer film with firm finger pressure. Rubbing through the primer to bare metal indicates that it has failed to cure properly.



Dimensions are in inches (mm)

FIGURE 1 - Aluminum/Graphite - Epoxy Test Specimen