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SUPERSEDING
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PERFORMANCE SPECIFICATION

COATING, ELASTOMERIC, POLYURETHANE, RAIN-EROSION

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification establishes the requirements for rain erosion coatings with a maximum volatile organic compound (VOC) content of 420 grams/liter (g/L) (3.5 pounds/gallon (lb/gal)) for use on exterior aircraft structures. The antistatic component (if applicable) will have a maximum VOC limit of 720 grams/liter (g/L) (6.0 lb/gallon (lb/gal)).

1.2 Classification. The coating covered by this specification is divided into the following types, classes, and grades (see 6.2).

1.2.1 Type. The types of coatings are as follows:

Type I - Conventionally cured (not dependent on moisture) polyurethane rain erosion resistant coating
Type II- Moisture cured polyurethane rain erosion resistant coating

1.2.2 Class. The classes of coatings are as follows:

Class A – General purpose coating
Class B – High operating temperature coating

1.2.3 Grade. The grades of coatings are as follows:

Grade A - Rain erosion resistant coating without antistatic coating component
Grade B - Rain erosion resistant coating with antistatic coating component

Comments, suggestions, or questions on this document should be addressed to: Commander, Naval Air Warfare Center Aircraft Division, Code 4L8000B120-3, Highway 547, Lakehurst, NJ 08733-5100 or emailed to michael.sikora@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

1.3 Part or Identifying Number (PIN). The PIN to be used for coatings acquired to this specification is created as follows:

M85322	-	X	-	X	-	X	-	XXXXX	-	XXXX
Specification Identifier		Type designator 1 = Type I 2 = Type II		Class designator 1 = Class A 2 = Class B		Grade designator 1 = Grade A 2 = Grade B		FED-STD-595 color designator		Kit Size designator (see 1.3.1)

1.3.1 Kit size designator. The coatings covered by this specification should be purchased by volume, the unit being a kit containing two or three components for the rain erosion coating and two or three components for the antistatic coating (if applicable). The kit component sizes need not be of the same size. When this part numbering system is used, the kit size is to be identified as:

Kit Size 1/	Designator
1 quart (0.94 liter)	001Q
1 gallon (3.79 liter)	001G
5 gallon (18.93 liter)	005G

1/ The kit size and its designator may be modified for ease of procurement and is not limited.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL SPECIFICATION

L-P-383	Plastic Material, Polyester Resin, Glass Fiber Base, Low Pressure Laminated

FEDERAL STANDARD

FED-STD-595	Colors Used in Government Procurement - Color Numbers 17038 and 36375

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-5425	Plastic, Sheet, Acrylic, Heat Resistant
MIL-DTL-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-C-8514	Coating Compound, Metal Pretreatment, Resin – Acid
MIL-A-8625	Anodic Coatings for Aluminum and Aluminum Alloys
MIL-PRF-23377	Primer Coatings: Epoxy, High-Solids
MIL-PRF-23699	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code Number O-152, O-154, O-156, and O-167
MIL-DTL-25421	Plastic Materials, Glass Fiber Base-Epoxy Resin, Low Pressure Laminated
MIL-R-81294	Remover, Paint, Epoxy, Polysulfide and Polyurethane Systems
MIL-T-81772	Thinner, Aircraft Coating
MIL-PRF-83282	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft, Metric, NATO Code Number H-537
MIL-PRF-85285	Coating: Polyurethane, Aircraft and Support Equipment
MIL-PRF-85582	Primer Coatings: Epoxy, Waterborne

(Copies of these documents are available online at http://quicksearch.dla.mil.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AEROSPACE INDUSTRIES ASSOCIATION (AIA) OF AMERICA

ARTC-4	Electrical Test Procedures for Radomes and Radome Materials

(Copies of this document are available from http://www.aia-aerospace.org.)

AMERICAN SOCIETY FOR QUALITY (ASQ)

ASQC Z1.4	-	Sampling Procedures and Tables For Inspection By Attributes

(Copies of this document are available from http://www.asq.org.)

ASTM INTERNATIONAL

ASTM D522	Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
ASTM D823	Standard Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels
ASTM D1210	Standard Test Method for Fineness of Dispersion of Pigment –Vehicle Systems by Hegman Type Gage
ASTM D1296	Standard Test Method for Odor of Volatile Solvents and Diluents
ASTM D1640	Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
ASTM D1729	Standard Practice for Visual Appraisal of Colors and Color Differences of Diffusely-illuminated Opaque Materials
ASTM D2196	Standard Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield) Type Viscometer
ASTM D2370	Standard Test Method for Tensile Properties of Organic Coatings
ASTM D3335	Standard Test Method for Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
ASTM D3718	Standard Test Method for Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy
ASTM D3924	Standard Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials
ASTM D3960	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D4708	Standard Practice for Preparation of Uniform Free Films of Organic Coatings
ASTM E1952	Standard Test Method for Thermal Conductivity and Thermal Diffusivity by Modulated Temperature Differential Scanning Calorimetry
ASTM G155	Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

(Copies of these documents are available online at http://www.astm.org/.)

SAE INTERNATIONAL

SAE AMS-QQ-A-250/5 - Aluminum Alloy Alclad 2024, Plate and Sheet –UNSA82024

(Copies of this document are available online at http://www.sae.org/.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. The coatings furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list (QPL) in the qualified products database (QPD) before contract award (see 4.3 and 6.3).

3.1.1 Formulation. Any change in the formulation of a qualified product shall necessitate its requalification.

3.1.2 Supplied coatings. The coatings supplied to this specification shall be identical, within manufacturing tolerances, to the product that was authorized for qualification.

3.2 Material. Materials used to manufacture these coatings are not limited, provided that the resulting coatings meet the requirements of this specification.

3.3 Toxicity. The coatings shall have no adverse effect on the health of personnel when used for its intended purpose and with the precautions listed in 3.10.1 through 3.10.3, when evaluated in accordance with 4.7 (see 6.8).

3.4 Composition. The coating kit shall be supplied such that the admixed coating consists of the minimum volume specified by the procuring activity (see 6.2). The volume mixing ratio shall be as specified by the manufacturer. When tested as specified in 4.6, no component of the coating shall contain cadmium, cadmium compounds, or more than 0.05 percent by weight of lead metal or lead compounds, and the coating shall not contain hexavalent chromium.

3.4.1 Type I, Class A and B, Grade A. The rain-erosion coating shall be a two or three-component system that is not dependent on moisture or high humidity for curing, consisting of Component A, a polyurethane elastomeric base component, Component B, a ketimine or other amine type curing agent, and Component C, a thinner (if applicable). They shall be mixed in the ratio specified by the manufacturer.

3.4.2 Type II, Class A and B, Grade A. The rain-erosion coating shall be a two or three-component system that is dependent on moisture or high humidity for curing, consisting of Component A, a polyurethane elastomeric base component, Component B, a curing agent, and Component C, a thinner (if applicable). They shall be mixed in the ratio specified by the manufacturer.

3.4.3 Type I and II, Class A and B, Grade B. The Type I rain-erosion coatings shall be a two or three-component system that is not dependent on moisture or high humidity for curing, consisting of Component A, typically a polyurethane elastomeric base component, and Component B, a ketimine or other amine type curing agent. The Type II rain-erosion coating shall be a two or three-component system that is dependent on moisture or high humidity for curing, consisting of Component A, typically a polyurethane elastomeric base component, and Component B, a curing agent and Component C, a thinner (if applicable). They shall be mixed in the ratio specified by the manufacturer. In addition to the above Types and Classes, an antistatic coating shall be applied over the rain erosion coating. Typically antistatic coatings

consist of two or three components, Component A, typically a polyurethane base component, Component B, a curing agent, and Component C, a thinner (if applicable), but is not limited to this packaging.

3.4.5 Volatile content. The maximum volatile organic compound (VOC) content of the rain erosion coating shall be a maximum of 420 g/L when tested as specified in 4.6. The maximum volatile organic compound (VOC) content of the antistatic coating (Grade B) shall be a maximum of 720 g/L when tested as specified in 4.6. Brominated and chlorinated solvents, except for para-chlorotrifluoromethylbenzene or equal, shall be prohibited in the formulation of these coatings.

3.5 Component properties.

3.5.1 Condition in container. All components of the rain-erosion and antistatic coatings shall be uniform, homogeneous, and free of skins, lumps, gels, or coarse particles. There shall be no separation of ingredients which cannot be readily dispersed to a smooth, homogeneous state by mixing with a hand paddle. The coating containers shall exhibit no evidence of excessive pressure or be deformed by gassing.

3.5.2 Storage stability. The unopened coating components, as packaged by the manufacturer, when admixed shall meet all of the requirements of this specification after storage for a minimum of six months at 90 ºF (32 ºC) (see 6.3.2).

3.5.3 Accelerated storage stability. The coating components, after storage for 4 days (see 4.6.1) as packaged by the manufacturer, when admixed shall meet all of the requirements of this specification as specified in 4.6.1. The container shall not develop excessive internal pressure, capable of causing it to swell.

3.6 Liquid properties.

3.6.1 Viscosity. The steady-state viscosity of the rain erosion and antistatic (if applicable) admixed coatings shall be not greater than 4000 centipoise (cP), when tested as specified in 4.6 and 4.6.2.

3.6.2 Pot life. When maintained in a full, closed container, in accordance with 4.6.3, the pot life of the admixed coating(s) shall be a minimum of two hours at a temperature of 73.5º ±2 ºF (23º ±1.1 ºC) and relative humidity (RH) of 50 ±10 percent. After exposure to these conditions, the admixed coating(s) shall show no signs of gelation or an increase in viscosity of more than 50 percent, and be capable of being spray applied to a smooth, uniform coating, in accordance with 3.7.1.

3.6.3 Fineness of grind. The fineness of grind (when measured on the Hegman scale) of the admixed coating shall be a minimum of 5, when tested as specified in 4.6.

3.6.4 Odor. The odor of the coating, as packaged components, as an admixed coating, and as a film after application, shall be characteristic of the solvents used, when tested as specified in 4.6. The air-dried coating shall retain no residual odor 72 hours after application.

3.7 Film properties.

3.7.1 Surface appearance. The coatings, applied to aluminum test panels in accordance with 4.5.2.1, 4.5.2.3, and 4.5.2.4 (if applicable) shall be free of pinholes, cracks, bubbles, or other film irregularities when visually examined under 10x magnification. Slight after-tack is permissible.

3.7.2 Color. The coatings, applied to aluminum test panels in accordance with 4.5.2.1, 4.5.2.3, and 4.5.2.4 (if applicable) shall be a visual color match to the specified color chips 36375 (gray, but with a gloss finish) and 17038 (black) in FED-STD-595 (see 6.3.1 and 6.7.1), when tested as specified in 4.6.

3.7.3 Drying time. The test coating(s), applied to test panels in accordance with 4.5.2.1, 4.5.2.3, and 4.5.2.4 (if applicable) shall dry hard within six hours, when tested as specified in 4.6.

3.7.4 Free-film strength. The free-film strength of the rain erosion coating shall be in accordance with table I, when tested as specified in 4.6.4.

TABLE I. Free-film strength.

Characteristic	Requirement
Tensile Strength (minimum)	1000 psi
Elongation-at-break (minimum)	350 percent

3.7.5 Peel adhesion. The peel adhesion of the applied rain erosion test coating shall be a minimum of 4 lbf/in (700 N/m) of width, when tested in accordance with 4.6.5. Breakage of the film, without peeling from the test panel, at values less than 4 lbf/in (700 N/m) shall be permissible.

3.7.6 Low-temperature flexibility. The rain erosion test coating, when tested in accordance with 4.6.6, shall show no evidence of cracking or loss of adhesion.

3.8 Resistance properties.

3.8.1 Water resistance. The coating after immersion in water as specified in 4.6.7 shall show no evidence of blistering, checking or visible color change.

3.8.2 Fluid resistance. When immersed in lubricating oil conforming to MIL-PRF-23699, hydraulic fluid conforming to MIL-PRF-83282, and JP-5 conforming to MIL-DTL-5624, the coating shall not exhibit blistering, softening, dark staining or other coating defects, when tested as specified in 4.6.8.

3.8.3 Rain-erosion resistance (Type I and II, Class A and B, Grade A and B rain erosion coatings). The coating(s), tested in accordance with 4.6.9, shall possess a minimum of 30 minutes erosion time without eroding through the coating at a dry-film thickness of 12-14 mils (304-356 microns [µm]). For Class B coatings, an additional set of panels after heat resistance exposure (see 4.6.9.1) shall be tested with a minimum of 30 minutes erosion-time.

3.8.4 Accelerated weather resistance. The test coating(s), applied to two test panels when exposed to accelerated weathering for 500 hours in accordance with 4.6.10, shall exhibit no cracking, checking, embrittlement, nor loss of adhesion.

3.8.5 Hydrolytic stability. The coating, when tested in accordance with 4.6.11, shall exhibit no softening or loss of adhesion.

3.8.6 Electrical transmission. The test coating, applied to test panels in accordance with 4.6.12.1 and tested in accordance with 4.6.12.2 through 4.6.12.5, shall meet the requirements specified in table II.

3.8.7 Surface resistivity (Grade B only). The resistivity of Type I and II, Grade B coatings, applied to test panels in accordance with 4.6.13.1 and tested in accordance with 4.6.13.2 and 4.6.13.3, shall be in accordance with table II.

TABLE II. Electrical transmission.

Characteristic	Requirement	
	After 7 day cure at 75º ±5 ºF (24º ±3 ºC) and RH of 50 ±10%	After 7 day cure plus 7 days at 100 ºF (38 ºC) and RH of 90%
Electrical transmission (minimum)	90%	85%
Surface resistivity	0.5 to 15 megohms	0.5 to 15 megohms

3.8.8 Thermal conductivity (Class B only). The coating when tested in accordance to 4.6.14 shall have a minimum thermal conductivity of 0.4 W/(m·K) (watts per meter Kelvin).

3.9 Working properties.

3.9.1 Application. The coatings shall be capable of being applied by brushing or spraying to plastic laminates, composites and aluminum alloy substrates. The material shall be mixed in accordance with the manufacturer's instructions.

3.9.2 Strippability. The rain erosion and antistatic test coatings shall be capable of being completely stripped through to the substrate, when processed as specified in 4.6.15.

3.10 Identification of material. Individual containers shall bear permanent labels showing the information contained herein.

- Component Identification (as applicable)
  Component A - Pigmented polyurethane resin component
  Component B - Curing agent component
  Component C - Thinning component (if applicable)
- Specification MIL-PRF-85322C
- Type, Class, and Grade
- Manufacturer's name, product number, and batch number
- Date of manufacture by month and year
- Color (name and FED-STD-595 color number)
- Net contents
- Mixing instructions for application

All unit and shipping containers of toxic and hazardous chemicals and materials shall also be labeled in accordance with the applicable laws, statutes, regulations or ordinances, including Federal, state and municipal requirements.

3.10.1 Component containers. All containers of toxic and hazardous chemicals and materials shall be labeled in accordance with the applicable federal, state, and municipal laws, statutes, regulations, and ordinances. In addition to the labeling, the following shall appear on each component container in every kit and on each exterior shipping container.

CAUTION

THIS COATING MATERIAL IS TOXIC AND FLAMMABLE AND SHALL NOT BE USED IN CONFINED AREAS WHERE THERE ARE OPEN FLAMES, ARCING EQUIPMENT, HOT SURFACES, NOR WHERE SMOKING IS PERMITTED.

USE ONLY WITH ADEQUATE VENTILATION.

AVOID BREATHING OF VAPOR.

DO NOT GET IN EYES, ON SKIN, OR ON CLOTHING.

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES AND/OR SKIN WITH PLENTY OF WATER. FOR EYES, GET MEDICAL ATTENTION.

3.10.2 Lid (Component A only). Each lid of Component A material shall bear a red printed label with the following information:

- USE CAUTION
- OPEN SLOWLY

3.10.3 Precautions. Each kit shall include a sheet listing the following precautions:

a. Open Component A (pigmented) carefully. Some outgassing may be evident. Do not open any container that is bulged or deformed. Discard any container that is bulged or deformed.

b. All spray equipment shall be adequately grounded. Clean equipment thoroughly after each use with thinner conforming to MIL-T-81772, Type I.

c. Mix only the number of kits that can be used within two hours. Keep containers closed when not in use.

d. Wear protective clothing, creams, gloves and goggles while spraying.

e. An air-line respirator is recommended for spraying operations. If it is not available, protective masks containing an organic-vapor cartridge respirator should be used.

f. Do not contaminate Components A or B with alcohol or water.

g. Keep containers closed when not in use. Both components are moisture sensitive.

h. Wash hands immediately after use.

i. Dispose of, without opening, any container that is bulged or deformed.

j. Perform production type operations only in specifically designated areas with local exhaust ventilation and other environmental control measures, as may be recommended on the basis of an on-site industrial hygiene survey.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.3).
b. Conformance inspection (see 4.4).

4.2 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the conditions specified in ASTM D3924, and testing shall be performed in duplicate. Unless otherwise stated in the test method or paragraph herein, room temperature shall be 21° ±5 °C (70° ±10 °F) and relative humidity as 50 ±10 percent.

4.3 Qualification inspection. The qualification inspection shall consist of all tests specified in 4.6 and table III.

4.4 Conformance inspection.

4.4.1 Tests. The conformance inspection shall be performed on each production batch and provided when requested by the contracting officer or the qualifying activity (see 6.2). Conformance inspection consists of the following tests: condition in container (3.5.1), viscosity (3.6.1), potlife (3.6.2), surface appearance (3.7.1), color (3.7.2), drying time (3.7.3), peel adhesion (3.7.5), and low-temperature flexibility (3.7.6). The examinations and tests shall be made prior to delivery to the procuring activity (see 6.4).

4.4.1.1 Visual inspection of filled containers. Samples shall be selected at random from each lot (see 6.7) in accordance with ANSI/ASQ Z1.4, inspection level S-2. The lot size for this examination shall be the number of kits fully prepared for delivery. The samples shall be examined for container fill, weight, and marking.

4.5 Test panels.

4.5.1 Aluminum test panels. Test panels for all tests, with the exception of free-film strength (see 4.6.4), peel adhesion (see 4.6.5), strippability (see 4.6.15), rain-erosion resistance (see 4.6.9), and electrical transmission (see 4.6.12), shall conform to SAE AMS-QQ-A-250/5, and be anodized in accordance with MIL-A-8625, Type I. Test panel dimensions shall be 3.0 by 6.0 by 0.020 inch (in.) (76.2 by 152.4 by 0.51 millimeter (mm)). The primer coating and test coat shall be applied in accordance with 4.5.2.1 and 4.5.2.3.

4.5.1.1 Glass fiber base laminate panels. Test panels for the peel adhesion (see 4.6.5) and strippability (see 4.6.15) tests shall conform to any type and cloth number of MIL-DTL-25421. The test panels shall be flat, dense, representative of high quality plastic laminate structure of low void content. Test panel dimensions for peel adhesion and strippability testing shall be 3.0 by 6.0 by approximately 0.04 in. (76.2 by 152.4 by approximately 1.0 mm). Test panel dimensions for surface resistivity testing shall be 24.0 by 24.0 by approximately 0.04 in. (609.6 by 609.6 by approximately 1.0 mm).

4.5.2 Application of coatings.

4.5.2.1 Aluminum test panel preparation. Test panels conforming to 4.5.1 shall be wiped with a clean cloth saturated with methyl ethyl ketone 30 minutes prior to coating. Primer coating, conforming to MIL-PRF-23377 or MIL-PRF-85582 shall then be applied to a dry film thickness of 0.6 to 0.9 mils (15.25 to 22.86 µm) in accordance with ASTM D823 Practice D, and allowed to dry for at least five and two hours respectively. The rain erosion coating shall then be applied in accordance with 4.5.2.3.

4.5.2.2 Vinyl and glass fiber base panel preparation. Test panels conforming to 4.5.1.1 shall be lightly sanded with 180 to 240 grit abrasive paper to remove the glossy finish. After sanding, the test panels shall be wiped with a clean cloth saturated with solvent (e.g., xylene or methyl isobutyl ketone) to remove dust and contamination. A 3.0 by 3.0 in. (76 by 76 mm) section of the test panel shall be covered with vinyl or TEDLAR film of an approximate thickness of 0.002 in. (0.051 mm). The vinyl or TEDLAR film shall be secured to the test panel

by pressure sensitive cellulose tape, 1/2 in. (12.7 mm) in width on both ends. The vinyl or TEDLAR film shall be secured by the tape at the exposed glass fiber surface. Wash primer conforming to MIL-C-8514 shall be applied to the test panels, covering the glass fiber base, the TEDLAR or vinyl film, and the cellulose tape. The wash primer shall be applied to a dry-film thickness of 0.3 to 0.5 mils (7.6 to 12.7 µm) and be permitted to dry for 60 minutes. The test coating shall then be applied over the wash primer in accordance with 4.5.2.3 and allowed to cure for seven days. After this period, the TEDLAR or vinyl film and the cellulose tape shall be carefully removed.

4.5.2.3 Rain erosion coating application (Types I and II, Classes A and B). The rain erosion coating shall be applied to a dry-film thickness of 12 to 14 mils (305 to 356 µm). The rate of application shall be 2 mils (51 microns (µm)) per pass in accordance with ASTM D823 Method D. The minimum cure time prior to testing shall be seven days.

4.5.2.4 Antistatic coating application (Grade B). The antistatic coating shall be applied to the rain erosion coating at a dry-film thickness of 0.5-2.0 mils (13-51µm), in accordance with the manufacturer's recommendations.

4.6 Test methods. The tests of this specification shall be conducted in accordance with table III and 4.6.1 through 4.6.15.5. The test panels used shall be prepared as specified in 4.5 through 4.5.2.3 and 4.5.2.4 (if applicable). Ingredient material submitted shall be tested to determine compliance with the applicable specification.

TABLE III. Test methods.

Inspection	Requirement	Test method	ASTM
Visual examination	----	4.4.3	
Lead and cadmium content	3.4	4.6	D3335
Chromium content	3.4	4.6	D3718
Volatile organic compound (VOC) content	3.4.5	4.6	D3960
Condition in container	3.5.1	----	
Storage stability	3.5.2	4.6	
Accelerated storage stability	3.5.3	4.6.1	
Viscosity	3.6.1	4.6.2	1/ D2196
Pot life	3.6.2	4.6.3	
Fineness of grind	3.6.3	----	D1210
Odor	3.6.4	----	D1296
Surface appearance	3.7.1	visual inspection	
Color	3.7.2	----	D1729
Drying time	3.7.3	4.6	D1640

TABLE III. Test methods - Continued.

Inspection	Requirement	Test method	ASTM
Free-film strength	3.7.4	4.6.4	D2370
Peel adhesion	3.7.5	4.6.5	
Low temperature flexibility	3.7.6	4.6.6	2/ D522
Water resistance	3.8.1	4.6.7	
Fluid resistance	3.8.2	4.6.8	
Rain erosion resistance	3.8.3	4.6.9	
Heat resistance testing (Grade B only)	3.8.3	4.6.9.1	
Accelerated weather resistance	3.8.4	4.6.10	G155
Hydrolytic stability	3.8.5	4.6.11	
Electrical transmission	3.8.6	4.6.12	
Surface resistivity (Grade B only)	3.8.7	4.6.13	
Thermal conductivity (Class B only)	3.8.8	4.6.14	E1952
Application properties	3.9.1	----	
Strippability	3.9.2	4.6.15	

1/ Method A
2/ Method B

4.6.1 Accelerated storage stability. Not less than one unopened, sealed container of each component shall be stored undisturbed for not less than 4 consecutive days in a location maintained at 49° ±3 °C (120° ±5 °F). At the end of 4 days, the container(s) shall be allowed to cool 24 hours to room temperature (see 4.2). During the storage period, it is advised that the unopened containers be placed in larger vented containers to confine any splash that may occur if the lid of the unopened container is blown off by gassing. If, upon removal, the unopened container is deformed, do not open. If the container is not deformed, open carefully and examine its contents for conformance to 3.5.3.

4.6.2 Viscosity. Allow the admixed coating(s) to stand undisturbed for 30 minutes. The viscosity shall be tested in accordance with ASTM D2196, method A, using a Brookfield viscometer (Model LVT, Spindle #2, 30 RPM), or equivalent as approved by the qualifying activity. Readings shall be made when a steady-state of the coating(s) is achieved. The coating(s) shall be examined for conformance to 3.6.1.

4.6.3 Pot life. The admixed coating(s) shall be stored in a full, closed container for two hours at 73.5° ±2 °F (23° ±1 °C) and RH of 50 ±10 percent. After this period, the coating(s) shall be examined for conformance to 3.6.2.

4.6.4 Free-film strength. The rain erosion resistant coating shall be applied to two sheets of vinyl or TEDLAR film with dimensions of 8.0 by 10.0 in (203 by 254 mm) in accordance with 4.5.2.2. After curing for four days, the coated films shall be placed in lukewarm water and the

free-films of the coating separated. After blotting with paper towels, the films shall be conditioned and tested in accordance with ASTM D2370 for conformance to 3.7.4.

4.6.5 Peel adhesion. Two test panels, conforming to 4.5.1.1, shall be prepared in accordance with 4.5.2.2 and then immersed in water for four hours. Four parallel razor blade cuts shall be made through to the fiberglass, crossing the non-adhered and adhered coating section and placed at ¼ in. (6.5 mm), 1¼ in. (31.75 mm), 1¾ in. (44.5 mm) and 2¼ in. (69.9 mm) from the edge of the test panel. A 1.0 in. (25.4 mm) free strip of test coating shall be folded back over the adhered coating and the uncoated panel and the free strip of coating shall be placed in the jaws of a Scott Tensile Test, or equivalent as approved by the qualifying activity, to provide a 180º pull at a rate of 2.0 inches per minute (51 mm per minute). The peel adhesion strength shall conform to 3.7.5.

4.6.6 Low-temperature flexibility. Two test panels, prepared in accordance with 4.5.1, 4.5.2.1 and 4.5.2.3, shall be conditioned for a minimum of 60 minutes at -60º ±5 ºF (-51º ±3 ºC) and, while at that temperature, bent 180º over a ¼ in. (6.4 mm) mandrel, in accordance with ASTM D522, method B, "Cylindrical Mandrel Test." The test panels shall be examined immediately after bending for evidence of failure, then conditioned at 70º ±5 ºF (21º ±3 ºC), and reexamined for conformance to 3.7.6.

4.6.7 Water resistance. Two test panels shall be prepared in accordance with 4.5.1 and 4.5.2.1, with the exception that the test coating shall be permitted to air-dry for 2 to 10 hours. The test coating shall then be topcoated with 2.0 ± 0.3 mils (51 ±7 µm) of coating conforming to MIL-PRF-85285 and cured for 7 days. The test panels shall then be immersed in distilled water for 4 days at a temperature of 120º ±5 ºF (49º ±2.8 ºC). After removal from the distilled water, the coating shall be examined for conformance to 3.8.1.

4.6.8 Fluid resistance. Nine aluminum test panels, prepared in accordance with 4.5.2.1, 4.5.2.3 and 4.5.2.4 (if applicable) shall be immersed separately (three test panels) in each of the following fluids: lubricating oil conforming to MIL-PRF-23699, hydraulic fluid conforming to MIL-PRF-83282, and fuel conforming to MIL-DTL-5624, grade JP-5 for a period of 4 hours at 70º ±10 ºF (21º ±5 ºC). Four hours after removal, the test panels shall be visually examined for conformance to 3.8.2.

4.6.9 Rain-erosion resistance. Four round disks, each with a diameter of 1.0 in. (25.4 mm) and a thickness of 3/16 in. (5 mm) and cut from a glass fiber base laminate conforming to any type and fabric number of MIL-DTL-25421, shall be used for testing each color (gray and black). The test panels shall be coated in accordance with 4.5.2.2, 4.5.2.3, and 4.5.2.4 (if applicable) without the use of Tedlar tape. Each coated disk shall be mounted in a horizontal whirling arm tester, at the end of the rotating arm so that the disk is perpendicular to the direction of travel. A water ring, mounted above the rotating blade, shall be used to simulate a natural rainfall of ½ inch per hour and 2.0 mm droplet size. The test shall be run at 500 miles/hour (800 kilometers/hour) at the sample's center. Determine the average time in which the 4 specimens of the same color and type, grade, and class have eroded through to the substrate (see 3.8.3).

4.6.9.1 Heat resistance testing (Class B only) The test panels shall prepared as described in 4.5.11 and shall be exposed to 250º ±5 ºF (121º ±3 ºC) for 24 hours. After exposure, allow the panels to cool to room temperature prior to testing for rain-erosion resistance (4.6.9). Determine the average time in which the 4 specimens of the same color and type, grade, and class have eroded through to the substrate (see 3.8.3).

4.6.10 Accelerated weather resistance. Two test panels, prepared in accordance with 4.5.2.1, 4.5.2.3, and 4.5.2.4 (if applicable) and tested in accordance with ASTM G155 using a Xenon-arc weatherometer (Atlas Material Testing Technology or equivalent as approved by the qualifying activity) that is cycling between 102 minutes of light only and 18 minutes of light and water spray for not less than 500 hours. Coatings shall be examined for conformance to 3.8.4.

Cabinet temperature:	42 ±3 ºC (108 ±5 ºF)
Black body temperature in cabinet:	63 ±3 ºC (145 ±5 ºF)
Relative humidity in cabinet:	50 ±5 percent
Intensity of xenon-arc:	0.3 - 0.4 watts/meter^2 at 340 nm

4.6.11 Hydrolytic stability. Two test panels shall be prepared in accordance with 4.5.2.1 and 4.5.2.3. The test panels shall be stored at 200º ±5 ºF (93º ±3 ºC) and RH of 95 percent for four days. The test panels shall be stored coated side up on the tray in a glass desiccator jar after this four day storage. The desiccators shall contain a glycerin (22 percent by weight) in water solution in the bottom, which shall produce a relative humidity of 95 percent at the test temperature. The desiccators shall then be closed and inserted into an air circulating oven maintained at 200º ±5 ºF (93º ±3 ºC). At the end of the exposure period, inspect the panels visually and check for softening of the film by pushing a thumbnail or spatula into the film, in accordance with 3.8.5.

4.6.12 Electrical transmission.

4.6.12.1 Test panels. Two test panels shall be fabricated from 16 layers of number 181E fiberglass and polyester resin conforming to L-P-383. The fiberglass to polyester ratio shall be 62 to 38 parts by weight. The laminate shall be dense, of low void content, and representative of a high quality laminate fabrication. Test panel dimensions shall be approximately 24.0 by 34 by 0.17 ±0.01 in. (610 by 864 by 4.19 ±0.03 mm). The dielectric constant of the laminate shall be 4.20 ±0.05. One panel shall be lightly sanded with 180 to 240 grit abrasive paper, wiped with solvent, and then coated with wash primer conforming to MIL-C-8514 to a dry film thickness of 0.3 to 0.5 mils (8 to 13 µm). The wash primer shall be permitted to dry for 60 minutes prior to application of the test coating, in accordance with 4.5.2.3. One panel shall be used as the control and remain uncoated.

4.6.12.2 Sequence of testing. The sequence of testing the panels shall be as follows:

a. Coated test panels for electrical transmission testing shall be cured in accordance with 4.5.2.3.

b. One uncoated control panel and one coated panel shall be tested as specified in 4.6.12.3 and 4.6.12.4 and the test results shall be determined by 4.6.12.5. The uncoated and coated test

panels shall be conditioned at a temperature of 100º ±5 ºF (38º ±3 ºC) and RH 90 ±5% for seven days and then tested as specified below.

4.6.12.3 Transmission test equipment. Flat test panels shall be tested in accordance with transmission testing and equipment described in ARTC-4.

4.6.12.4 Test procedure. The test shall be conducted at a frequency of 9.375 gigahertz (GHz). The test sample shall be clamped at the approximate midpoint between the horns at a 60º incident angle. The horns shall be adjusted so that polarization is horizontal. The incident angle shall be varied slightly on either side of 60º to maximize power transmission. Minimum and maximum power transmission shall be determined through a 3/8-in (9.5 mm) lateral movement of the test panel and averaged. The average of the two values shall be considered the power transmission.

4.6.12.5 Test results and computation. The test results shall be converted to percent transmission using the following formula:

$$\text{percent transmission} = \frac{\text{T2 sample}}{\text{T2 blank}} \times 100$$

Where:
T2 sample = power transmission of coated panel
T2 blank = power transmission of uncoated panel

The test results for electrical transmission shall be examined for accordance with 3.8.6 and Table II.

4.6.13 Surface resistivity (Grade B only).

4.6.13.1 Test panels. The test panels shall be as specified in 4.5.1.1 except the size shall be 24 by 24 by 0.050-0.055 inch. Primer coating, conforming to MIL-PRF-23377 or MIL-PRF-85582, shall be applied to the test panels to a dry film thickness of 0.6 to 0.9 mils (15.25 to 22.86 µm) and allowed to dry for at least five and two hours, respectively. The panels shall then be coated and cured in accordance with 4.5.2.3 and 4.5.2.4.

4.6.13.2 Test panel template. Acrylic plastic panes shall conform to MIL-PRF-5425 and shall have a pattern of 12 holes that are ½ inch in diameter. The holes shall be drilled in three rows of 4 holes spaced 6 inches apart (center to center).The first hole shall start 3 inches from the side edge and 6 inches from the top edge. The acrylic template is used as a means for spacing the electrode at an equal distance for obtaining resistivity readings (see Figure 1).

4.6.13.3 Measurement procedure. The equipment used for the surface resistivity test shall be as specified on Figures 2 and 3. Two 3/8 inch wire spring loaded electrodes having a pressure capacity of 3 to 5 pounds shall be as specified on Figure 2. Use a 500 volt megohmmeter to measure accurately the range of 0-1000 megohms. The acrylic template shall be placed over an individual panel which has been exposed to the conditions listed in Table II. The two electrodes with their wire leads connected to the 500 volt megohmmeter shall be placed to coincide with the

two holes of the template. All readings shall be taken with uniform pressure of 3 to 5 pounds on the electrodes. Seventeen different readings shall be taken between holes of the template and averaged. After one hour, repeat the readings and average. The test data for surface resistivity shall be examined for accordance with 3.8.7 and Table II.

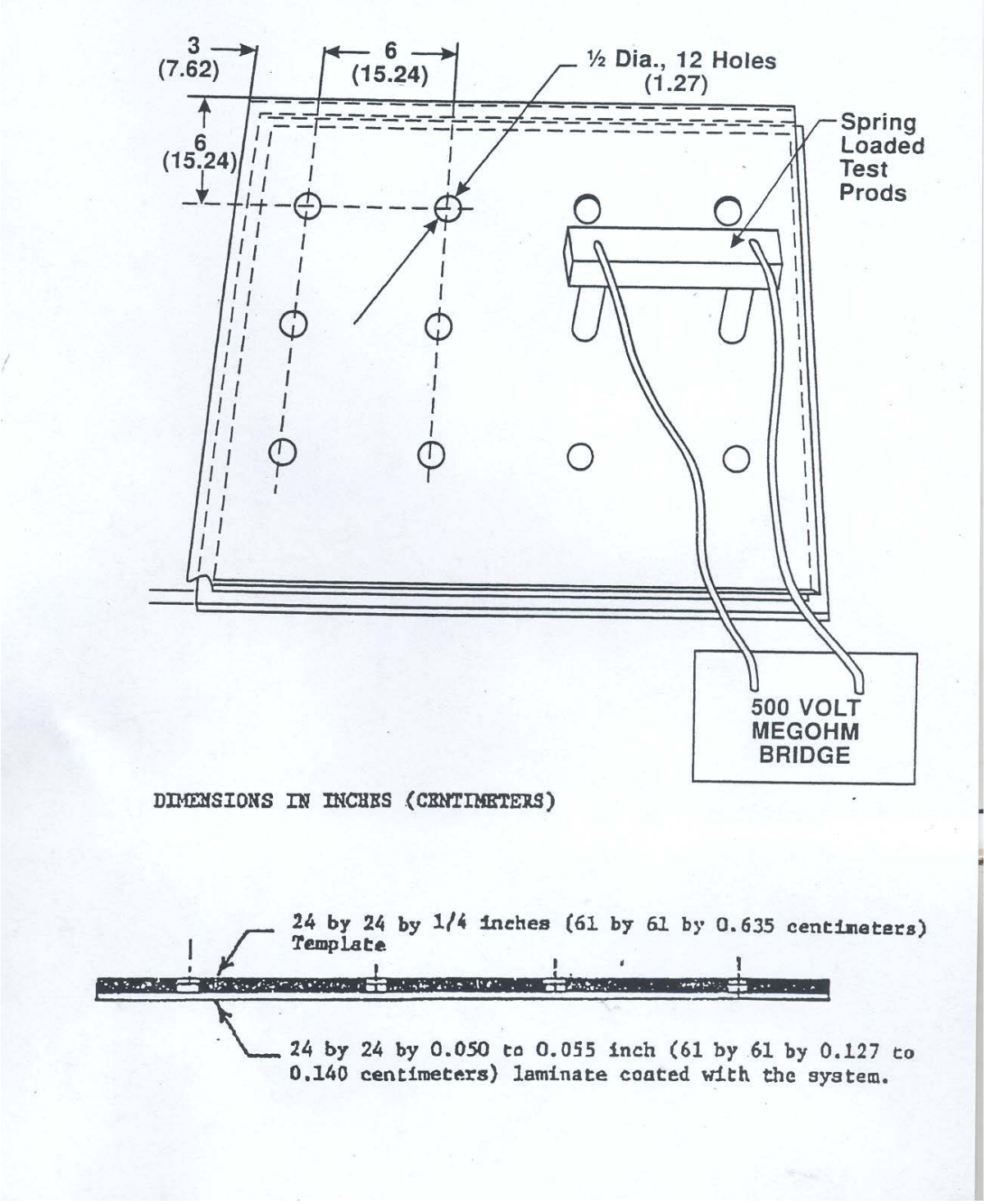


FIGURE 1. Apparatus used for surface resistivity.

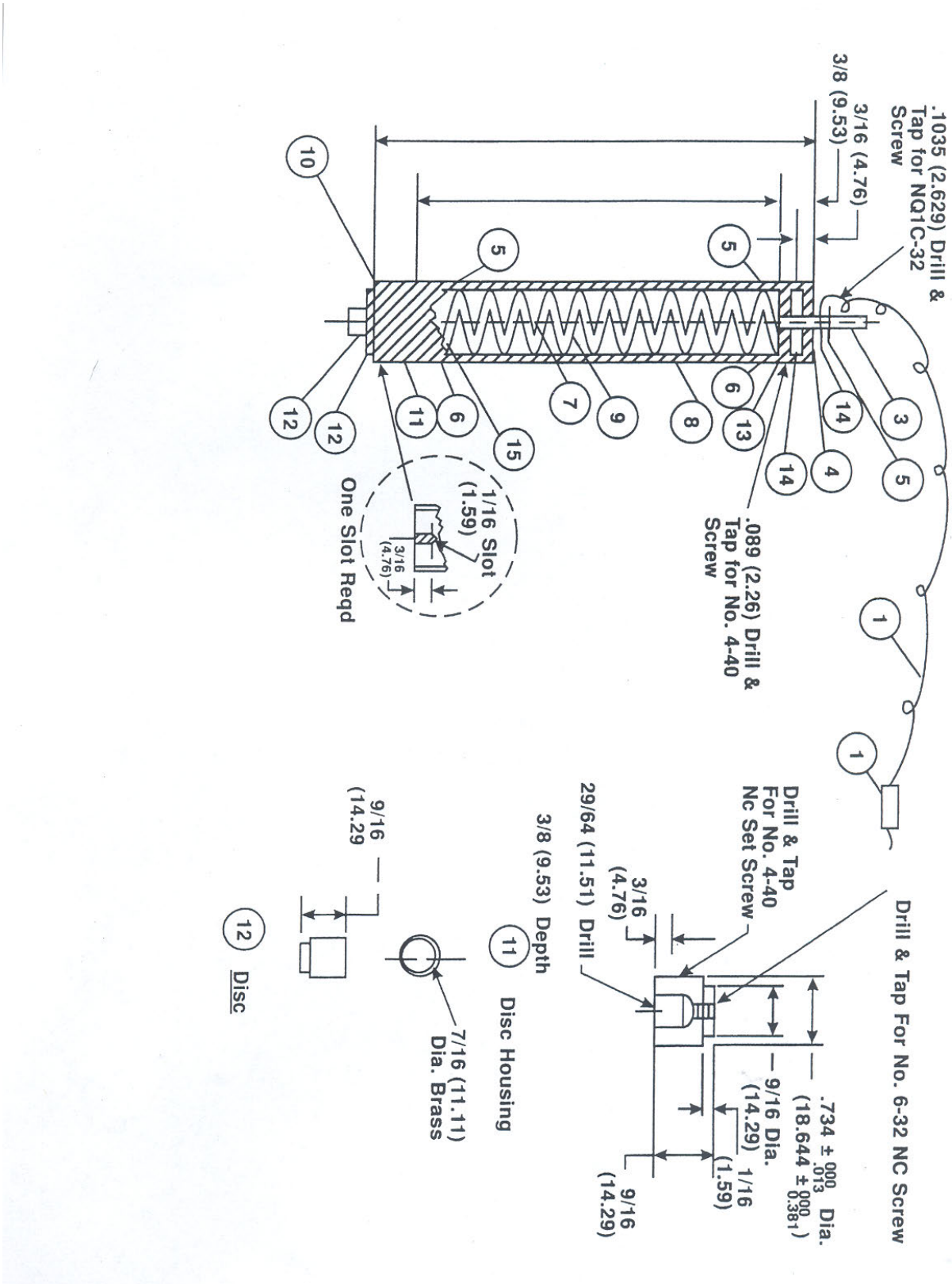
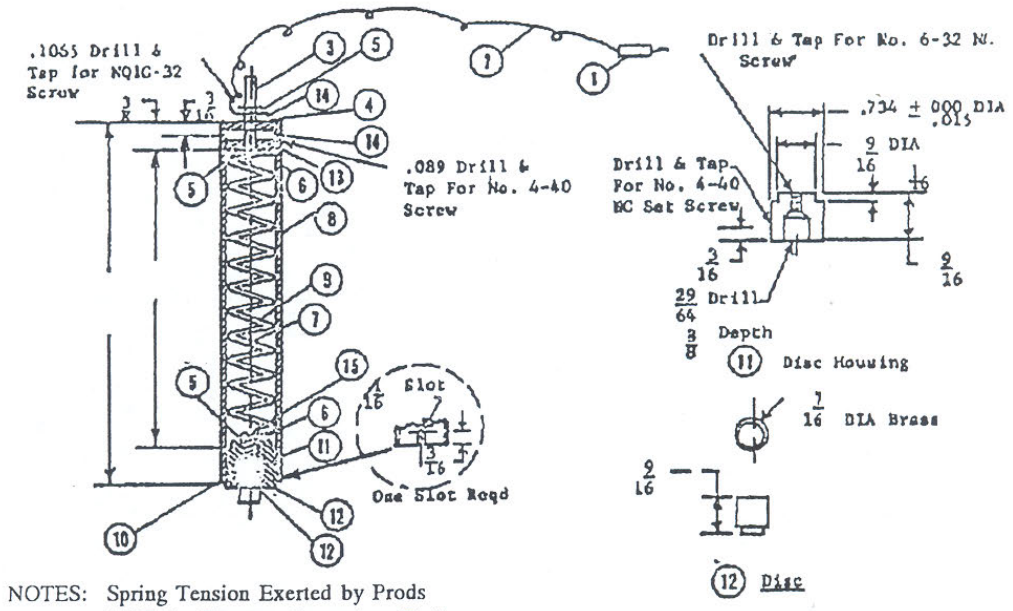


FIGURE 2. Spring-loaded prods -1.



NOTES: Spring Tension Exerted by Prods
WHEN: They are Pressed to Their
LIMIT: Is 3 to 5 lb.
Bend Terminal Lug No. 5 Around Bolt
Head to Clear Spring
Shorten Wire No. 7 to Allow Disc
Housing to Extend Maximum of 1/16 Beyond Tube.
DIMENSIONS IN INCHES

Part No.	No. Reqd	MATERIAL DESCRIPTION	SIZE
1	2	Instrument Lead	As Required
2	2	Rubber Covered Lead Wire	As Required
3	2	Round Head Mach Screw	No. 6-32 NCX1-1/8 Long
4	4	Hex Nut	No. 6-32 NC
5	6	Terminal Lug Shakeproof	2106-6
6	4	Internal Type Lock Washer	For No. 6-32 NC Screw
7	2	Pig Tail Wire	.035 DIA X5-1/2 Long
8	2	Phenolic Tubing	7/80.D X 3/41.DX5-5/16 Long
9	2	Compression Spring	.063 GA 11/16 O.D.X4/12 Long
0	2	Socket Head Set Screw	No. 4-40 NC X1/8 Long
11	2	Disc Housing	Brass - 3/4 Rod Stock X 9/16 Long
12	2	Brass Disc	7/16 DIA X 9/16
13	2	Phenolic Rod	3/4 DIA X 9/16
14	4	Flathead Mach Screw	No. 4-40 NC X 1/4 Long
15	2	Roundhead Mach Screw	No. 6-40 NC X 1/4 Long

FIGURE 3. Spring-loaded prods -1A

4.6.14 Thermal Conductivity (Class B only). A free-film of the rain erosion coating shall be prepared at a dry film thickness of 3.0-5.0 mils (75 to 125 µm) in accordance with ASTM D4708. The resulting free-film shall be tested in accordance to ASTM E1952 in the temperature range of 104 to 176 ºF (40 ºC - 80 ºC). Examine for conformance to 3.8.8.

4.6.15 Strippability. Wash primer conforming to MIL-C-8514 shall be applied to a dry film thickness of 0.3 to 0.5 mils (8 to 13 µm) to test panels conforming to 4.5.1.1 and be permitted to dry for 60 minutes. The test coating shall then be applied over the wash primer in accordance with 4.5.2.3 and 4.5.2.4 (if applicable). Chemical stripper, conforming to MIL-R-81294, Type IV, shall be applied to the test coating on the test panels and allowed to stand a maximum of 30 minutes or until blistering and lifting of the test coating occurs. The softened coating shall then be removed with a plastic scraper. If necessary, reapply stripper and allow to stand no longer than 30 minutes to remove any residual primer or test coating. Rub the test panel surface with a clean cloth saturated with methyl-ethyl-ketone (MEK) to clean the coating residue from the test panel. The panel shall then be examined for conformance to 3.9.2.

4.7 Toxicity. The product shall be evaluated by the Navy and Marine Corps Public Health Center (NMCPHC) using the administrative Health Hazard Assessment (HHA) (see 6.8).

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The material covered by this specification is intended as a rain-erosion coating for aircraft radomes and leading edges. Class B of this polyurethane coating is primarily for use on heated leading edges that are subjected to temperatures of up to 250˚F (120˚C). Grade B of this polyurethane coating is intended for use on aircraft weapons systems where discharge and dissipation of static electricity is necessary to alleviate radio and radar interference. The use of an aliphatic polyurethane topcoat is recommended as this coating may fade when exposed to sunlight.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Type, class, and grade (see 1.2).

c. Quantity and size of containers.

d. Conformance report (see 4.4).

e. Any formulation modifications (see 6.3.3.1).

f. Color number and name (see 6.7).

g. Packaging requirements (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion on the Qualified Products List, QPL-85322, in the Qualified Products Database (QPD), whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from the Commander, Naval Air Warfare Center Aircraft Division, Code 4.9.7.2, Building 2188, Patuxent River, MD 20670-1908. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.dla.mil.

6.3.1 Qualification samples. Qualification test samples will consist of a minimum of three quarts in each color, medium gray or black. The material will be furnished in containers of the type to be used in filling contract orders. Samples must be identified as follows and forwarded to the laboratory designated in the letter of authorization (see 6.3).

- Qualification test samples
- Specification MIL-PRF-85322C, Type_____, Class_____, Grade ____, Color_____ (as applicable)
- Coating, Elastomeric, Polyurethane, Rain-Erosion
- Manufacturer's name and product number
- Submitted by (name and date) for qualification testing in accordance with authorization (reference authorizing letter)

6.3.2 Storage stability, inspection, and other information. In addition to the qualification test samples, the qualifying activity will request the manufacturer to submit to the qualification activity: (a) certification that the manufacturer's material meets the storage stability requirements (see 3.5.2); (b) one copy of the MSDS (see 6.6); (c) a certified test report showing that the material conforms to the requirements of this specification; and (d) certification that the following chemicals were not used in the formulation of this coating: methylene chloride,

trichloroethane and trichlorotrifluoroethane.

6.3.3 Retention of qualification. To retain qualification of products approved for listing on the Qualified Products Database (QPD), one of the items that the manufacturer will be requested to verify by certification to the qualifying activity is that its product(s) complies with the requirements of this specification. Unless otherwise specified by the qualifying activity, the time of periodic verification by certification will be in two-year intervals from the date of original qualification and will be initiated by the qualifying activity.

6.3.3.1 Retention of qualification for formulation modifications. Manufacturers must request formulation modifications in writing. The request is reviewed and approval is determined by the preparing activity. The approval process may include limited testing of the modified material, complete qualification testing, and/or laboratory data and certification of the performance properties by the manufacturer. Formulation modifications include any change of resin, additive, pigment/fillers, activator/catalyst, supplier(s) of raw materials, solvent etc.

6.4 Government testing. The Government reserves the right to conduct tests for storage stability and weather resistance or to conduct any or all tests of this specification at any time within six months from the date of manufacture of the coating as attested by the date appearing on the container's label. Samples for testing should be taken from previously unopened containers.

6.5 Moisture. The polyurethane components should be kept dry. The presence of moisture degrades the quality of the paint. Packaging of the materials should be done in a dry atmosphere. Solvents for the resins should be examined for evidence of contamination before they are incorporated, even though they are of urethane grade. Urethane grade solvents or thinners may become contaminated with water in tank cars or storage tanks. The purchase of urethane grade solvents or thinners is no guarantee that excessive moisture is not present. It is therefore recommended that all users check for moisture contamination. The following suggested method may be used to determine the presence of water: add one drop of aluminum secondary butoxide to 100 ml of the solvent in a stoppered flask and shake. An appreciable amount of turbidity indicates the presence of water. The pigments used in the topcoats must be absolutely dry before being incorporated into the resin solution. If not, the package stability will suffer.

6.6 Material Safety Data Sheets (MSDS). 29 CFR 1910.1200 requires that the MSDS for each hazardous chemical used in an operation must be readily available to personnel using the material. Contracting officers should identify the activities requiring copies of the MSDS.

6.7 Batch and lot formation. A batch consists of all coating material manufactured during one continuous operation and forming part of one contract or order for delivery. A lot consists of all the coatings of the same color, manufactured at one-time from one batch, forming part of one contract, and submitted for acceptance.

6.7.1 Color designation codes. The five-digit color designator is the FED-STD-595 color number. Medium gray and black are two colors frequently used by the Department of Defense, but are not necessarily all of the colors authorized, used, or available. Approval of colors other than those submitted for qualification is at the discretion of the qualifying activity.

6.8 Toxicity evaluation. A flowchart for the HHA process can be found as enclosure (1) of BUMEDINST 6270.8. The HHA is a review of the product based on information submitted by the manufacturer, to assess health hazards associated with the handling, application, use and removal of the product. Sufficient data to permit an HHA of the product should be provided by the manufacturer/distributor to the NAVENVIRHLTHCEN. To obtain current technical information requirements specified by the NAVENVIRHLTHCEN or any questions concerning toxicity, information required to conduct a HHA, and requests for a HHA should be addressed to the Commanding Officer, Navy and Marine Corps Public Health Center, ATTN: Hazardous Materials Department, Industrial Hygiene Directorate, 620 John Paul Jones Circle, Suite 1100, Portsmouth, VA 20378-2103. Upon receipt of the HHA, a copy should be provided to Commander, Naval Sea Systems Command, ATTN: SEA 05M1, 1333 Isaac Hull Ave., SE, Stop 5133 Washington Navy Yard, DC 20376-5133.

6.8.1 Toxicity of polyurethane coatings. Some free isocyanate is released during the mixing and application of multi-component polyurethane coatings. Released free isocyanates can product a significant irritation to the skin, eyes, and respiratory tract. Personnel exposed to free isocyanates may develop an allergic pulmonary sensitization, particularly if there is an inhalation of the vapor and mist produced during spray application. This sensitization may cause an asthmatic reaction with wheezing, dyspnea, and cough. Once sensitized, further exposure cannot be tolerated. For this reason, there is a restriction on the issuance and use of this material. Personnel exposed to free isocyanates on a regular basis should receive a periodic medical exam that includes a chest roentgenograph (X-ray), pulmonary function tests, and an evaluation of any respiratory disease or history of allergy. Periodic testing of pulmonary functions may aid in detecting the onset of pulmonary sensitization. Questions pertinent to the effect(s) of these coatings on the health of personnel using them should be referred by the procuring activity to the appropriate medical service, who will act as an advisor.

6.8.2 Personnel protective methods. Eye protection and appropriate clothing to prevent repeated or prolonged skin contact should be worn while applying material that contains free isocyanates. Additional information pertaining to protective equipment and other necessary precautions should be available from the coating application facility’s Occupational Safety and Health Office.

6.9 Safely handling MEK solvent. To minimize exposure to MEK solvent, it is recommended that personnel conducting the solvent resistance (cure) test, as a minimum, wear either butyl rubber or Teflon gloves and a National Institute of Occupational Safety and Health (NIOSH) approved half-face respirator equipped with organic vapor cartridges and goggles or a full-face respirator equipped with organic vapor cartridges.

6.10 Subject term (key word) listing.

Flammable
Flexible
Sulfuric acid

6.11 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians:
Army - MR
Air Force - 11

Preparing activity:
Navy - AS
(Project 8010-2014-006)

Review activities:
Army - AV
Navy - MC

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil.