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24 June 1981
SUPERSEDING
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MILITARY SPECIFICATION

COATINGS, POLYURETHANE, RAIN EROSION RESISTANT FOR EXTERIOR AIRCRAFT AND MISSILE PLASTIC PARTS

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

1. SCOPE

1.1 Scope. This specification covers the requirements for two classes and two types of rain erosion resistant coatings.

1.2 Classification. The coatings shall be of the following classes, types and compositions as specified. (See 6.1.)

Class A - Polyurethane prepolymers which are not dependent on moisture or high relative humidity for curing (see 6.4).

Type I Rain erosion resistant coating.
Type II - Antistatic rain erosion resistant coating.
Composition G - General use.
Composition L - Limited use.

Class B - Polyurethane prepolymers which are dependent on moisture of high relative humidity for curing (see 6.4).

Type I - Rain erosion resistant coating.
Type II - Antistatic rain erosion resistant coating.
Composition G - General use.
Composition L - Limited use.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to the Aeronautical Systems Division, ENESS, Wright-Patterson Air Force Base, Ohio 45433, by using the self addressed Standardization Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 8010

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2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

TT-S-735	Standard Test Fluids; Hydrocarbon
PPP-P-1892	Paint Varnish, Lacquer and Related Materials: Packaging, Packing and Marking of

MILITARY

MIL-P-5425	Plastic, Acrylic, Heat Resistant
MIL-R-7705	Radomes, General Specification For
MIL-A-8625	Anodic Coatings, For Aluminum and Aluminum Alloys
MIL-R-25134	Remover, Paint and Lacquer, Solvent Type
MIL-P-25421	Plastic Materials; Glass Fiber-Epoxy Resin Low Pressure Laminated

STANDARDS

FEDERAL

FED-STD-141	Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling and Testing

BULLETIN

U.S. Air Force 535 Free Diisocyanate Test Method

(Copies of specifications, standards, drawings and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

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2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D93	Flash Point by Pensky-Martin Closed Tester
ASTM D1014	Conducting Exterior Exposure Tests of Paints
ASTM D1296	Odor of Volatile Solvents and Diluents
ASTM D1475	Density of Paint, Varnish, Lacquer and Related Materials
ASTM D1644	Non-Volatile Content of Varnishes
ASTM D2196	Rheological Properties of Non-Newtonian Materials
ASTM D2267	Method of Test for Aromatics in Light Naphthas, Reformates and Gasolines by Gas Chromatography
ASTM D2369	Volatile and Non-Volatile Content

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

Federal Hazardous Substances Labeling Act

(Application for copies should be addressed to the U.S. Department of Health, Education and Welfare, Food and Drug Administration, Washington, DC 20203.)

CODE OF FEDERAL REGULATIONS (CFR)

49CFR 171-178	Department of Transportation (DOT) Regulations for the Transportation of Explosives and Other Dangerous Articles by Land and Water

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, DC 20402. Orders should cite the latest edition and supplements thereto.)

SOUTHERN CALIFORNIA AIR POLLUTION CONTROL DISTRICT

Rule 102	Photochemically Reactive Solvents

(Application for copies should be addressed to the Southern California Air Pollution Control District, 434 South San Pedro Street, Los Angeles, CA 90013.)

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3. REQUIREMENTS

3.1 Qualification. The coating materials furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.1 and 6.1). Qualified contractors shall certify that the products offered conform to the requirements specified in 3.5.5.

3.2 Materials. The coating material shall be of a polyurethane type formulated from a chemically curing composition of such ingredients as may be necessary to produce high quality materials. The coating materials shall cure completely at standard conditions. The Class A coatings shall contain cycloaliphatic or aliphatic isocyanate only (see 6.4).

3.2.1 Toxic products and formulations. The material shall have no adverse effect on the health of personnel when used for its intended purpose and applied in approved facilities with the use of approved safety equipment. Questions pertinent to this effect shall be referred by the procuring activity to the appropriate department medical service who will act as an advisor to the procuring agency.

3.3 Components

3.3.1 Class A, Types I and II, Compositions G and L. The Class A coatings shall be a polyurethane prepolymer vehicle which can be polymerized with a curing agent at standard conditions without dependence on moisture or high relative humidity. Unless otherwise specified, class A, type I coating components shall be individually packaged and furnished as a kit. The kit shall consist of the following: a primer plus primer activator; polyurethane prepolymer vehicle plus the curing agent; and a thinning solvent. For class A, type II coatings, an antistatic film shall be applied to the surface of the type I coating. The class A, type II coating kit shall consist of all the components required for the class A, type I kit plus the antistatic polyurethane prepolymer vehicle and the curing agent. Class A coatings shall be applied by spray or brush techniques. All solvents and thinners contained in and furnished with class A, composition G coatings shall be nonphotochemically reactive. The solvents and thinners contained in and furnished with class A, composition L coatings are photochemically reactive (see 6.5).

3.3.2 Class B, Types I and II, compositions G and L. The class B coatings shall be moisture curing polyurethane prepolymers which the polymerization may be accelerated by a catalyst. The class B coatings can be polymerized at standard temperature conditions but are dependent on moisutre or high relative humidity. Unless otherwise specified, class B, type I coating components shall be individually packaged and furnished as a kit. The kit shall consist of the following: a primer plus primer activator; polyurethane prepolymer vehicle plus a catalyst when applicable; and a thinning solvent. For class B, type II coatings, an antistatic film shall be applied to the surface of the type I coating.

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The class B, type II coating kit shall consist of all the components required for the class B, type I kit plus the antistatic polyurethane vehicle and the catalyst when applicable. Class B coatings shall be applied by brush or spray techniques. All solvents and thinners contained in and furnished with class B, composition G coatings shall be nonphotochemically reactive. The solvents and thinners contained in and furnished with class B, composition L coatings are photochemically reactive (see 6.5).

3.3.3 Solvents. The solvents and thinners for classes A and B, types I and II, composition G coatings shall be nonphotochemically reactive and shall be compatible with the coating materials.

3.3.4 Nonphotochemically reactive solvent. A nonphotochemically reactive solvent is any solvent with an aggregate of less than 20 percent of its total volume composed of the chemical compounds classified below or which does not exceed any of the following individual percentage composition limitations with reference to the total volume of solvent (see 6.5).

a. A combination of hydrocarbons, alcohols, aldehydes, esters, ethers or ketones having an olefinic or cyclo-olefinic type of unsaturation: 5 percent.

b. A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethyl benzene: 8 percent.

c. A combination of ethylbenzene, ketones having hydrocarbon structures, trichloroethylene or toluene: 25 percent.

d. Total (a) + (b) + (c): 20 percent maximum.

e. Ethylene glycol monoethyl ether acetate: 25 percent minimum.

3.4 Quantitative requirements. The quantitative requirements of the coatings shall be as specified in table I.

3.4.1 Polyurethane prepolymers (free diisocyanate content). The free diisocyanate content of the polyurethane prepolymers for classes A and B, types I and II coatings shall be not greater than 1 percent when tested as specified in 4.7.2 and Appendix.

3.5 Qualatative requirements.

3.5.1 Mixing. Components of classes A and B, types I and II coatings shall be individually mixed in accordance with the manufacturers instructions. The resulting individual mixtures shall be smooth, homogeneous materials free from lumps, gelling, seeding, separation or other objectional characteristics.

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TABLE I. Quantitative requirements - classes I and II.

Component	Nonvolatile (Solids Content) % by Weight	Weight per Gallon, pounds	Viscosity, Centipoises		Flash Point °F
	Minimum	Minimum	Minimum	Maximum	Minimum
Primer (Mixed components, if applicable)	10.0	7.0	100	400	50
CLASS A					
Type I, Compositions G & L Polyurethane Prepolymer	40	7.5	250	500	50
Type II, Compositions G & L Polyurethane Prepolymer	40	7.5	250	500	50
Antistatic Polyurethane Prepolymer	50	7.5	900	1500	50
CLASS B					
Type I, Compositions G & L Polyurethane Prepolymer	45	8.0	130	500	50
Type II, Compositions G & L Polyurethane Prepolymer	45	8.0	130	500	50
Antistatic Polyurethane Prepolymer	35	7.5	900	1500	50

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3.5.2 Odor. The odor of the wet coatings shall not be obnoxious when tested as specified in 4.7.

3.5.3 Color. Classes A and B coatings shall be tinted black. The color shall be sufficiently intense when the specified film thickness is applied that the surface is completely hidden.

3.5.4 Accelerated storage stability. Classes A and B coatings shall be subjected to 4 days of accelerated storage. At the end of the 4 day storage period, the component materials shall be free of lumps, skins and gels and shall disperse readily to a smooth homogeneous mixture when tested in accordance with 4.7.7.

3.5.5 Shelf storage life. When stored as specified in 4.7.8, classes A and B coatings shall meet all the requirements of this specification except that the minimum viscosity in table I shall not have decreased by more than 10 percent from the specified value and the maximum viscosity in table I shall not have increased by more than 10 percent above the specified value.

3.5.6 Pot life. Classes A and B coatings shall have a minimum pot life of 4 hours at standard conditions. At the end of the 4 hour period, the coatings shall show no signs of lumping, seeding, separation or an increase in viscosity of more than 20 percent from the initial viscosity.

3.5.7 Application and drying time. The class A and B coatings shall be applied in accordance with the manufacturer's instructions to a total dry film thickness of 12 to 14 mils. The total application time, including priming and intervals between coatings shall not exceed 8 hours. The tack free drying time for class A coatings shall not exceed 4 hours after application of the final coat when tested in accordance with 4.7.10. The tack free drying time for class B coatings shall not exceed 10 hours after application of the final coat when tested in accordance with 4.7.10.

3.5.7.1 Rate-of-cure. The rate-of-cure of the classes A and B coatings shall have a maximum set-to-touch or recoat time of one hour. For class B materials, the manufacturer shall furnish instructions for catalyzing or accelerating the polyurethane prepolymer materials for a temperature range from 10°C to 35°C (65°F to 95°F) and a relative humidity range from 40 percent to 75 percent.

3.5.8 Curing time. Class A coatings shall be fully cured within 5 days and shall be free of pinholes, cracks, bubbles or other film irregularities. Class B coatings shall be fully cured within 10 days and shall be free of pinholes, cracks, bubbles, or other film irregularities.

3.5.9 Peel strength. Class A coatings shall have a peel strength of not less than 7 pounds per inch and class B coatings shall have a peel strength of not less than 10 pounds per inch when tested in accordance with 4.7.12.

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3.5.10 Flexibility. Films of the coatings shall show no cracking or loss of adhesion in the bend area when tested in accordance with 4.7.12.

3.5.11 Water and aromatic fuel resistance. After immersion in water and fuels, the coatings shall show no evidence of blistering, swelling, checking, or visible color change. After immersion, the peel strength shall not decrease to less than 7 pounds per inch when tested in accordance with 4.7.13 and 4.7.14.

3.5.12 Rain erosion resistance. Class A types I and II coatings, and class B types I and II coatings shall not erode through a 12 to 14 mils thick coating when tested as specified in 4.7 and Table III.

3.5.13 Electrical transmission. Class A types I and II coatings and class B types I and II coatings shall have a minimum electrical transmission of 85, 90 or 95 percent when tested as specified in 4.7 and table III.

3.5.14 Surface resistivity. The surface resistivity of the class A, type II coating shall be not less than 0.5 megohms nor more than 15 megohoms per square when tested as specified in 4.7 and table III.

3.5.15 Weather resistance. Class A, types I and II coatings and class B, types I and II coatings, when exposed to outdoor weathering for 6 months shall show no film deterioration such as chalking, checking, cracking, embrittlement, loss of adhesion, or loss of resiliency. After weathering, the coatings shall meet the surface resistivity requirements as specified in 3.5.14.

3.5.16 Strippability. Newly applied, fully cured and weathered class A, types I and II and class B, types I and II coatings shall be easily strippable when tested as specified in 4.7.22.

3.5.17 Reparability. The cured coatings shall be reparable as specified by the manufacturer.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

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

a. Qualification inspection (see 4.3).
b. Quality conformance inspection (see 4.4).

4.3 Qualification inspection. Qualification tests shall consist of all of the tests specified in 4.7 except the test inspection of filled containers.

4.3.1 Qualification samples. Unless otherwise specified, qualification test samples shall consist of the following materials and test panels:

a. Materials

Primer (for types I and II)	1 pint (for each class and each type)
Primer activator	Quantity specified by manufacturer
Polyurethane prepolymer	1 gallon (for each class and each type)
Catalyst	Quantity specified by manufacturer
Antistatic coating (for type II)	1 quart for each class
Antistatic catalyst (for type II)	Quantity specified by manufacturer
Diluent	1 gallon (for each class and each type)

b. Test panels

Uncoated airfoils (see 4.7.16)	18 (for each class and each type)
Coated void-free laminate panels (see 4.7.18)	5 (2 for type I, classes A and B) (3 for type II, classes A and B)
Uncoated void-free control panel (see 4.7.18)	1
Coated void-free panels (see 4.7.22)	1 (for each class and type)

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The samples shall be plainly identified and forwarded to the qualifying activity or as otherwise directed in the letter of authorization from the qualifying activity (see 6.3). The identification shall include the manufacturer's production code or compound number.

4.3.2 Test report. Qualification samples shall be accompanied by a certified test report showing results of all tests required by this specification except the test for inspection of filled containers.

4.3.2.1 Instruction sheet. The manufacturer shall forward 3 copies of the instruction sheet detailing mixing, thinning, application and curing procedures for his material with all qualification samples submitted for approval. Qualification approval of the manufacturer's coating system shall also constitute approval of the applicable instruction sheets. The instruction sheets shall not be changed in any way without specific approval of the qualifying activity.

4.4 Quality conformance inspection. Quality conformance inspection for acceptance of individual lots shall consist of sampling and tests as specified herein.

4.4.1 Sampling.

4.4.1.1 Lot. A lot shall consist of all coating materials of the same type and class manufactured at one time and offered for delivery at one time.

4.4.1.2 Samples. One gallon samples shall be selected from each lot and subjected to the following tests:

a. Nonvolatile (solids) content (see 4.7).

b. Viscosity (see 4.7).

c. Condition in container (see 4.7.6).

d. Accelerated storage (see 4.7.7).

e. Peel strength (see 4.7.12).

f. Surface resistivity (type II system only) (see 4.7.19).

4.5 Test conditions. Standard laboratory test conditions shall be $24^{\circ} \pm 1^{\circ}C$ ($75^{\circ} \pm 2^{\circ}F$) with a relative humidity of 50 ± 2 percent. All component materials shall be conditioned for at least 24 hours at this temperature and relative humidity before being tested or used in the preparation of test panels. Except as otherwise specified herein, all physical tests on the coating material or test films thereof shall be made under these conditions in an atmosphere that is dust free.

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4.6 Test panels. Unless otherwise specified, test panels shall be flat, glass fiber base laminate conforming to any type and fabric number of MIL-P-25421. Except as otherwise specified, panels shall be 3 inches wide, 8 inches long, and 1/8 inch thick. The glass laminate panels shall be of low void content, dense and representative of high quality plastic laminate structures. They shall be lightly sanded with 320 grit abrasive paper to remove the glossy finish and wiped clean with a solvent such as xylene or methyl isobutyl ketone before applying any primer or coating material.

4.6.1 Coating of panels. Except as otherwise specified herein, test panels shall be coated as follows:

Classes A and B

Type I - 1 to 2 mils of primer and 10 to 12 mils of rain erosion resistant coating.

Classes A and B

Type II - 1 to 2 mils of primer, plus 9 to 11 mils of rain erosion resistant coating, plus 1 to 2 mils of antistatic coating.

4.7 Test methods. Test methods shall be as specified in table II and 4.7.1 through 4.7.22.

Table II. Test methods.

Characteristics	Requirement Reference	Test Method (ASTM)
Nonvolatile (solids) content	Table I	D2369
Flash point	Table I	D93
Weight per gallon, pounds	Table I	D1475
Viscosity, Brookfield	Table I	D2196
Odor	3.5.2	D1296

4.7.1 Toxicological data and formulations. The contractor shall furnish the toxicological data and formulations required to evaluate the safety of the material for the proposed use.

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4.7.2 Urethane-base prepolymers (free diisocyanate content). The free diisocyanate content of class B, types I and II coatings shall be determined in accordance with U. S. Air Force Bulletin 535. The free diisocyanate content of class A, types I and II shall be determined in accordance with the Appendix.

4.7.3 Nonphotochemically reactive solvent. The nonphotochemically reactive volatile content shall be determined by the use of a gas chromatograph or other suitable device in accordance with ASTM D2267.

4.7.4 Mixing. A 1-quart sample of each of the tinted base resins of classes A and B, types I and II coatings shall be vigorously mixed by hand. The complete mixing shall be accomplished in a maximum of 5 minutes. After the mixture appears homogeneous or at the end of the 5-minute period, whichever occurs first, the material shall be allowed to stand for 1 minute then poured slowly into another container. The coating shall be observed during pouring and the residue remaining in the mixing container visually observed for conformance to 3.5.1. When a catalyst is added to the coatings, the mixture shall be agitated on a commercial type paint shaker instead of by hand for a minimum of 5 minutes prior to application.

4.7.5 Color. The amount of black tint contained in the base resin component of the classes A and B, types I and II materials shall be such that as the coatings are applied the surface becomes increasingly darker with each successive coat. When the specified coating thickness has been obtained, the color shall be sufficiently intense to completely hide the surface.

4.7.6 Condition in container. Component materials of each container shall be tested in accordance with FED-STD-141, method 3011.

4.7.7 Accelerated storage. The component materials for classes A and B, types I and II coating systems shall be stored (uncatalyzed) at a temperature of 120°F ± 2°F (49°C ± 1°C) for 4 days. After this storage period, the materials shall be examined for conformance to 3.5.4.

4.7.8 Shelf storage life. The separate components of classes A and B, types I and II coating systems shall be stored in original unopened containers for a period of one year from the date of manufacture at a temperature of 75°F ± 5°F (24°C ± 2°C) and 50 ± 5 percent relative humidity. After this storage period, the coating systems shall be capable of meeting the requirements of this specification.

4.7.9 Pot life. A 1-quart sample of the classes A and B, types I and II coatings shall be mixed as specified in 4.7.3 and stored in closed containers for 4 hours at standard conditions. At the end of the storage period, the coatings shall be visually examined and a viscosity measurement made as specified in 4.7.

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4.7.10 Drying (tack-free) time. Classes A and B, types I and II coatings shall be applied in accordance with the manufacturers instructions to two each test panels for each class and type of coating material as specified in 4.6. At the end of the rated tack free time, (not to exceed 4 hours for the class A coatings or 10 hours for the class B coating), a polyethylene film 1 inch (2.54 cm) wide, 6 inches (15.24 cm) long, and 0.001 inch (0.010 ± 0.005 cm) thick shall be pressed with a 28.3 gram (1-ounce) weight (approximately 12.9 square centimeters) onto each of the coated test panels. The polyethylene film shall then be progressively withdrawn at right angles to the surface of the coating. The time at which there is no evidence of removal of the coating by adherence to the polyethylene film shall be considered the tack-free time.

4.7.11 Curing time. Classes A and B, types I and II coatings shall be applied in accordance with the manufacturers instructions. The class A, types I and II coatings shall be cured for 5 days at 75°F (24°C) and 50 percent relative humidity to determine conformance to 3.5.8. The class B, types I and II coatings shall be cured for 10 days at 75°F (24°C) and 50 percent relative humidity to determine conformance to 3.5.8.

4.7.12 Peel strength. For each class and type coating, three panels as specified in 4.6 shall be coated with primer on one half of one side. Twelve to 14 mils of rain erosion resistant coating is then applied to the entire side of each panel and air-dried at standard conditions as specified in 4.7.11. At the end of the curing period, two 1-inch wide (2.54 cm) strips shall be cut, lengthwise, through the coating to the panel and extended the full length of the panel. A 1-inch (2.54 cm) coating strip over the unprimed area shall be peeled back to the primer and clamped in one jaw of a suitable tension testing machine and the matching end of the test panel clamped in the other jaw to provide a 180-degree pull. The jaw separation rate shall be 2 inches (5 cm) per minute. The results shall be the numerical average of the peak loads. If the coating separates cohesively and does not separate from the panel surface, the peel strength shall be reported as greater than the measured value.

4.7.13 Water resistance. Three coated panels of each class and type coating shall be prepared as specified in 4.6.1 and cured as specified in 4.7.11. The panels shall then be immersed in distilled water for 24 hours at standard conditions. At the end of the 24-hour immersion period, the specimens shall be removed from the water and visually examined for conformance to 3.5.11. The specimens shall then be subjected to the peel strength test of 3.5.9 to determine conformance to 3.5.11.

4.7.14 Aromatic fuel resistance. Three coated panels of each class and type coating shall be prepared as specified in 4.6.1 and cured as specified in 4.7.11. The panels shall then be immersed in hydrocarbon test fluid conforming to type III of TT-S-735 at standard conditions for 1 hour. At the end of the 1-hour period, the specimens shall be removed

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from the fluid and visually examined for conformance to 3.5.11. The specimens shall then be subjected to the peel strength test of 3.5.9 to determine conformance to 3.5.11.

4.7.15 Flexibility. Three 3-inch by 4-inch by 0.020 inch (7.62 cm by 10.16 cm by .050 cm) 2024-T3 aluminum test panels anodized according to type II of MIL-A-8625 shall be coated with 12 to 14 mils of the coating systems and cured as specified in 4.7.11. The coated panels shall then be conditioned for 1 hour at -65°F (-54°C) and while at that temperature bent 180 degrees over a 1/8-inch (0.317 cm) conical mandrel in accordance with method 6223 of FED-STD-141. The panels shall be visually examined immediately after bending for evidence of failure, then conditioned at 75°F ± 2°F (24°C), and again examined for conformance to 3.5.10.

4.7.16 Rain erosion resistance.

4.7.16.1 Test panels. Eighteen airfoil shaped panels shall be used for testing each class and type coating. The specimens shall be in accordance with figure 1 and shall be of low void content, dense and representative of high quality plastic laminate structures. A 12 to 14 mils thick coating shall be applied to the air-foil shapes in accordance with 4.6.1, cured as specified in 4.7.11 and tested as follows: six of the airfoil shapes shall be tested immediately, six panels shall be subjected to outdoor weathering as specified in 4.7.20; and six panels shall be aged for 24 hours in a circulating air-oven at 225°F ± 5°F (107° ± 2°C).

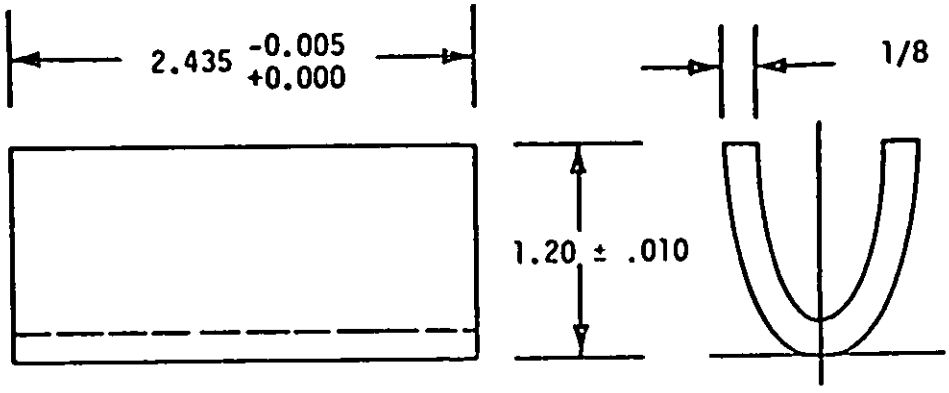
4.7.16.2 Test procedure. Six coated airfoil shapes, exposed as specified in 4.7.16.1, shall be mounted on a suitable diameter 2-bladed propeller (0.0025 chord) in such a manner that 1 end of each panel extends to near the tip of each 0° pitch propeller blade. The propeller should be mounted horizontally and driven by a variable speed motor designed to permit testing at the center of the specimens at selected speeds. A suitable water ring, mounted above the rotating blade, shall be used to simulate a natural rainfall of 1 inch per hour and a 2 millimeter droplet size. The test shall be run at 500 miles per hour and shall conform to table III. Failure is determined as the average time at which six specimens have eroded through to the substrate.

4.7.17 Sequence of testing. The sequence of testing the panels for classes A and B, types I and II coatings shall be as follows:

a. All panels shall be cured as specified in 4.7.11.

b. The uncoated control panel and 2 coated panels shall be tested as specified in 4.7.18 and 4.7.19 immediately after curing.

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0.0025 AIRFOIL - 4 INCH CHORD
DISTANCE FROM LEADING EDGE

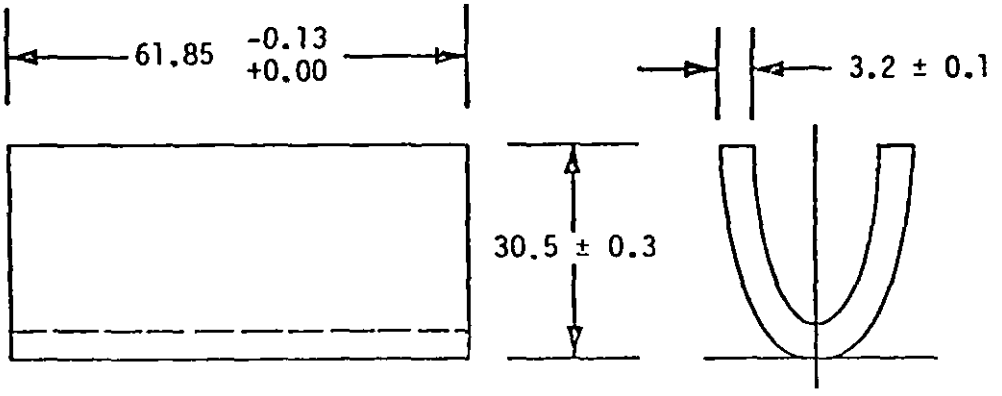
% CHORD	ORDINATE (Y)	ABSCISSA (X)
0.00	0.00	0.000
1.25	0.05	0.158
2.50	0.10	0.218
5.00	0.20	0.296
7.50	0.30	0.350
10.00	0.40	0.390
15.00	0.60	0.446
20.00	0.80	0.478
25.00	1.00	0.485
30.00	1.20	0.500

OUTER DIMENSIONS OF 1/8 INCH SPECIMEN

DIMENSIONS IN INCHES

FIGURE 1. Rain erosion test specimen.

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0.064 AIRFOIL - 100 mm CHORD
DISTANCE FROM LEADING EDGE

% CHORD	ORDINATE (Y)	ABSCISSA (X)
0.00	0.00	0.000
1.25	1.27	4.013
2.50	2.54	5.537
5.00	5.08	7.518
7.50	7.62	8.890
10.00	10.16	9.906
15.00	15.24	11.33
20.00	20.32	12.14
25.00	25.40	12.32
30.00	30.48	12.70

OUTER DIMENSIONS OF 3 mm SPECIMEN

DIMENSIONS IN MILLIMETERS

FIGURE 1(SI). Rain erosion test specimen.

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c. The panels specified in b. above shall be exposed to a temperature of 100°F ± 5°F (38°C ± 2°C) and a relative humidity of 95 percent for 7 days then tested as specified in 4.7.18. Additional testing as specified in 4.7.19 shall be conducted on the type II coated panels.

d. The control panel and 2 coated panels shall be subjected to outdoor weathering as specified in 4.7.20. The 2 panels shall then be tested as specified in 4.7.18 and for type II coatings additional testing as specified in 4.7.19.

e. One each panel coated with the type II coatings shall be maintained at a temperature of -65°F (-54°C) for 4 hours and tested as specified in 4.7.19. The same panels shall then be aged in a circulating air-oven for 24 hours at 225°F ± 5°F (107°C ± 2°C) and again tested as specified in 4.7.19.

4.7.18 Electrical transmission.

4.7.18.1 Test panels. Except for size, 6 test panels as specified in 4.6 and coated on 1 side only as specified in 4.6.1, shall be tested to conform to table III. The panels shall be 24 inches by 24 inches by 0.050 to 0.055 inch thick (61 cm by 61 cm by 0.127 cm to 0.140 cm). Two of the panels are for type I coating, 3 for type II and 1 panel shall remain uncoated for use as a control panel.

4.7.18.2 Transmission test equipment. Test equipment performance requirements for flat panel samples shall meet the transmission efficiency test of MIL-R-7705.

4.7.18.3 Test procedure. The electrical transmission test procedure for flat panel samples shall be in accordance with MIL-R-7705 and as specified herein.

4.7.18.4 Microwave power frequency. The cured panels shall be subjected to one way microwave power measurements at incidence angles from -30 to +30 degrees, using parallel and perpendicular polarization of the incident energy. The microwave power transmission test shall be conducted at a frequency of 9.375 gigahertz (GHZ).

4.7.18.5 Sample test plane. The test sample shall be clamped perpendicular to and at the approximate midpoint between the horns. The center of the sample will be coincident with the centerline of the horns.

4.7.18.6 Sample supporting structure. The sample supporting structure for holding the test sample in a perpendicular position between the horns shall be a wood clamp extending across the entire length of the

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Table III. Rain-erosion resistance, electrical transmission and surface Resistivity (Types I and II).

Property	After drying & normal cure (See 3.5.8)	After normal cure & aging 7 days at 95% RH & 100°±2°F (38°±2°C)	After normal cure & outdoor weathering	After normal cure & aging 24 hours at 225°±5°F (107°±2°C)	Exposure at -65°F (-54°C) for 6 hours
Rain erosion resistance (Erosion through 12 to 14 mils at 500 mph and 1 in/hr rainfall, time in minutes, minimum)					
Class A, Type I	180		180	180	
Class A, Type II	150		150	150	
Class B, Type I	120		120	120	
Class B, Type II	100		100	100	
Electrical transmission (Two coated panels required for each coating, percent, minimum)					
Classes A & B, Type I 1/	95	90	95		
Classes A & B, Type II 1/	90	85	90		
One uncoated control panel	87	84	87		
Surface resistivity (in megohms per square)					
Classes A & B, Type II only	0.5 to 15	0.5 to 15	0.5 to 15	0.5 to 15	0.5 to 15

1/ The percentage of electrical transmission of a panel coated with either a type I or type II coating is equal to 100 times the electrical transmission of the coated panel divided by the electrical transmission of the uncoated control panel.

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bottom edge of the sample. The clamp shall not cover more than a one-inch border of the panel edge. The wood clamp shall be covered with absorbing material if it causes interference.

4.7.18.7 Angular displacement turn table. The test sample shall be mounted on a turn table with provisions for moving the panel through 0 to 70 degrees and for lateral movement of a minimum of 1 inch (2.54 cm) reproducibly. Readings shall be taken in maximum increments of 10 degrees and each 0.1 inch (0.25 cm) setting for angles up to 30 degrees.

4.7.18.8 Test data and computation. The test data shall be converted to and reported as percent transmission using the equation listed below:

$$\frac{T^2 \text{ sample}}{T^2 \text{ blank}} \times 100 = \% \text{ transmission}$$

Where T^2 sample = power transmission of coated panel
T^2 blank = power transmission of uncoated panel.

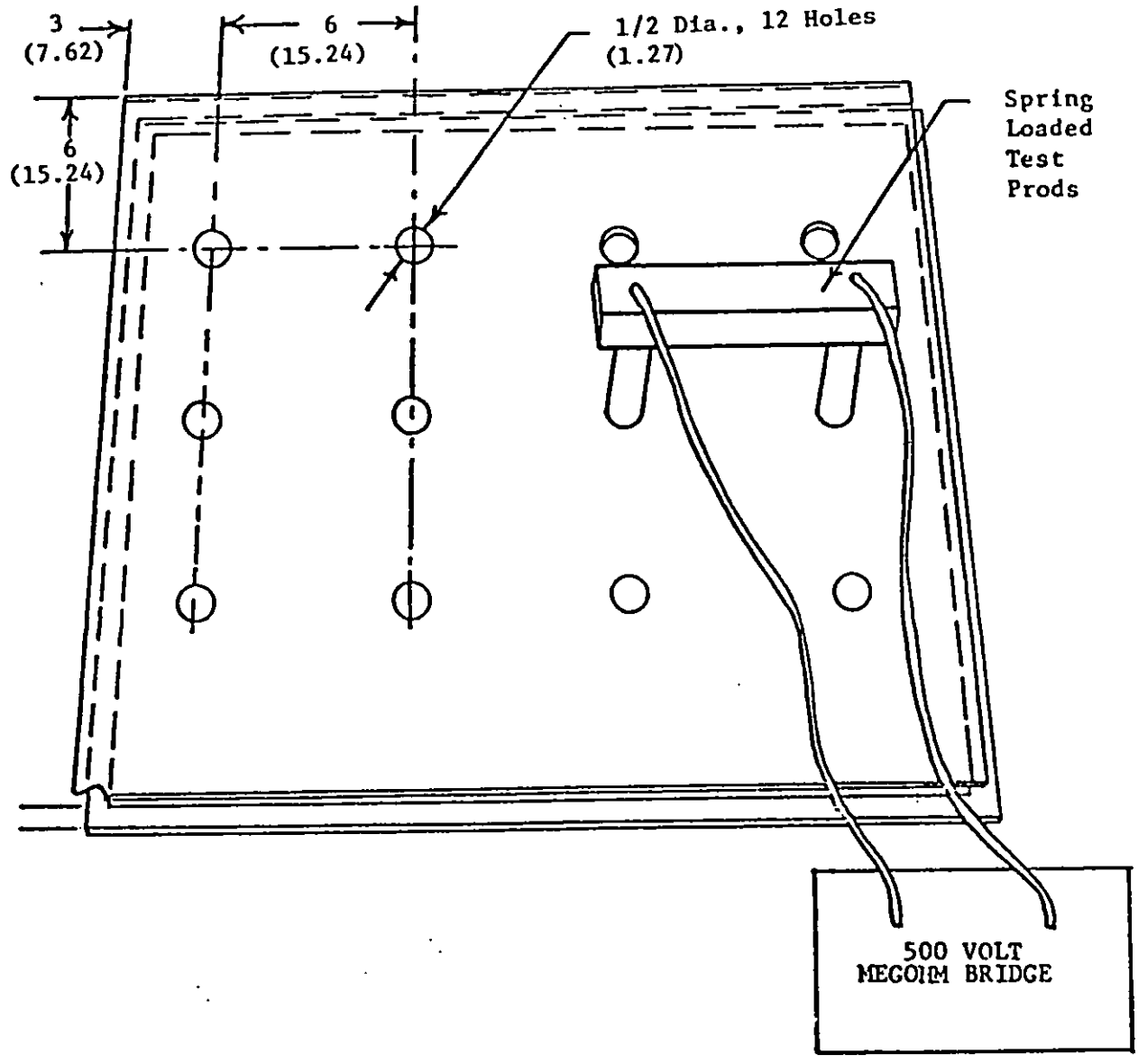
4.7.19 Surface resistivity (type II only). Tests for surface resistivity shall be in accordance with table III.

4.7.19.1 Equipment. The equipment used for the surface resistivity test shall be as specified in figures 2 and 3; two 3/8 inch (1.20 cm) wire spring loaded electrodes having a pressure capacity of 3 to 5 pounds (1.36 to 2.27 kilograms (kg)) shall be as specified in figure 3. Use a 500-volt megohmeter to measure accurately the range of 0 to 1000 megohms. The acrylic plastic panel shall conform to MIL-P-5425 and shall have a pattern of 12 holes, 1/2 inch (1.27 cm) in diameter, drilled in three rows of 4 holes spaced 6 inches (15.24 cm) apart, center to center. The first hole shall start at a point 3 inches (7.62 cm) from the side edge and 6 inches (15.24 cm) from the top edge. This template shall be used as a means of spacing the electrodes at equal distance for the resistivity readings.

4.7.19.2 Test panels. The panels shall be as specified in 4.6 except the size shall be 24 inches by 24 inches by 0.50 to 0.055 inch (61 cm by 61 cm by 0.127 cm to 0.140 cm) thick. The panels shall be coated as specified in 4.6.1 and cured as specified in 4.7.11.

4.7.19.3 Measurement procedure. The template shall be placed over an individual panel which has been exposed to the conditions as specified in 4.7.17. The two electrodes with their wire leads connected to the 500-volt megohmeter shall be placed to coincide with two holes of the template. All readings shall be taken with a uniform pressure of 3 to 5 pounds (1.36 to 2.27 kg) on the electrodes. Seventeen different readings shall be taken between holes of the template and averaged. After 1 hour, a repeat 17 readings shall be taken and averaged.

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DIMENSIONS IN INCHES (CENTIMETERS)

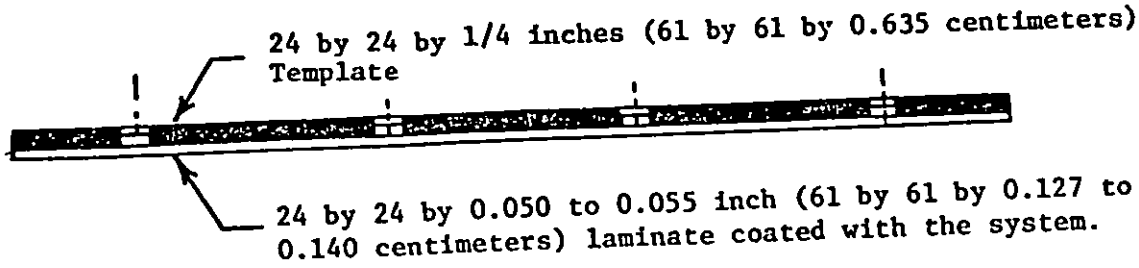
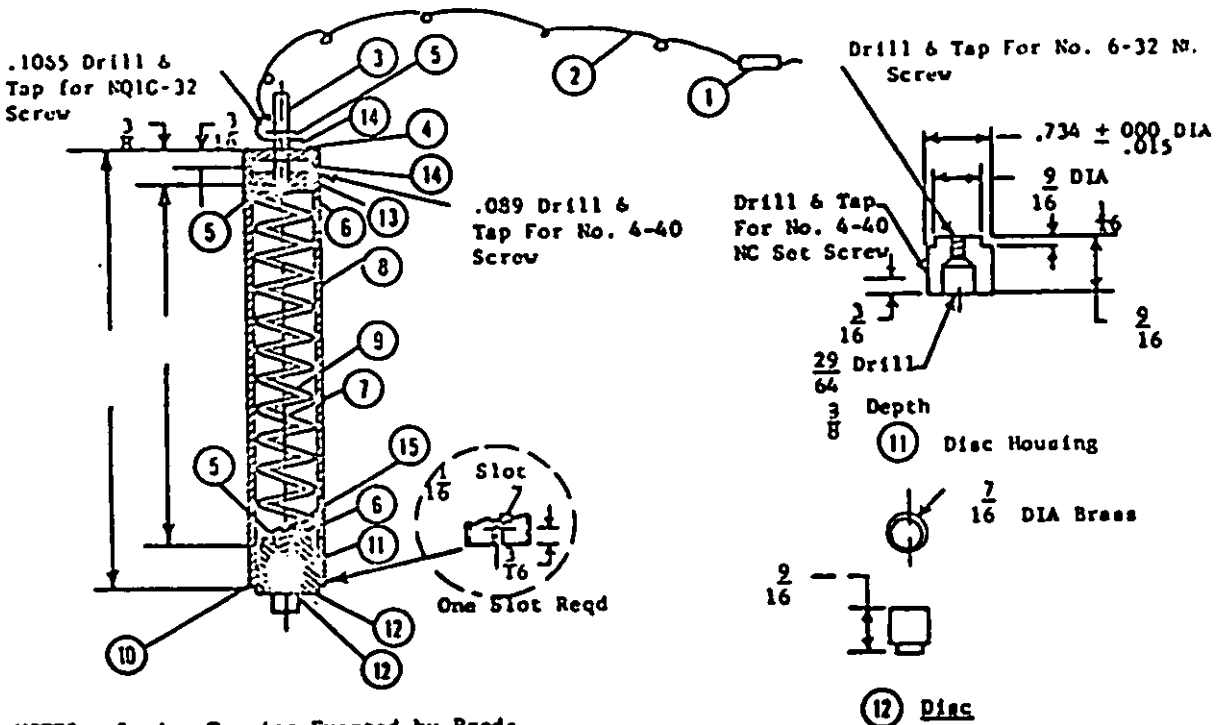


FIGURE 2. Apparatus used for surface resistivity.

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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
10	2	Socket Head Set Screw	No. 4-40 NC X1/8 Long
11	2	Disc Housing	Brass - 3/4 Rod Stock X9/16 long
12	2	Brass Disc	7/16 DIA X 9/16
13	2	Phenolic Rod	3/4 DIA X 9/16 Long
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 test Prods

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4.7.20 Weather resistance. The panels shall be as specified in 4.6 except the size shall be 24 inches by 24 inches by 0.050 to 0.055 (61 cm by 61 cm by 0.127 cm to 0.140 cm) thick. Panels shall be exposed to outdoor weathering for 6 months and tested in accordance with ASTM D1014 at an approximate 45 degree south latitude.

4.7.21 Pot life. The tinted base resin of classes A and B types I and II and the type II antistatic coatings shall be mixed with the catalyst at standard conditions. The coatings shall have a minimum usable pot life of 4 hours when stored in a closed container. At the end of the 4-hour storage period, the coatings shall conform to 3.5.6.

4.7.22 Strippability. Four panels, one for each class and type, shall be as specified in 4.6 except the size shall be 24 inches by 24 inches by 0.050 to 0.055 inch (61 cm by 61 cm by 0.127 cm to 0.140 cm) thick. Panels shall be tested in the sequence specified in 4.7.17. The stripper used shall conform to MIL-R-25134. Apply the stripper to the panels by brushing. After the stripper has been in contact with the coating system for 15 minutes, remove the residues with a gentle stream of tap water. Inspect the panel for complete removal of the coatings, including primer, to determine conformance to 3.5.16.

4.7.23 Packaging, packing and marking. The coating shall be inspected for compliance with section 5.

5. PACKAGING

5.1 Preservation-packaging. Preservation-packaging shall be level A or C, as specified (see 6.2).

5.1.1 Packaging. The coatings shall be packaged in 1-gallon or 5-gallon (3.8 liters or 19.0 liters) containers. The components of the classes A and B, type I coatings shall be packaged in separate companion containers; the primer in one and the primer activator in the other; the rain erosion resistant coating in one container and the catalyst in the other. The quantity of rain erosion coating furnished shall be 1 full gallon (3.8 liters) plus catalyst or 1 full 5-gallon (19.0 liters) container plus catalyst. The quantity of primer shall be sufficient to primer coat an area equivalent to the area coverage of the base coating. The primer shall be furnished in completely filled containers. The components of the classes A and B, type II coatings shall be packaged as specified for type I and additional separate companion containers for the antistatic coating and catalyst. The quantity of antistatic coating shall be 1 full quart (0.95 liters) plus catalyst for the 1-gallon (3.8 liters) container and 1 full gallon (3.8 liters) of antistatic coating plus catalyst for the 5 gallon (19.0 liters) container.

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5.2 Packing. Packing shall be level A, B, or C as specified (see 6.2). Packing for classes A and B, type I coatings shall be 1 container each of primer, primer activator, rain erosion resistant coating, catalyst and thinner or solvent. Packing for classes A and B, type II coatings shall be as specified for type I and additional containers of anti-static coating, catalyst for antistatic coating and thinner. The thinner for the 1-gallon size, classes A and B, types I and II coatings shall be packed in the same unit.

5.3 Marking. Each container of the coatings shall show the following precautionary marking: DO NOT STORE AT TEMPERATURES ABOVE 100°F. Each 1-gallon can and 5-gallon container shall be labeled as specified in 5.3.1.

5.3.1 Labeling. The following labeling in compliance with the provisions of the Federal Hazardous Substances Labeling Act shall appear on all containers:

CAUTION: THIS COATING MATERIAL IS FLAMMABLE AND SHALL NOT BE USED IN CONFINED AREAS WHERE THERE ARE OPEN FLAMES, ARCING EQUIPMENT, HOT SURFACES OR WHERE SMOKING IS PERMITTED.

USE ONLY WITH ADEQUATE VENTILATION.

AVOID PROLONGED OR REPEATED BREATHING OF VAPOR.

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

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES: FOR EYES, GET MEDICAL ATTENTION.

5.4 Mixing and application instructions. The contractor shall include mixing and application instructions with each package of the coatings.

6. NOTES

6.1 Intended use. Classes A and B, types I and II coatings are intended for exterior laminated plastic parts of high-speed aircraft and missiles for protection from rain erosion while in flight. The classes A and B, type II coatings will also discharge and dissipate static electricity, alleviating radio and radar interferences.

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6.2 Ordering data. Procurement documents should specify the following:

a. Title, number and date of this specification.

b. Class and type.

c. Type and size of container.

d. Selection of applicable levels of packaging and packing (see section 5).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, 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. The activity responsible for the Qualified Products List is the Air Force Wright Aeronautical Laboratories, ATTN: AFWAL/MLSA, Wright-Patterson Air Force Base, Ohio 45433 and information pertaining to qualification of products may be obtained from that activity.

6.4 Class A polyurethane prepolymers which contain cycloaliphatic isocyanates are not dependent on high humidity conditions to accelerate curing of the coating material. Therefore, they can be applied over a wide temperature range as recommended by the manufacturer and do not require high humidity to effect curing of the coating. Class B polyurethane prepolymers contain aromatic isocyanates and require high humidity to accelerate curing of the coatings. Therefore, the class B coatings must be catalyzed in accordance with the manufacturers instructions for the temperature and humidity conditions existing at the time the coatings are being applied.

6.5 Nonphotochemically reactive solvents. The classes A and B, types I and II composition G coatings should be used in areas where AIR POLLUTION REGULATIONS control the emission of solvents into the atmosphere.

Custodians:
Air Force - 11
Army - ME
Navy - AS

Preparing activity:
Air Force - 11

(Project No. 8010-0940)

Review activities:
Air Force - 99
DLA - IS
Navy - SH

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APPENDIX

DETERMINATION OF FREE METHYLENE
BIS (4-CYCLOHEXYLENE ISOCYANATE) MONOMER
BY GEL PERMEATION CHROMATOGRAPHY

10. SCOPE

10.1 Scope. Gel Permeation Chromatography (GPC) is used to determine the amount of unreacted Methylene bis (4-Cyclohexylene Isocyanate) in prepolymer formulations.

20. PRINCIPLE

1 cc of 1 percent solution of sample in tetrahydrofuran (THF) is injected into the GPC instrument. The area under the peak due to the monomer measured and this value is converted to concentration of monomer with the aid of a calibration curve.

30. EQUIPMENT AND REAGENTS

30.1 Gel Permeation Chromatograph, Water Model 100 or equivalent.

30.2 Styragel packed columns, type B (Waters) 3/8 inch by 4 feet.

1	300° A pore size
1	700° A pore size
1	1000° A pore size
1	2000° -5000° A pore size
1	Reference Column

30.3 Differential Refractometer Detector.

30.4 Fisher T-397 Tetrahydrofuran.

30.5 Graduated Cylinders, 100 ml.

30.6 Centrifuge tubes, 100 ml., conical tips.

30.7 Analytical balance.

30.8 Centrifuge capable of handling 100 ml. tubes.

30.9 Beakers 150 ml.

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40. PROCEDURE

Instrumental Conditions

Flow rate thru sample columns	1 ml. per minute
Chart Speed	10 mins. per inch
Oven Temperature	30°C
Refractometer Temperature	40°C
Span Selector	4X

Standardization

40.1 Prepare five standard samples by spiking a sample of Prepolymer (having a low concentration of monomer) with weighed amounts of monomer to give a series with 0 percent to 10 percent monomer. Run them through the GPC instruments.

40.2 Measure the areas under the peaks due to monomer.

40.3 Plot the areas vs. percent monomer added. The intercept will be the percent monomer in the original coating sample, and when subtracted from the other standards, should result in a calibration curve which intercepts through the origin. (See figure 1.)

ANALYTICAL PROCEDURE

40.4 Weigh accurately about 0.80 grams of sample and dissolve in 60 ml. of THF. Add THF in an amount to give a 1 percent (weight/volume) concentration of sample.

40.5 Transfer to centrifuge tube and cover top with aluminum foil to prevent loss of THF. Centrifuge for 15-20 minutes to precipitate TiO_2 pigment. (NOTE: Unpigmented samples need not be centrifuged.)

40.6 When solution is clear of pigment, inject in GPC instrument and record curve.

50. CALCULATIONS

Measure area under peak due to monomer. Interpolate percent free monomer from calibration curve.

Reference: N. D. Kornbau, D. C. Ziegler, ANAL. CHEM. 42, 1291 (1970).

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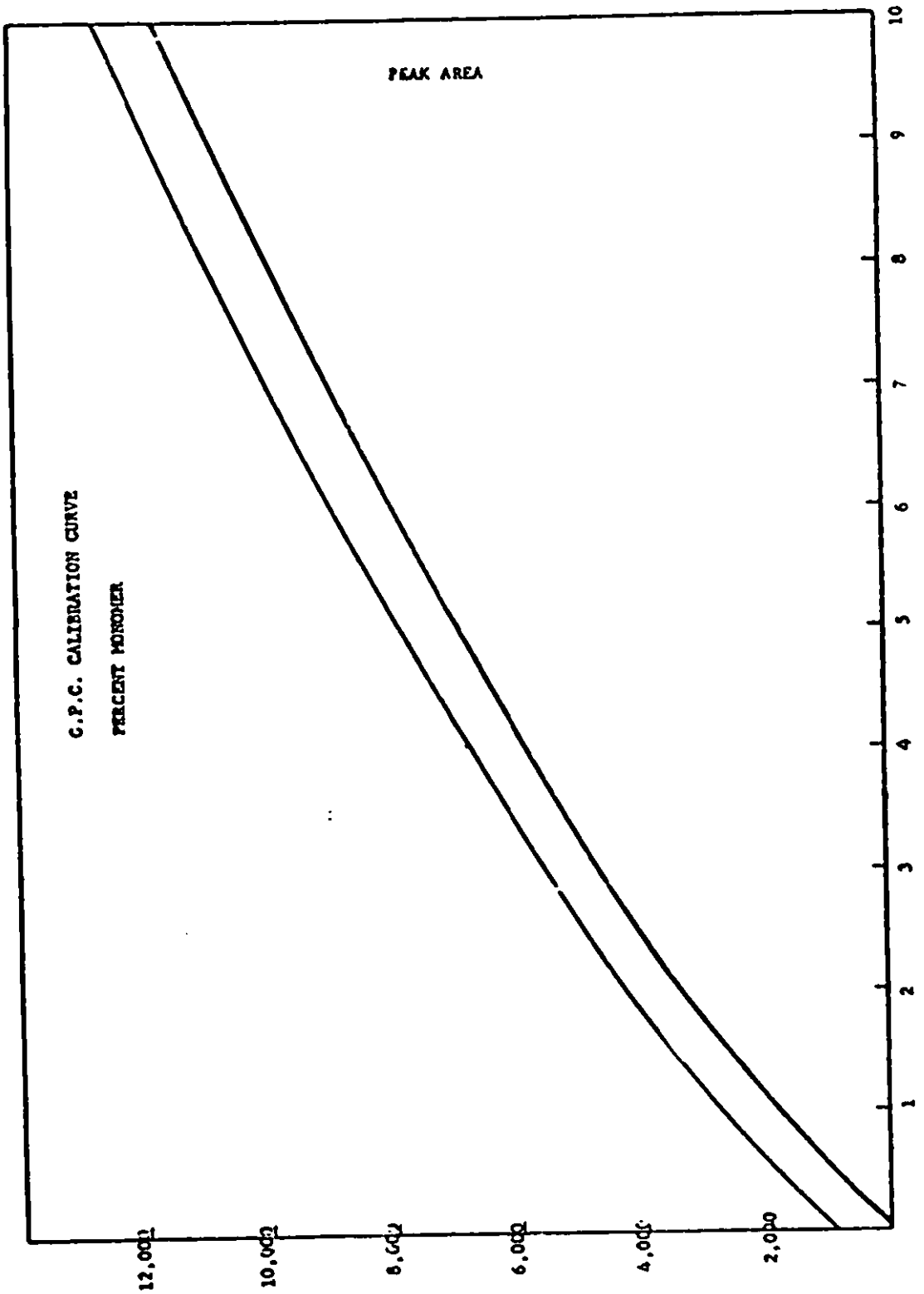


Figure 1

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ VENDOR ☐ USER ☐ MANUFACTURER ☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)

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