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30 SEPTEMBER 1994
SUPERSEDING
MIL-P-23377F
5 MAY 1989

PERFORMANCE SPECIFICATION

PRIMER COATINGS: EPOXY, HIGH-SOLIDS

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 types (see 1.2.1) and two classes (see 1.2.2) of low volatile organic compound (VOC) content (see 3.4.2), solvent-borne, epoxy primer coatings that are corrosion inhibiting, and chemical and solvent resistant. The maximum volatile organic compound (VOC) content of the admixed primer coatings is 340 grams per liter (g/l) (2.8 pounds per gallon (lbs/gal)). Unless a specific type and/or class is referenced in the contract or purchase order, MIL-P-23377G, Type I, Class C is the default. Class N may not be substituted for Class C, unless authorization for its use is given by the procuring activity or engineering authority for the system or item to which the primer coating is to be applied. See 6.13 for the cross-reference of classes to previous revisions of this specification. See 6.1 for the intended use of these materials.

1.2 Classification. The primer coatings shall be of the following types and classes, as specified (see 6.2):

1.2.1 Type. The primer coatings consist of the following types:

Type I - Standard pigments
Type II - Low infrared reflective pigments

1.2.2 Class. The primer coatings consist of the following classes:

Class C - Strontium chromate based corrosion inhibitors
Class N - Non-chromate based corrosion inhibitors

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Systems Engineering Department, Code 4.1.4.2B120-3, Naval Air Warfare Center Aircraft Division, Highway 547, Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1476) appearing at the end of this document or by letter.

AMSC N/A

FSC 8010

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1.3 Part numbers. Part numbers, for cataloging purposes, may be assigned in accordance with 6.7.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

QQ-A-250/4 - Aluminum Alloy 2024, Plate and Sheet
QQ-A-250/5 - Aluminum Alloy Alclad 2024, Plate and Sheet
QQ-A-250/12 - Aluminum Alloy 7075, Plate and Sheet
PPP-P-1892 - Paint, Varnish, Lacquer and Related Materials: Packaging, Packing and Marking

MILITARY

MIL-C-5541 - Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-C-8514 - Coating Compound, Metal Pretreatment, Resin-Acid
MIL-A-8625 - Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-L-23699 - Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code Number O-156
MIL-C-38334 - Corrosion Removing Compound, Prepaint, for Aircraft Aluminum Surfaces
MIL-R-81294 - Remover, Paint, Epoxy, Polysulfide and Polyurethane Systems
MIL-T-81772 - Thinner, Aircraft Coating
MIL-H-83282 - Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft, Metric, NATO Code Number H-537
MIL-C-83286 - Coating, Urethane, Aliphatic Isocyanate, for Aerospace Applications
MIL-C-85285 - Coating: Polyurethane, High-Solids

STANDARDS

FEDERAL

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

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FED-STD-313 - Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

FED-STD-595 - Colors Used in Government Procurement

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes

(Unless otherwise indicated, copies of federal and military specifications and standards are available from the Defense Printing Service, Standardization Documents Order Desk, Attn: DODSSP - Customer Service, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents. The following other Government documents and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

CODE OF FEDERAL REGULATIONS (CFR)

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

29 CFR 1910.1200 - Occupational Safety and Health Standards - Hazard Communications

DEPARTMENT OF TRANSPORTATION (DOT)

49 CFR 171-178 - Subchapter C - Hazardous Materials Regulations

(Application of copies of the Code of Federal Regulations (CFR) should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z129.1 - American National Standard for the Precautionary Labeling of Hazardous Industrial Chemicals

(Application for copies should be addressed to the American National Standards Institute, Inc., 11 West 42nd Street, New York, NY 10036.)

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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM-B117 - Standard Test Method of Salt Spray (Fog) Testing
- ASTM-D1200 - Standard Test Method for Viscosity of Paints, Varnishes and Lacquers by Ford Viscosity Cup
- ASTM-D1210 - Standard Test Method for Fineness of Dispersion of Pigment - Vehicle Systems
- ASTM-D1296 - Standard Test Method for Odor of Volatile Solvents and Diluents
- ASTM-D1640 - Standard Test Method for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
- ASTM-D1649 - Standard Specification for Strontium Chromate Pigment
- ASTM-D2803 - Standard Test Method for Filiform Corrosion Resistance of Organic Coatings on Metal
- 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-E275 - Standard Practice for Describing and Measuring Performance of Ultraviolet, Visible, and Near-Infrared Spectrophotometers

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

(Nongovernment standards and other publications are normally available from the organizations which prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. 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 coating furnished under this specification shall be products which are authorized by the qualification activity for listing on the applicable Qualified Products List (QPL) at the time set for award of bids (see 4.3 and 6.4). Any change in the formulation of a qualified product will necessitate its requalification. The material supplied under contract shall be identical, within manufacturing tolerances, to the product receiving qualification.

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3.2 Material. Materials used to manufacture coatings supplied under this specification shall be of such a quality as to produce coatings conforming to the requirements of this specification.

3.3 Toxicity. The manufacturer shall certify (see 6.3) that the coatings supplied under this specification have no adverse effect on the health of personnel when used for its intended purpose and with the precautions listed in 5.2.1. A Material Safety Data Sheet (MSDS) shall be prepared and submitted in accordance with FED-STD-313. The MSDS shall also meet the requirements of 29 CFR 1910.1200 (see 6.6). Questions pertinent to the effect(s) of these coatings on the health of personnel using them shall be referred by the procuring activity to the appropriate medical service, who will act as its adviser.

3.4 Composition. The coating shall consist of two components, as follows:

Component A - epoxy resin and solvents

Component B - polyamide and/or amine resin and solvents

Component B shall act as the curing agent for Component A. The components shall be packaged separately and furnished as a kit (see 5.1). Pigments may be included with either component. When the components are mixed in the proportions specified by the manufacturer, a product meeting the requirements of this specification shall result. Chlorinated solvents are prohibited from the formulation of this coating. When tested in accordance with ASTM D3335 (see 4.6 and Table II), no component of the coating shall contain cadmium, cadmium compounds, or more than 0.06 percent by weight of lead metal or lead compounds. Class N primer coating shall not contain chromium (see 3.4.1.2).

3.4.1 Pigments.

3.4.1.1 Class C. The pigment portion of the Class C primer coating shall contain: strontium chromate (as the corrosion inhibitor, which shall conform to ASTM D1649); siliceous extenders; and other pigments, as required.

3.4.1.2 Class N. The pigment portion of the Class N primer coating shall contain: non-chromate corrosion inhibitors; siliceous extenders; and other pigments, as required. When tested in accordance with ASTM D3718 (see 4.6 and table II), the Class N primer coating shall not contain chromium.

3.4.2 Volatile organic compound (VOC) content. The maximum VOC content of the primer coating at application shall be 340 g/l (2.8 lbs/gal), when tested in accordance with ASTM D3960 (see 4.6 and Table II). The resistivity of the solvents shall be suitable for electrostatic spray application.

3.4.2.1 Thinner compatibility. The admixed primer coating shall be compatible with thinner conforming to MIL-T-81772, Type II (see 6.12).

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3.5 Physical properties - individual components.

3.5.1 Fineness of grind. The fineness of grind of the pigmented component(s) shall be a minimum of 5 on the Hegman scale when tested in accordance with ASTM D1210 (see 4.6 and Table II).

3.5.2 Condition in container. Components A and B, after standing without agitation for a minimum of 14 days at room temperature, in accordance with 4.6.1, shall be capable of being mixed by hand by vigorously stirring with a paddle and, within 5 minutes, shall be smooth, homogeneous, and pourable. The material shall be free of grit, seeds, lumps, abnormal thickening or livering, and shall not exhibit pigment floatation or excessive settling that cannot be reincorporated to a smooth, homogeneous state by mixing with a hand paddle. In addition, the containers shall exhibit no deformation due to internal pressure, when examined in accordance with 4.4.3.2.

3.5.3 Storage stability. The coating components, as packaged by the manufacturer, shall meet all requirements specified herein after storage for a minimum of one year from the date of manufacture at a daily ambient air temperature of 1.7° to 46°C (35° to 115°F).

3.5.4 Accelerated storage stability. The primer coating, as packaged by the manufacturer, shall meet all requirements specified herein after storage for 14 days at 60° ± 3°C (140° ± 5°F), when tested in accordance with 4.6.2.

3.6 Physical properties - admixed components.

3.6.1 Color.

3.6.1.1 Type I. The color of the admixed Type I primer coating shall be the natural color of the corrosion inhibiting pigments used, with the exception that tinting to a darker shade is permitted to improve hiding power.

3.6.1.2 Type II. The color of the admixed Type II primer coating shall be dark green.

3.6.2 Odor. The odor of the admixed coating, wet or dry, shall be characteristic of the solvents used and shall not be obnoxious, when tested in accordance with ASTM D1296 (see 4.6 and Table II).

3.6.3 Viscosity. Immediately after mixing Components A and B, the maximum viscosity of the unthinned, admixed primer coating shall be 40 seconds through a #4 Ford Cup, when tested in accordance with ASTM D1200 (see 4.6 and Table II).

3.6.4 Pot life. After storage at room temperature (see 4.6) for 4 hours, the maximum viscosity of the unthinned primer coating from 3.6.3 shall be 70 seconds through a #4 Ford Cup, when tested in accordance with ASTM D1200 (see 4.6 and Table II).

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3.7 Physical properties - film.

3.7.1 Surface appearance. The admixed primer coating shall not sag, run, or streak, and shall dry to a smooth, uniform surface free from grit, seeds, craters, blisters, and other irregularities (see 3.9.2).

3.7.2 Drying time. The admixed primer coating, applied to "A" test panels (see 4.5) and tested in accordance with ASTM D1640 (see 4.6 and Table II), shall be tack-free within 5 hours and dry-hard within 8 hours.

3.7.3 Lifting. The admixed primer coating, applied to "A" test panels (see 4.5) and topcoated after the primer coating has air-dried for 5 hours, shall exhibit no lifting or other film irregularity, when tested in accordance with 4.6.10.3.

3.7.4 Adhesion. The primer coating, applied to "C" test panels (see 4.5), shall not peel away from the substrate after immersion in water for 24 hours, when tested in accordance with FED-STD-141, Method 6301 (see 4.6 and Table II).

3.7.5 Flexibility. The primer coating, applied to "B" test panels (see 4.5), shall exhibit a minimum impact elongation of 10 percent when tested in accordance with 4.6.3.

3.7.6 Strippability. The primer coating, applied to "A" test panels (see 4.5), shall have a minimum of 90 percent of the primer coating stripped within 60 minutes at room temperature (see 4.6) with remover conforming to MIL-R-81294, Type I, when tested in accordance with 4.6.4.

3.7.7 Infrared reflectance (Type II primer coating only). The Type II primer coating, applied to "A" test panels (see 4.5), shall have a maximum total reflectance (specular and diffuse) of 10 percent throughout the range of 450 to 2700 nanometers (nm), when tested in accordance with 4.6.5.

3.8 Resistance properties.

3.8.1 Water resistance. The topcoated primer coating, applied to "A" test panels (see 4.5), shall withstand immersion for 4 days in distilled water maintained at $49^\circ \pm 3^\circ\text{C}$ ($120^\circ \pm 5^\circ\text{F}$) without exhibiting any softening, wrinkling, blistering, or other deficiency when tested in accordance with 4.6.6.

NOTE: Some strontium chromate pigments may contain soluble impurities that cause blistering in the water resistance test.

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3.8.2 Corrosion resistance.

3.8.2.1 Salt spray.

3.8.2.1.1 Aluminum test panel. The primer coating, applied to "A" test panels (see 4.5), shall exhibit no blistering, lifting of the coating system, or substrate corrosion after exposure to 5 percent salt spray for 2000 hours when tested in accordance with 4.6.7.1.1.

3.8.2.1.2 Aluminum/graphite-epoxy test panel. The primer coating, applied to the aluminum/graphite-epoxy test panel (see 4.6.7.1.2 and figure 1) shall exhibit no pitting greater than 0.039 inch (in.) (1.0 millimeter (mm)) after exposure to 5 percent salt spray for 500 hours, when tested in accordance with 4.6.7.1.2.

3.8.2.2 Filiform. The topcoated primer coating, applied to "D" test panels (see 4.5), shall exhibit no filiform corrosion extending beyond 1/4 in. (6.4 mm) from the scribe when exposed to 12 normal (N) hydrochloric acid (HCl) for one hour and then placed in a humidity cabinet maintained at $40^\circ \pm 1.7^\circ\text{C}$ ($104^\circ \pm 3^\circ\text{F}$) and relative humidity (RH) of $80 \pm 5\%$ for 1000 hours, in accordance with 4.6.7.2. A majority of the filaments shall be less than 1/8 in. (3.2 mm) in length.

3.8.3 Solvent resistance (cure). The primer coating, applied to "A" test panels (see 4.5), shall withstand repeated (50 passes) rubbing with a terrycloth rag soaked in methyl ethyl ketone (MEK) solvent without removal when tested in accordance with 4.6.8. Rubbing through to bare substrate constitutes failure of the primer coating to cure properly.

3.8.4 Fluid resistance. The primer coating, applied to "A" test panels (see 4.5), shall exhibit no softening, blistering, loss of adhesion or other film defect(s) after immersion for 24 hours, in accordance with 4.6.9, in the following:

- a. Lubricating oil conforming to MIL-L-23699, maintained at $121^\circ \pm 3^\circ\text{C}$ ($250^\circ \pm 5^\circ\text{F}$);
- b. Hydraulic fluid conforming to MIL-H-83282, maintained at $65.5^\circ \pm 3^\circ\text{C}$ ($150^\circ \pm 5^\circ\text{F}$).

Discoloration of the coating is acceptable and shall not indicate failure.

3.9 Working properties.

3.9.1 Mixing and dilution. When admixed in the volume mixing ratio specified by the manufacturer, all components of the primer coating, including thinner, if required (see 6.12), shall blend homogeneously when commingled with a mechanical mixer (see 4.6.10.1). Within one hour of mixing, the admixed coating shall not separate into visually distinct layers.

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3.9.2 Application. The admixed primer coating shall be capable of being applied by conventional, airless, electrostatic, and HVLP (high volume, low pressure) spray equipment. When tested in accordance with 4.6.10.2, application shall yield a smooth, uniform film with no runs or sags at a dry-film thickness of 0.6 to 0.9 mils (15 to 23 microns (μ m)).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facility 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 ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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 inspection shall consist of all requirements and tests specified in section 3.

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4.3.1 Qualification samples. Qualification test samples shall consist of a minimum of one quart of each component of the primer coating. The material shall be furnished in type of containers to be used in filling contract orders. Samples shall be identified as follows and forwarded to the laboratory designated in the letter of authorization (see 6.4).

- Qualification test samples.
- Specification MIL-P-23377G, Type I or II, Class C or N (as applicable)
- Primer Coatings: Epoxy, High-Solids
- Manufacturer's name and product number
- Submitted by (name and date) for qualification testing in accordance with authorization (reference authorizing letter)

4.3.2 Test report. In addition to the qualification test samples, the manufacturer shall furnish the following to the qualification activity (see 6.4): (a) one copy of the MSDS (see 3.3); (b) a certified test report showing that the material conforms to the requirements of this specification; (c) certification that the following chemicals were not used in the formulation of this primer coating: methylene chloride, trichloroethane and trichlorotrifluoroethane.

4.3.3 Retention of qualification. In order to obtain qualification of products approved for listing on the Qualified Products List (QPL), the manufacturer shall verify by certification to the qualifying activity that its product(s) comply with the requirements of this specification. Unless otherwise specified by the qualifying activity, the time of periodic verification by certification shall be in two-year intervals from the date of original qualification. The certification action shall be initiated by the qualifying activity.

4.4 Quality conformance inspection.

4.4.1 Lot and batch formation. A lot shall consist of all of the primer coating manufactured at one time from one batch, forming part of one contract or purchase order and submitted for acceptance. A batch shall consist of all primer coating manufactured during one continuous operation.

4.4.2 Batch data. When required for data submission (see 6.2d), the manufacturer shall furnish a certified test report (see 6.3) showing that the supplied material has satisfactorily passed the quality conformance inspection (see 4.4.3) and that there has been no formulation or process change from that which resulted in the production of the qualification inspection sample.

4.4.3 Examinations.

4.4.3.1 Tests. The quality conformance examination shall consist of all tests specified in section 3, with the exception of storage stability (3.5.3), accelerated storage stability (3.5.4), strippability (3.7.6), and corrosion resistance (3.8.2 - 3.8.2.2). There shall be no failures. As a minimum, samples for testing purposes shall consist of one complete, unopened kit

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selected at random from each lot and/or batch. Containers shall only be opened when the container contents are being tested. Failure shall result in rejection of the batch and may justify removal of the product from the QPL (see 4.3).

4.4.3.2 Examination of packaging and marking. An examination shall be made to ensure compliance with section 5. Samples shall be selected from each lot in accordance with MIL-STD-105, inspection level S-2. The lot size for this examination shall be the number of kits fully prepared for delivery. If palletization is required (see 4.4.3.3 and 6.2), kits fully prepared for delivery shall be examined prior to being palletized. Acceptance criteria shall be as specified in the contract or purchase order (see 6.2i and 6.9). Defects are defined in the following list.

Examine	Defect
Packaging	Containers not as specified, closures not accomplished by specified or required methods or materials. Leakage or seepage of contents. Non-conforming component, component missing, damaged or otherwise defective. Rusted, bulged or distorted container.
Marking	Data, including directions for use, omitted, illegible, incorrect, incomplete, or not in accordance with contract requirements.

4.4.3.3 Visual inspection of filled containers. Samples selected at random for examination in accordance with 4.4.3.2 shall be examined for proper filling and weight, and excessive internal pressure.

4.4.3.4 Examination for palletization. If palletization is required (see 6.2h), an examination shall be made to ensure that there are no defects. Defects are as defined in the following list.

Examine	Defect
Finished dimension	Length, width or height exceeds specified maximum requirement.
Palletization	Not as specified. Pallet pattern not as specified. Interlocking of loads not as specified. Load not bonded with required straps as specified.
Weight	Exceeds maximum load limits.
Marking	Omitted, incorrect, illegible, of improper size, location, sequence or method of application.

4.4.4 Rejection and retest. Failure in any quality conformance test shall result in the rejection of that batch and shall constitute sufficient justification for removal from the qualified products list. Rejected material shall not be resubmitted for acceptance without written approval from the Commander, Naval Air Warfare Center - Aircraft Division, Code 6062, Box 5152, Warminster, PA 18974-0591. The application for resubmission shall contain

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full particulars concerning previous rejections and measures taken to correct these deficiencies. Samples for retest shall be randomly selected (see 4.4.3) and forwarded to the designated testing activity.

4.5 Test panels. Test panels shall be prepared under laboratory conditions (see 4.6). With the exception of the salt-spray tests (see 4.6.7.1 - 4.6.7.1.2), test panels shall be constructed of aluminum alloy with dimensions of 0.020 by 3 by 6 in. (0.50 by 76.2 by 152.4 mm). Alloy composition and pretreatments of test panels shall be in accordance with Table I. Unless other specified in the test method or paragraph, the primer coating shall be applied in accordance with 4.5.1 and the topcoat, when required, shall be applied in accordance with 4.5.2.

TABLE I. Aluminum test panels.

Panel	Substrate	Pretreatment
A	QQ-A-250/4 (T3 temper)	MIL-C-5541, Class 1A (conversion coating)
B	QQ-A-250/4 (O temper)	MIL-A-8625, Type I or IC (anodize)
C	QQ-A-250/5 (T3 temper)	Deoxidized 1/
D	QQ-A-250/5 (T3 temper)	MIL-C-5541, Class 1A (conversion coating)

1/ Immerse test panel for 2 minutes in corrosion removing compound conforming to MIL-C-38334, Type I, Class I, then remove test panel and rinse with distilled water. Apply the primer coating within one hour.

4.5.1 Application of primer coating. When required by the test method or paragraph, the primer coating shall be prepared by:

- a. Thoroughly mixing each component separately;
- b. Slowly pouring Component B into Component A while stirring the mixture until the manufacturer's specified volume mixing ratio is achieved;
- c. Diluting the admixed primer coating, if necessary, with thinner conforming to MIL-T-81772, Type II. If dilution of the primer coating is required, do not exceed 340 g/l (2.8 lb/gal) (see 6.12).
- d. Allowing admixed coating to stand undisturbed for 30 minutes prior to use, unless the manufacturer's directions state otherwise;
- e. Spraying the test panels with primer coating to a dry-film thickness of 0.6 to 0.9 mils (15 to 23 μ m)

When required by the test method or paragraph, apply a topcoat conforming to MIL-C-83286 or MIL-C-85285 after air drying for 5 hours, in accordance with 4.5.2. If a topcoat is not used, the primer coating shall be allowed to air

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dry for a minimum of 14 days, or air dry for 1 hour followed by 24 hours at 50° ± 3°C (122° ± 5°F) prior to testing.

4.5.2 Application of topcoat. When a topcoat is required by the test method or paragraph, coating conforming to MIL-C-83286 or MIL-C-85285 (untinted gloss white, FED-STD-595, color number 17925) shall be mixed and reduced with thinner, if required, conforming to MIL-T-81772, Type I, and allowed to stand for 30 minutes prior to use. Apply the coating to a dry-film thickness of 1.7 to 2.3 mils (43 to 58 µm). If applying in two coats, allow the first coat to air dry for 40 to 55 minutes prior to application of the second coat. Allow the coating to air dry for a minimum of 14 days or air dry for 1 hour followed by 24 hours at 50° ± 3°C (122° ± 5°F) prior to testing.

4.6 Test methods. The tests of this specification shall be conducted in accordance with Table II and paragraph 4.6.1 through 4.6.10.3. When directed by the test method or paragraph, test panels shall be prepared in accordance with 4.5 through 4.5.2. Unless otherwise specified in the test method or paragraph, all testing shall be conducted under laboratory test conditions in accordance with ASTM D3924 and in duplicate. Unless otherwise stated in the test method or paragraph, room temperature shall be defined as 18° to 29.5°C (65° to 85°F) and relative humidity of 50 ± 10%.

TABLE II. Test methods.

Requirement paragraph	Test	Test Paragraph	Fed-STD-141 Method Number	ASTM Test Method
3.4	Lead and cadmium content	--	--	D3335
3.4.1.2	Chromium (Class 2 only)	--	--	D3718
3.4.2	VOC	--	--	D3960
3.5.1	Fineness of grind	--	--	D1210
3.5.2	Condition in container	4.6.1	--	--
3.5.3	Storage stability	--	--	--
3.5.4	Accelerated storage stability	4.6.2	--	--
3.6.2	Odor	--	--	D1296
3.6.3	Viscosity	--	--	D1200
3.6.4	Pot life	--	--	D1200

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TABLE II. Test methods, continued.

Requirement paragraph	Test	Test Paragraph	Fed-STD-141 Method Number	ASTM Test Method
3.7.1	Surface appearance	--	--	--
3.7.2	Drying time	--	--	D1640
3.7.3	Lifting	4.6.10.3	--	--
3.7.4	Adhesion	--	6301	--
3.7.5	Flexibility	4.6.3	--	--
3.7.6	Strippability	4.6.4	--	--
3.7.7	Infrared reflectance (Type II only)	4.6.5	--	--
3.8.1	Water resistance	4.6.6	--	--
3.8.2.1.1	Salt-spray corrosion resistance (Aluminum test panel)	4.6.7.1.1	--	B117
3.8.2.1.2	Salt-spray corrosion resistance (Aluminum/graphite epoxy test panel)	4.6.7.1.1	---	B117
3.8.2.2	Filiform corrosion resistance	4.6.7.2	--	--
3.8.3	Solvent resistance (cure)	4.6.8	--	--
3.8.4	Fluid resistance	4.6.9	--	--
3.9.1	Mixing and dilution	4.6.10.1	--	--
3.9.2	Application	4.6.10.2	--	--

4.6.1 Condition in container. Allow each component to stand without agitation for a minimum of 14 days at room temperature (see 4.6). After this period, examine open the container and examine its contents for conformance to 3.5.2.

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4.6.2 Accelerated storage stability. A minimum of one full, unopened, sealed container of each component shall be stored undisturbed for a minimum of 14 consecutive days in a location maintained at $60^\circ \pm 3^\circ\text{C}$ ($140^\circ \pm 5^\circ\text{F}$). At the end of the 14 day period, the containers shall be allowed to cool to room temperature (see 4.6). (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 the container carefully and examine its contents for conformance to 3.5.4.

4.6.3 Flexibility. The primer coating shall be applied to "B" test panels (see 4.5) in accordance with 4.5.1. The coating shall then be tested for flexibility with a GE Universal Impact-Flexibility Tester, Model 172 (see 6.10), or equivalent. The impacter for this test weighs 3.6 lbs, and has formed on each end four convex spherical segments, each of different radii and extension. The test shall be conducted in the following manner:

- a. Place the coated test panel, film downward, on the rubber pad at the bottom of the impacter guide.
- b. Drop the impacter on the panel such that the impression of the entire rim of the impacter is made in the panel.
- c. Reverse the impacter ends and drop it on the panel adjacent to the first impact area.
- d. Use 10 power magnification to examine fine surface cracking and report the percent elongation, corresponding to largest spherical impression at which no cracking occurs. Examine for conformance to 3.7.5.

4.6.4 Strippability. The primer coating shall be applied to "A" test panels (see 4.5) in accordance with 4.5.1. The coated test panels shall then be artificially aged at $99^\circ \pm 1^\circ\text{C}$ ($210^\circ \pm 2^\circ\text{F}$) for 4 days. After aging, place the test panels on a rack, coated side up, at 60° to the horizontal. In a well ventilated area maintained at room temperature (see 4.6), pour remover conforming to MIL-R-81294, Type I, along the top edge of the test panel to completely cover the coating surface. Just enough remover to cover the coating surface shall be used. After 60 minutes exposure to the remover, the loosened film shall be brushed off with a stiff, non-metallic, bristle brush while rinsing under a stream of cool water. The test panels shall then be examined for conformance to 3.7.6. The amount of primer coating removed in this manner is determined by the percentage of substrate surface area exposed.

4.6.5 Infrared reflectance (Type II primer coating only). The Type II primer coating shall be applied to "A" test panels (see 4.5) in accordance with 4.5.1. The total reflectance (specular and diffuse) of the primer coating relative to barium sulfate shall be measured using a Perkin-Elmer LAMBDA 9 spectrophotometer (or equivalent) over a range of 450 to 2700 nm. ASTM E275 may be used to compare performance of the equivalent unit to the LAMBDA 9. Examine for conformance to 3.7.7.

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4.6.6 Water resistance. The primer coating shall be applied to "A" test panels (see 4.5) in accordance with 4.5.1 and topcoated in accordance with 4.5.2. The coated test panels shall then be completely immersed in distilled water maintained at $49^\circ \pm 3^\circ\text{C}$ ($120^\circ \pm 5^\circ\text{F}$) for four days. Two hours after removal from the water, the coating shall be examined for conformance to 3.8.1.

4.6.7 Corrosion resistance.

4.6.7.1 Salt spray.

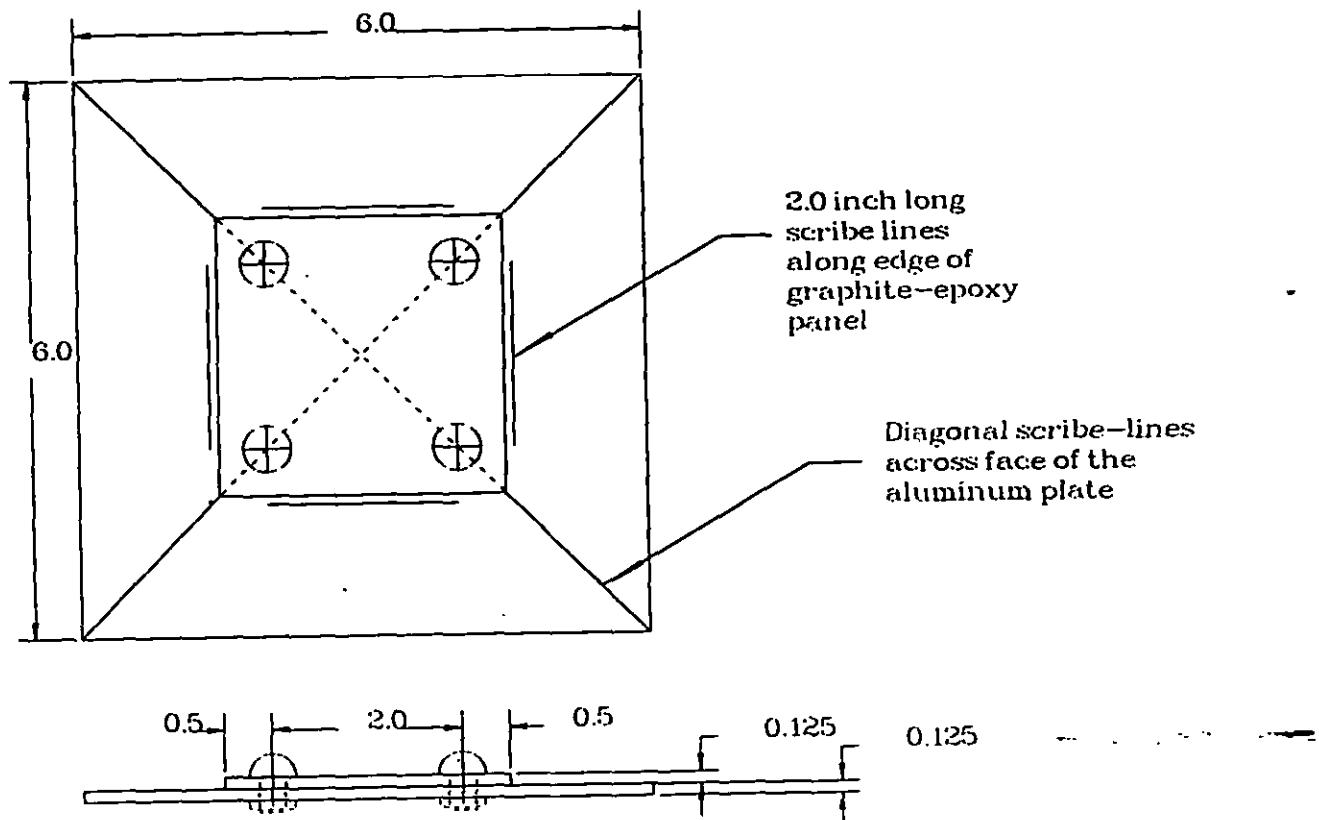
4.6.7.1.1 Aluminum test panel. The primer coating shall be applied to "A" test panels (see 4.5) in accordance with 4.5.1. Two intersecting lines shall then be scribed diagonally across the coated surface of each panel, exposing the aluminum substrate. The test panels shall then be placed in a 5 percent salt-spray cabinet for 2000 hours in accordance with ASTM B117. After removal the test panels shall be examined for conformance to 3.8.2.1.1.

4.6.7.1.2 Aluminum/graphite-epoxy test panel. The primer coating shall be applied to the aluminum/graphite-epoxy test specimen (see figure 1), in accordance with the following manner:

- a. An aluminum alloy 7075 (T6 temper) plate conforming to QQ-A-250/12, dimensions of 3 by 152.4 by 152.4 mm (0.125 by 6 by 6 in.), shall be anodized in accordance with MIL-A-8625, Type I or IC;
- b. Primer coating shall be applied to the test panel in accordance with 4.5.1;
- c. Two intersecting lines shall be scribed diagonally across the coated surface of the plate, exposing the bare substrate;
- d. A graphite-epoxy panel with a 0° , 90° orientation (Hercules AS4/3501-6 or equivalent) of approximately 16 plies, dimensions of 2.4 by 76 by 76 mm (0.094 by 3 by 3 in.), shall be joined to the center of the primer coated plate with four nylon fasteners.
- e. Four additional lines, length of 51 mm (2 in.), shall be scribed along the edge of the panel, exposing the bare substrate of the plate.

The assembled test specimen shall then be placed in a 5 percent salt-spray cabinet for 500 hours in accordance with ASTM B117. After removal, examine the coating for conformance to 3.8.2.1.2.

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All dimensions are in inches

FIGURE 1. Aluminum/graphite - epoxy test specimen.

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4.6.7.2 Filiform. The primer coating shall be applied to "D" test panels (see 4.5) in accordance with 4.5.1 and topcoated in accordance with 4.5.2. Two intersecting lines shall be scribed diagonally across the coated surface of the test panels, exposing the bare substrate. The test panels shall then be placed vertically in a desiccator containing 12N HCl (equivalent to American Chemical Society (ACS) reagent grade) for 1 hour. Within 5 minutes of removal from the desiccator, the test panels shall be placed in a humidity cabinet maintained at $40^\circ \pm 1.7^\circ\text{C}$ ($104^\circ \pm 3^\circ\text{F}$) and RH of 80 ± 5 percent for 1000 hours. The test panels shall then be examined for conformance to 3.8.2.2. Filiform corrosion appears as threadlike filaments initiating from the exposed substrate and spreading underneath the coating film. A general description of filiform growth appears in ASTM D2803.

4.6.8 Solvent resistance (cure). The primer coating shall be applied to "A" test panels (see 4.5) in accordance with 4.5.1. The primer coating shall then be examined for cure, as follows:

- a. Soak a cotton, terrycloth rag in MEK solvent (see 6.11).
- b. Rub the coating with the soaked rag for 50 passes (25 times) with firm finger pressure.
- c. Examine coating for conformance to 3.8.3

4.6.9 Fluid resistance. The primer coating shall be applied to "A" test panels (see 4.5) in accordance with 4.5.1. The test panels shall then be separately immersed to half their length for 24 hours in the following liquids, contained in glass covered beakers:

- a. Lubricating oil conforming to MIL-L-23699, maintained at $121^\circ \pm 3^\circ\text{C}$ ($250^\circ \pm 5^\circ\text{F}$);
- b. Hydraulic fluid conforming to MIL-H-83282, maintained at $65.5^\circ \pm 3^\circ\text{C}$ ($150^\circ \pm 5^\circ\text{F}$).

After removal from the test fluids, cool the test panels to room temperature (see 4.6) and examine for conformance to 3.8.4.

4.6.10 Working properties.

4.6.10.1 Mixing and dilution. Thoroughly mix each component separately. Slowly pour Component B into Component A, while constantly stirring, until the manufacturer's specified volume mixing ratio is achieved. If necessary, dilute the admixed primer coating with thinner conforming to MIL-T-81772, Type II (see 6.12). Stir well and allow coating to dwell for 30 minutes. Examine for conformance to 3.9.1.

4.6.10.2 Application. Using conventional, airless, HVLP (high volume, low pressure), or electrostatic spray equipment, apply the primer coating to test panels to a dry film thickness of 0.6 to 0.9 mils (15 to 23 μm) in accordance with 4.5.1. Examine for conformance to 3.7.1 and 3.9.2.

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4.6.10.3 Lifting. The primer coating shall be applied to "A" test panels in accordance with 4.5.1 and topcoated in accordance with 4.5.2. Examine for conformance to 3.7.3.

5. PACKAGING

5.1 Preservation, packaging, and marking. The primer coatings shall be preserved, packaged, and marked in accordance with PPP-P-1892. The level of preservation shall be A or C and the level of packing shall be A, B, or C, as specified (see 6.2). The primer coatings shall be supplied as a kit. The size of the individual components in each kit need not be the same.

5.2 Marking and labeling. In addition to the marking specified in PPP-P-1892, individual cans and containers shall bear printed labels showing the following, as applicable:

- Component Identification
 - Component A - Epoxy resin and solvents
 - Component B - Curing agent (polyamide and/or amine resin and solvents)
- Specification MIL-P-23377G,
 - Type I or II and Class C or N (as applicable)
- Manufacturer's name and product number
- Date of manufacture by month and year
- Batch number/Net contents
- VOC content in grams/liter
- Mixing and thinning instructions

The following is to be included on a printed sheet with each kit:

Precautions

- a. The surface to be coated must be clean (free of oil, dust, etc.).
- b. Spray equipment must be adequately grounded. Clean equipment immediately after use with thinner conforming to MIL-T-81772, Type II.
- c. Mix only the amount of primer coating to be used within 4 hours.
- d. Always add Component B to Component A - NEVER THE REVERSE.
- e. Primer coating from one vendor, or individual component, shall never be mixed with that of another vendor.
- f. Apply over pretreated metal. On fiberglass-reinforced plastic surfaces, a prior coating of metal pretreatment conforming to MIL-C-8514 will facilitate stripping without damage to the fiberglass.
- g. Do not open any container which is bulged or deformed.

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5.2.1 Precautionary markings. Unit, intermediate and shipping containers shall contain the following precautionary marking, if applicable:

"WARNING! Flammable."

Shipping containers shall be marked in accordance with 49 CFR 171-178 and shall bear the "Flammable Liquid" red label, if applicable, as specified therein. All unit and intermediate containers, including unit containers that serve as shipping containers shall be marked with the applicable precautionary information detailed in ANSI Z129.1 and shall be labeled in accordance with the applicable federal, state, and municipal laws, statutes, regulations, and/or ordinances.

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 materials covered by this specification are low VOC, corrosion-inhibitive, chemical resistant, and strippable primer coatings. Type I is for general use. Type II is for use where low infrared reflectance is required. Unless a specific type and/or class is referenced in a contract or purchase order, Type I, Class C is the default reference. The non-chromated (Class N) primer coatings are for use where federal, state, or local regulations restrict the use of chromate based materials. Class N primer coatings may only be used when authorization for its use is given by the procuring activity or the engineering authority for the system or item to which the primer coating is to be applied. For users of MIL-P-23377F, Class 2, "High-Solids," use Class C of this document.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification, including any amendments.
- b. Classification (Type I or II, and Class C or N, as applicable) (see 1.2 and 6.7).
- c. Issue of DODISS to be cited in the solicitation; and, if required, the specific issue of individual documents referenced (see 2.1 and 2.2).
- d. Data requirements (see 6.3).
- e. Quantity and kit size (see 6.7.1).
- f. Levels of packaging and packing required (see 5.1).
- g. Marking and labeling required (see 5.2 through 5.2.1).
- h. Specify if palletization is required.
- i. Acceptance criteria (see 6.9 and 6.10).
- j. FAR clause 52.223-3.

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6.3 Consideration of data requirements. The following Data Item Descriptions (DID) must be listed, as applicable, on the Contract Data Requirements List (DD Form 1423) when this specification is applied on a contract, in order to obtain the data, except where DOD FAR Supplement 227.405-70 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
3.3, 4.3.2, 4.4.2	DI-NDTI-80809A	Test/Inspection Reports	---

The above DID were those cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 Qualification. With respect to products requiring qualification, awards will only be made for products which are qualified for inclusion in the applicable Qualified Products List at the time set for award of contract(s), whether or not such products have actually been so listed by that date. The attention of manufacturers and suppliers is called to this requirement. Manufacturers are urged to arrange having the products that they propose to offer to the Federal Government tested for qualification in order to be eligible for award of contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Commander, Naval Air Systems Command (AIR-5304), Arlington, VA 22243; however, information pertaining to qualification of products should be obtained from the Commander, Naval Air Warfare Center - Aircraft Division, Code 6062, Box 5152, Warminster, PA 18974-0591.

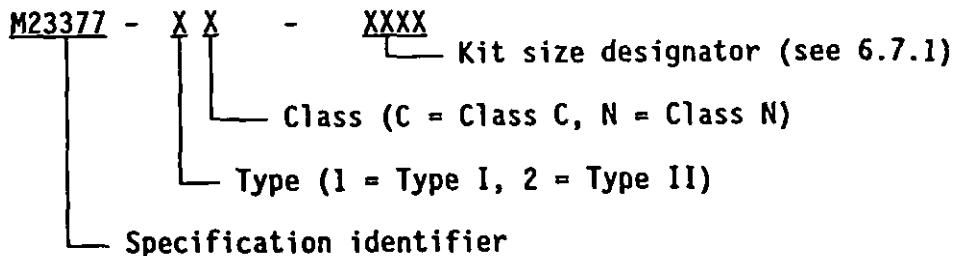
6.5 Subject term (keyword) listing.

Chemical resistance
Corrosion inhibitive
Flammable
Hydrochloric acid (HCl)
Low infrared reflectance
Methyl ethyl ketone (MEK)
Strontium chromate

6.6 Material Safety Data Sheet (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 will identify the activities requiring copies of the MSDS.

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6.7. Part numbers. Part numbers for cataloging purposes under this specification may be coded as follows:



6.7.1 Kit size. The four digit kit size designation in the part number assignment is as follows:

<u>Kit size</u>	<u>Kit size designator</u>
4 pint (1.88 liter (1))	004P
4 quart (3.76 l)	004Q
4 gallon (15.14 l)	004G
20 gallon (75.7 l)	020G

6.8 Compatibility. For some applications, and only when authorized by the procuring activity, MIL-P-85582, "Primer Coatings: Epoxy, Waterborne," may be substituted for MIL-P-23377. Both MIL-P-23377 and MIL-P-85582 are compatible with the following coatings: TT-P-2756, "Polyurethane Coating: Self-Priming Topcoat, Low Volatile Organic Compounds (VOC);" MIL-C-22750, "Coating, Epoxy, High-Solids;" MIL-C-46168, "Coating, Aliphatic Polyurethane, Chemical Agent Resistant;" MIL-C-53039, "Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant;" MIL-C-83286, "Coating, Urethane, Aliphatic Isocyanate, for Aerospace Applications;" and MIL-C-85285, "Coating: Polyurethane, High-Solids." Compatibility with other topcoats should be tested prior to use.

6.9 Acceptance criteria for packaging and marking. Previous revisions of this document specified an acceptable quality level (AQL) of 4.0 defects per hundred units, in accordance with MIL-STD-105.

6.10 Impact tester source. The instrument used for the Flexibility test (see 4.6.3) is the GE Universal Impact Tester, Model #172, available from the Paul N. Gardner Company, 316 N.E. First Street, P.O Box 10688, Pompano Beach, FL 33061-6688. The impacter for this test weighs 3.6 lbs, and has formed on each end four convex spherical segments, each of different radii and extension. There may be other instruments equivalent to this unit.

6.11 Safety handling MEK solvent. To minimize exposure to MEK solvent, it is recommended that personnel conducting the solvent resistance (cure) test (see 4.6.8) wear, as a minimum, 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.

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6.12 Thinning. If it is necessary to add thinner to this coating:

- a. Use only thinner conforming to MIL-T-81772, Type II;
- b. In areas where air quality regulations restrict volatile emissions, do not add thinner to the primer coating if that addition will raise the VOC content to greater than 340 g/l (2.8 lbs/gal).

6.13 Cross-reference of classes from MIL-P-23377F to MIL-P-23377G.

Class C of MIL-P-23377G was Class 2 of MIL-P-23377F. Class N of MIL-P-23377G was not covered by MIL-P-23377F. MIL-P-23377F, Classes 1 and 3, are not covered by, nor available under MIL-P-23377G. Unless a specific type and/or class is referenced in the contract or purchase order, MIL-P-23377G, Type I, Class C is the default. Class N may not be substituted for Class C, unless authorization for its use is given by the procuring activity or engineering authority for the system or item to which the primer coating is to be applied.

6.14 Changes from previous issues. Asterisks (or vertical lines) are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:

Army - ME
Navy - AS
Air Force - 99

Preparing Activity:

Navy - AS
(Project No. 8010-0552)

Review Interest:

Army - MI, AR, EA, AV, MR
Navy - CG, MC, OS, SH
Air Force - 11, 84
Other - DS, GSA/FSS (9FTE-10)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER

MIL-P-23377G

2. DOCUMENT DATE
(YYMMDD)

940930

3. DOCUMENT TITLE

PRIMER COATINGS: EPOXY, HIGH-SOLIDS

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE
(Include Area Code)

7. DATE SUBMITTED
(YYMMDD)

(1) Commercial:

(2) DSN:

(if Applicable)

8. PREPARING ACTIVITY

a. NAME
COMMANDER
NAVAL AIR WARFARE CENTER
AIRCRAFT DIVISION

b. TELEPHONE NUMBER (Include Area Code)
(1) Commercial (2) DSN
(908) 323-7488 624-7488

c. ADDRESS (Include Zip Code)
CODE SR3
HIGHWAY 547
LAKEHURST, NJ 08733-5100

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Defense Quality and Standardization Office, 5203 Leesburg Pike,
Suite 1403, Falls Church, VA 22041-3466
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