NOT MEASUREMENT SENSITIVE

MIL-PRF-23377K
7 June 2012
SUPERSEDING
MIL-PRF-23377J
W/AMENDMENT 2
10 April 2007

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 corrosion inhibiting, chemical and solvent resistant, solvent-borne, high-solids epoxy primer coatings that have a maximum volatile organic compound (VOC) content of 340 grams per liter (g/L)(2.8 pounds per gallon [lb/gal]) as supplied by the manufacturer.

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

1.2.1 Types. The types of primer coatings are as follows:

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

1.2.2 Classes. The classes of primer coatings are as follows:

Class C1	-	Barium chromate based corrosion inhibitors
Class C2	-	Strontium chromate based corrosion inhibitors
Class N	-	Non-chromate based corrosion inhibitors

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

AMSC N/A FSC 8010

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

M23377	-	X	-	XX	-	XXXX
Specification identifier		Type designator 1 = Type I 2 = Type II		Class designator (C1, C2 or N)		Kit size designator (see 1.3.1)

1.3.1 Kit size. The primer coatings covered by this specification should be purchased by volume, the unit being a kit containing two or three components. The kit component sizes need not be of the same size. When this part numbering system is used, the kit size is to be identified as:

Kit Size 1/	Kit Size Designator
Less than one pint	2/
4-pint (0.47-liter)	004P
4-quart (0.95-liter)	004Q
4-gallon (3.79-liter)	004G
20-gallon (75.7-liter)	020G

1/ The kit size and its designator may be modified for ease of procurement and is not limited.
2/ Designators for less than pint size kits (small touch-up kits) should be expressed in cubic centimeters (cc) and should be designated by "C." Example: A type I, class C2, 50 cc kit should be designated M23377-1-C2-050C.

2. APPLICABLE DOCUMENTS

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

2.2 Government documents.

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

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FEDERAL SPECIFICATION

TT-R-2918	-	Remover, Paint, No Hazardous Air Pollutants (HAPs).

FEDERAL STANDARD

FED-STD-595	-	Colors Used in Government Procurement/ Color numbers 17925, 36375.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-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-PRF-23699	-	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code Number 0-156.
MIL-R-81294	-	Remover, Paint, Epoxy, Polysulfide, and Polyurethane Systems.
MIL-T-81772	-	Thinner, Aircraft Coating.
MIL-PRF-83282	-	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Metric, NATO Code Number H-537.
MIL-PRF-85285	-	Coating: Polyurethane, Aircraft and Support Equipment.

(Copies of these documents are available on line at https://assist.dla.mil/quicksearch/ or https://assist.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

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

ASTM INTERNATIONAL

ASTM B117	-	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D823	-	Standard Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels
ASTM D1200	-	Standard Test Method for Viscosity by Ford Viscosity Cup
ASTM D1210	-	Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
ASTM D1296	-	Standard Test Method for Odor of Volatile Solvents and Diluents
ASTM D1649	-	Standard Specification for Strontium Chromate Pigment.
ASTM D1849	-	Standard Test Method for Package Stability of Paint

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ASTM D2803	-	Standard Guide for Testing of 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 D3359	-	Standard Test Method for Measuring Adhesion by Tape Test
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 D5402	-	Standard Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs
ASTM D5895	-	Standard Test Method for Evaluating Drying and Curing During Film Formation of Organic Coatings Using Mechanical Recorders
ASTM D6905	-	Standard Test Method for Impact Flexibility of Organic Coatings

(Copies of these documents are available from www.astm.org or ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

AMERICAN SOCIETY FOR QUALITY (ASQ)

ANSI/ASQ Z1.4	-	Sampling Procedures And Tables For Inspection By Attributes

(Copies of this document are available from www.asq.org or American Society for Quality, 600 Plankinton Avenue, Milwaukee, WI 53203.)

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SAE INTERNATIONAL

SAE-AMS1640 - Compound, Corrosion Removing for Aircraft Surfaces
SAE-AMS-QQ-A-250/4 - Aluminum Alloy 2024, Plate and Sheet – UNS A92024.
SAE-AMS-QQ-A-250/5 - Aluminum Alloy Alclad 2024, Plate and Sheet – UNS A82024.

(Copies of these documents are available from www.sae.org or SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

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

3. REQUIREMENTS

3.1 Qualification. The primer coatings furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list in the qualified products database (QPD) before contract award (see 4.2 and 6.3). The material supplied under contract shall be identical, within manufacturing tolerances, to the product receiving qualification.

3.2 Material. Materials used in the manufacture of the primer coatings supplied under this specification shall be products conforming to the requirements of this specification.

3.3 Toxicity. The primer coatings shall have no adverse effect on the health of personnel when used for its intended purpose and with the precautions listed in 3.11, when evaluated in accordance with 4.5.12 (see 6.8).

3.4 Composition. The primer coatings shall consist of two or three components, as follows:

Component A - a base component composed of epoxy resin and solvents.
Component B - a curing agent containing polyamide or amine resin and solvents.
Component C (optional) - thinning component composed predominately of organic solvents.

Component B shall act as the curing agent for component A. The components shall be packaged separately and furnished as a kit (see 1.3.1). Pigments may be included with either component A or B. When the components are mixed in the proportions specified by the manufacturer, a primer coating meeting the requirements of this specification shall result. Chlorinated solvents, except for para-chlorotrifluoromethylbenzene or equal, shall be prohibited in the formulation of these primer coatings. Incidental cadmium and cadmium compounds shall be not greater than one part per million (ppm). The non-volatile portion shall contain not more than 0.05 percent by weight of lead metal or lead compounds.

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3.4.1 Pigment.

3.4.1.1 Class C1. Primer coatings containing barium chromate based corrosion inhibitors, along with extenders and other pigments, shall be identified as class C1.

3.4.1.2 Class C2. Primer coatings containing strontium chromate conforming to ASTM D1649 as the corrosion inhibitor, along with extenders and other pigments, shall be identified as class C2.

3.4.1.3 Class N. Primer coatings containing non-chromium corrosion inhibitors, along with extenders and other pigments, shall be identified as class N. Incidental hexavalent chromium content of class N primer coatings shall be not greater than 5 ppm (see 4.5).

3.4.2 Volatile organic compound (VOC) content. The VOC content of admixed primer coatings shall be not greater than 340 g/L (2.8 lb/gal). The resistivity of the solvents shall permit application of the coatings by electrostatic spray application (see 4.5).

3.4.2.1 Thinner compatibility. The admixed primer coatings shall be compatible with thinner conforming to MIL-T-81772, type II (see 6.11).

3.5 Physical properties – components before mixing.

3.5.1 Fineness of grind. The fineness of grind of the pigmented component shall be 5 or greater on the Hegman scale (see 4.5).

3.5.2 Condition in container. Components A, B, and C (if applicable) shall be free of grit, seeds, lumps, abnormal thickening or livering, and shall not show pigment flotation nor excessive settling. They shall mix to a smooth, homogeneous, and pourable condition. In addition, the containers shall exhibit no deformation (see 4.5.1).

3.5.3 Storage stability. The unopened coating components, as packaged by the manufacturer, shall meet all requirements of this specification after storage for a period of one year for metal containers and six months for plastic containers. The conditions for the storage shall be a daily ambient air temperature that is maintained at 1.7 to 46° C (35 to 115° F) (see 4.5 and 6.3.1).

3.5.4 Accelerated storage stability. The primer coating, as packaged by the manufacturer, shall meet all requirements of this specification after storage for 14 days and admixing (see 4.5.2). The container shall not become deformed or the lid shall not become unsealed during the storage period.

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3.6 Physical properties - admixed components.

3.6.1 Color.

3.6.1.1 Type I. The color of the admixed type I primer coatings shall be the natural color of the corrosion inhibiting pigments used. Tinting to a different shade is permitted.

3.6.1.2 Type II. The color of the admixed type II primer coatings shall be dark green, black, or gray.

3.6.2 Odor. The odor of the admixed coatings, wet or dry, shall be characteristic of the solvents used (see 4.5).

3.6.3 Viscosity. Immediately after mixing components A and B, the maximum viscosity of the unthinned, admixed primer coatings shall be 40 seconds through a #4 Ford cup (see 4.5).

3.6.4 Pot life. After mixing and storage at room temperature in a closed container (see 4.5) for 4 hours, the maximum viscosity of the unthinned primer coatings (see 3.6.3) shall be 70 seconds through a #4 Ford cup (see 4.5).

3.7 Physical properties - film.

3.7.1 Surface appearance. The admixed primer coatings, applied to a vertical surface, shall not sag, run, or streak. The dried film shall have a smooth, uniform surface free of grit, seeds, craters, blisters, and other irregularities (see 4.4.1). No orange peel (wavy appearance) shall be evident when viewed from six feet away.

3.7.2 Drying time. The admixed primer coatings shall be tack free within 5 hours and shall dry hard within 8 hours (see table II).

3.7.3 Lifting. There shall be no evidence of lifting or any other film irregularity after topcoating the admixed primer coatings that have air dried for 5 hours (see 4.5.3).

3.7.4 Adhesion. There shall be no peeling or delamination between the primer and topcoat or at the primer and substrate interface. The coatings shall have a rating of no less than a 4A when examined in accordance with ASTM D3359 (see 4.5.4).

3.7.5 Flexibility. The primer coatings shall exhibit an elongation of not less than 10 percent when tested in accordance with 4.5.5.

3.7.6 Infrared reflectance (type II primer coatings only). The total reflectance (specular and diffuse) of the type II primer coatings, relative to barium sulfate, shall be not greater than ten percent throughout the range of 700 to 2,600 nanometers (nm) (see 4.5.6).

3.8 Resistance properties.

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3.8.1 Water resistance. The topcoated primer coatings shall withstand immersion in distilled water maintained at 49 ±3° C (120 ±5° F) for 4 days without exhibiting any evidence of wrinkling, blistering, or any other coating deficiency (see 4.5.7).

3.8.2 Corrosion resistance.

3.8.2.1 Salt spray. The primer coatings, with and without a topcoat, shall not exhibit blistering, lifting of either coating, nor substrate pitting after exposure to a 5 percent salt spray for 2,000 hours. There shall be no white corrosion or pitting in the scribe (see 4.5.8.1).

3.8.2.2 Filiform. The topcoated primer coatings shall not exhibit filiform corrosion extending beyond 6.35 millimeters (mm) (0.25 inch) from the scribe, and the majority of the filaments shall be less than 3.175 mm (0.125 inch) in length (see 4.5.8.2).

3.8.3 Solvent resistance (cure). The primer coatings shall withstand 50 passes (25 back and forth rubs) by a cloth rag soaked in methyl ethyl ketone (MEK). Rubbing through to bare substrate constitutes failure of the primer coatings to properly cure (see 4.5.9).

3.8.4 Fluid resistance. The primer coatings shall withstand immersion for 24 hours in synthetic lubricating oil conforming to MIL-PRF-23699, and synthetic hydraulic fluid conforming to MIL-PRF-83282. Four hours after removal from the respective fluid, the coatings shall not exhibit any softening, blistering, loss of adhesion, nor any other coating deficiency. Discoloration of the coatings is acceptable and shall not be cause for rejection (see 4.5.10).

3.9 Working properties.

3.9.1 Mixing and dilution. The components of the primer coatings, including thinner if required (see 6.11), shall homogeneously blend when mixed by a paint shaker in the volume mixing ratio specified by the manufacturer. Within one hour of mixing, the admixed coatings shall not separate into visually distinct layers (see 4.5.11.1).

3.9.2 Application. The admixed primer coatings shall be capable of being applied by conventional, airless, high volume/low pressure (HVLP) or electrostatic spray equipment. Application shall yield a uniform film with no runs or sags at a dry-film thickness of 15 to 23 microns (µm) (0.6 to 0.9 mil) (see 4.5.11.2).

3.10 Identification of material. Individual containers greater than one pint and cases of containers less than one pint shall be identified with the following information:

> MIL-PRF-23377K, “Primer Coatings: Epoxy, High-Solids” type I or II, class C1, C2, or N
> Component identification (as applicable):
> Component A - base component or Component B - curing agent or Component C - thinning component
> Manufacturer’s name and product number

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Date of manufacture (month/year)
Batch number/net contents
VOC content in grams/liter
Mixing and thinning instructions

3.10.1 Component containers. Component A, component B, and component C (if applicable) containers shall have the following warning:

"WARNING! FLAMMABLE."

3.11 Precaution sheet. A printed precaution sheet with the following information shall be included 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. Never mix coating or individual component from one vendor with that of another vendor.
f. Apply over pretreated metal. On fiberglass-reinforced plastic, a prior coating of wash primer in accordance with MIL-C-8514 will facilitate stripping without damage to the fiberglass.
g. Allow admixed coating to stand undisturbed for 30 minutes prior to use.

3.12 Strippability. The primer shall be tested in accordance with Methods A and B of 4.5.13, and a minimum of 90 percent of the coating shall be stripped by one of the methods.

4. VERIFICATION

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

a. Qualification inspection (see 4.2).
b. Conformance inspection (see 4.3).

4.2 Qualification inspection. Qualification inspection shall consist of all the inspections listed in this specification. The samples shall be legibly identified (see 6.3.1.1).

4.3 Conformance inspection. The conformance inspection shall be performed on each production batch and provided when requested by the contracting officer or the qualifying activity (see 6.2). Conformance inspection consists of all the tests specified in 4.5, with the exception of storage stability (see table II), accelerated storage stability (see 4.5.2), corrosion resistance (see 4.5.8), toxicity (see 4.5.12), and strippability (see 4.5.13). There shall be no failures (see 6.5).

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4.3.1 Primer coating test samples. Samples for tests shall consist of one complete unopened kit selected at random from each batch (see 6.6). Containers shall only be opened when being tested.

4.3.2 Visual inspection of filled containers. Samples shall be selected at random from each lot (see 6.6) in accordance with ASQ-Z1.4, inspection level S-2. The lot size for this inspection shall be the number of kits fully prepared for delivery. The selected samples shall be examined for container fill, and completion of item identification (see 3.10), warning statements (see 3.10.1), and the precaution sheet (see 3.11). There shall be no defects (see 6.5).

4.4 Test panels. Test panels shall be prepared under laboratory conditions (see 4.5). Test panels shall be constructed of aluminum alloy. Alloy composition and pretreatments of test panels shall be in accordance with table I. Unless otherwise specified in the test method, the primer coatings shall be applied in accordance with 4.4.1 and the topcoat, when required, shall be applied in accordance with 4.4.2.

TABLE I. Aluminum test panels.

Panel	Substrate	Pretreatment
A	SAE AMS-QQ-A-250/4 (T3 temper)	MIL-DTL-5541, class 1A (conversion coating)
B	SAE AMS-QQ-A-250/4 (0 temper)	MIL-A-8625, type I or IC (anodize)
C	SAE AMS-QQ-A-250/5 (T3 temper)	Deoxidized 1/
D	SAE AMS-QQ-A-250/5 (T3 temper)	MIL-DTL-5541, class 1A (conversion coating)

1/ Immerse test panel for 2 minutes in corrosion removing compound conforming to SAE AMS1640, then remove test panel and rinse with distilled water. Apply the primer coating within one hour.

4.4.1 Application of primer coatings. When required by the test method, the primer coatings shall be prepared and applied as follows:

a. Thoroughly mix each component separately.
b. Slowly pour component B into component A while stirring the mixture to achieve the manufacturer's specified volume mixing ratio.
c. Dilute the admixed primer coating with component C (if applicable). If necessary, dilute the admixed coating with thinner conforming to MIL-T-81772, type II (see 6.11).
d. Allow admixed coating to stand undisturbed for 30 minutes prior to use, unless the manufacturer’s directions state otherwise.
e. Spray apply one cross-coat of primer coating to a dry-film thickness of 15 to 23 µm (0.6 to 0.9 mil) in accordance with ASTM D823 Method D.

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If a topcoat is not used, the primer coatings shall be allowed to air dry for not less than 14 days, prior to testing. If a topcoat is required, the primer coatings shall be air-dried for 5 hours and then coated with a polyurethane coating conforming to MIL-PRF-85285 in accordance with 4.4.2.

4.4.2 Application of topcoat. When a topcoat is required by the test method, mix polyurethane coating conforming to MIL-PRF-85285, Type I or IV, adding thinner, if required, and allow it to stand 30 minutes prior to application. Type I primer coatings shall be coated with untinted gloss white conforming to FED-STD-595, color number 17925 and Type II primer coatings shall be coated with camouflage grey conforming to FED-STD-595, color number 36375. For filiform corrosion resistance testing (see 4.5.8.2) both Type I and Type II primer coatings shall be tested with FED-STD-595, color number 17925. Apply the topcoat to a total dry-film thickness of 43 to 58 µm (1.7 to 2.3 mils) in accordance with ASTM D823 Method D. If the topcoat is applied in two coats, allow the first coat to air dry for 60 minutes prior to application of the second coat. After application of the topcoat to the required thickness and prior to testing, allow the coating to air dry for not less than 14 days.

4.5 Test methods. The tests of this specification shall be conducted in accordance with table II and 4.5.1 through 4.5.12. Unless otherwise specified in the test method or paragraph, laboratory test conditions shall be in accordance with ASTM-D3924. Room temperature conditions shall be 18 to 29.5° C (65 to 85° F) and a relative humidity of 50 ±0 percent.

TABLE II. Test Methods.

Test	Requirement Paragraph	Test Paragraph	Test Method
Lead and cadmium content	3.4	---	ASTM D3335
Chromium content (class N only)	3.4.1.3	---	ASTM D3718
VOC solvent content	3.4.2	---	ASTM D3960
Fineness of grind	3.5.1	---	ASTM D1210
Condition in container	3.5.2	4.5.1	---
Storage stability	3.5.3	---	---
Accelerated storage stability	3.5.4	4.5.2	ASTM D1849
Color – Type I	3.6.1.1	---	Visual
Color – Type II	3.6.1.2	---	Visual
Odor	3.6.2	---	ASTM D1296

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TABLE II. Test Methods – Continued.

Test	Requirement Paragraph	Test Paragraph	Test Method
Viscosity	3.6.3	---	ASTM D1200
Pot life	3.6.4	---	ASTM D1200
Surface appearance	3.7.1	4.4.1	---
Drying time 1/	3.7.2	---	ASTM D5895
Lifting	3.7.3	4.5.3	---
Adhesion	3.7.4	4.5.4	ASTM D3359
Flexibility	3.7.5	4.5.5	ASTM D6905
Infrared reflectance (type II only)	3.7.6	4.5.6	---
Water resistance	3.8.1	4.5.7	---
Salt-spray corrosion resistance	3.8.2.1	4.5.8.1	---
Filiform corrosion resistance	3.8.2.2	4.5.8.2	---
Solvent resistance (cure)	3.8.3	4.5.9	ASTM D5402
Fluid resistance	3.8.4	4.5.10	---
Mixing and dilution	3.9.1	4.5.11.1	---
Application	3.9.2	4.5.11.2	---
Toxicity	3.3	4.5.12	---
Strippability	3.12	4.5.13	---

1/ Use panels designated A in table I.

4.5.1 Condition in container. Each component in its unopened container shall stand without agitation for not less than 14 days at room temperature (see 4.5). After this period, the containers shall be examined for bulging or other deformation due to internal pressure. Each component container shall be opened and examined, then mixed by hand vigorously stirring with a paddle for not more than 5 minutes, and examined for conformance to 3.5.2.

4.5.2 Accelerated storage stability. Not less than one full, unopened, sealed container of each component shall be stored undisturbed for not less than 14 consecutive days in a location maintained at 60 ±3° C (140 ±5° F). At the end of 14 days, the container(s) shall be allowed to cool to room temperature (see 4.5). During the storage period, it is advised that the unopened containers be placed in larger, vented containers to confine any splash that may occur if the lid of the unopened container is blown off by gassing. If, upon removal, the unopened container is deformed, do not open. If the container is not deformed, open carefully and examine its contents. The primer coatings shall be admixed by 300 hand stirs in 2 minutes and examined for conformance to 3.5.4.

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4.5.3 Lifting. The primer coatings shall be applied to test panels designated A (see table I) in accordance with 4.4.1. Panels shall air dry for 5 hours and then be topcoated in accordance with 4.4.2. Examine for conformance to 3.7.3 during and after the drying of the topcoat.

4.5.4 Adhesion. Primer only in accordance with 4.4.1 and primer with topcoat in accordance with 4.4.1 and 4.4.2 shall be applied to test panels designated C (see table I). The test panels shall be immersed in distilled water for 24 hours at room temperature (see 4.5). Remove the test panels from the water and wipe dry with a soft cloth. Within 3 minutes after removal from the water make two parallel scribes with a stylus through the coating to the substrate. The scribes shall be ¾ of an inch apart and 2 inches long. The panels shall then be scribed to the substrate from opposing ends of the parallel scribes to form an "X". Immediately apply a 1-inch wide strip of masking tape with the adhesive side down across the scribes. Press the tape against the surface of the coating by passing a 4-1/2-pound rubber covered roller, approximately 3-1/2 inches in diameter and 1-3/4 inches in width across the tape eight times. Remove the tape with one quick motion and examine for coating damage. Examine the coating for conformance to 3.7.4. The masking tape shall have an average adhesion of at least 60-ounces/inch width (3M Company #250 or equivalent as approved by the qualifying activity). The tape shelf life is typically one year from date of manufacture.

4.5.5 Flexibility. The primer coating shall be applied to test panels designated B (see table I) in accordance with 4.4.1. The coating shall be tested at the room temperature and relative humidity conditions as specified in 4.5 and in accordance with ASTM D6905, using a Gardco GE Universal Impact Tester, Model #172 (or equivalent as approved by the qualifying activity) (see 6.7). Place the coated panel, film side downward, on the rubber pad at the bottom of the impacter guide. Drop the impacter on the panel through the impacter guide, ensuring that the impression of the entire rim of the impacter is made in the panel. Reverse the impacter ends and drop it through the guide on the panel adjacent to the first area of impact. Using 10 power magnification, examine for conformance to 3.7.5; record the percent elongation corresponding to the largest spherical impression at which no cracking occurs.

4.5.6 Infrared reflectance (type II primer coatings only). The type II primer coatings shall be applied to test panels designated A (see table I) in accordance with 4.4.1. The total reflectance (specular and diffuse) of the primer coatings relative to barium sulfate shall be measured using a near infrared spectrophotometer over a range of 700 to 2,600 nm. Examine for conformance to 3.7.6.

4.5.7 Water resistance. The primer coatings shall be applied to test panels designated A (see table I) in accordance with 4.4.1 and topcoated in accordance with 4.4.2. The coated test panels shall then be completely immersed in distilled water maintained at 49 ±3° C (120 ±5° F) for four days. Two hours after removal from the water, the coatings shall be examined for conformance to 3.8.1.

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4.5.8 Corrosion resistance.

4.5.8.1 Salt spray. Six test panels designated A (see table I) shall be prepared with primer coating (see 4.4.1). Three of the primer coated panels shall be topcoated (see 4.4.2). Two intersecting lines shall be scribed diagonally across the coated surface of each panel, exposing the bare substrate. The test panels shall then be placed in a 5 percent salt-spray cabinet for 2,000 hours in accordance with ASTM B117. After removal, the test panels shall be examined for conformance to 3.8.2.1.

4.5.8.2 Filiform. The primer coatings shall be applied to test panels designated D (see table I) in accordance with 4.4.1 and topcoated in accordance with 4.4.2. 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 approximately one inch of 12 Normal (N) HCl for 1 hour at room temperature (see 4.5), only the HCl fumes shall come in contact with the sample. Within 5 minutes of removal from the desiccator, the test panels shall be placed in a humidity cabinet maintained at 40 ±2° C (104 ±3° F) and relative humidity of 80 ±5 percent for 1,000 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 description of filiform growth can be found in ASTM D2803.)

4.5.9 Solvent resistance (cure). The primer coatings shall be applied to test panels designated A (see table I) in accordance with 4.4.1. A cotton, terrycloth rag shall be soaked in MEK solvent (see 6.10) and rubbed back and forth 25 times (50 passes) over the coating with firm finger pressure in accordance with ASTM D5402 method A. The coating shall then be examined for conformance to 3.8.3.

4.5.10 Fluid resistance. The primer coatings shall be applied to test panels designated A (see table I) in accordance with 4.4.1. The test panels shall then be separately immersed to half their length for 24 hours in glass covered beakers containing the following liquids:

a. Lubricating oil conforming to MIL-PRF-23699, maintained at 121 ±3° C (250 ±5° F);
b. Hydraulic fluid conforming to MIL-PRF-83282, maintained at 65.5 ±3° C (150 ±5° F).

After removal from the test fluids, cool the test panels to room temperature (see 4.5) and examine for conformance to 3.8.4.

4.5.11 Working properties.

4.5.11.1 Mixing and dilution. Thoroughly mix each component separately. Slowly pour component B into component A then add component C (if applicable), while constantly stirring, until the manufacturer's specified volume mixing ratio is achieved. If necessary, dilute the

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admixed primer coating with thinner conforming to MIL-T-81772, type II (see 6.11). Stir well and allow coating to dwell for 30 minutes. Examine for conformance to 3.9.1.

4.5.11.2 Application. Using conventional, airless, high volume/low pressure (HVLP), or electrostatic spray equipment, apply the primer coating to test panels to a dry film thickness of 15 to 23 μm (0.6 to 0.9 mil) in accordance with 4.4.1. Examine for conformance to 3.7.1 and 3.9.2.

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

4.5.13 Strippability.

Method A: Prepare two test panels with the primer coating only (see 4.4 and 4.4.1). All of the test panels shall then be aged at room temperature for seven days followed by seven days at 65.5° C (150° F). Using a stylus the panels shall be scribed to the substrate with an "X" 1-inch in length in the middle of the panel on the coated surface side. Seal the edges of the prepared test panels with beeswax by dipping in melted wax to a depth not to exceed 6 mm (0.25 in.) from all edges. The test panels shall then be placed on a rack at 60° to the horizontal, coated side up. Enough coating remover conforming to the control formulation of TT-R-2918, type I, shall be poured along the upper edge of the test panels to completely cover the coating surface. Allow the remover to dwell 4 hours, the panel shall then be scraped with a rubber scraper to remove loosened coating; apply additional remover conforming to the control formulation of TT-R-2918, type I, to cover any remaining coating and allow it to dwell for an additional 4 hours. Immediately after this second 4 hour exposure, the test panels shall be scraped with a rubber scraper to remove the bulk of the loosened coatings and remover residue. The test panels shall then be rinsed with cool tap water and brushed with a soft, nylon bristle brush. Paint removal shall be determined for each test panel by estimating the percentage of the substrate revealed by the stripping process. The result shall be the average of the two panels tested. The result shall conform to 3.12.

Method B: Prepare two test panels with the primer coating only (see 4.4 and 4.4.1). All of the test panels shall then be aged at room temperature for seven days followed by seven days at 65.5° C (150° F). Seal the edges of the prepared test panels with beeswax by dipping in melted wax to a depth not to exceed 6 mm (0.25 in.) from all edges. The panels shall then be placed on a rack at a 60° angle with the horizontal. Enough paint remover conforming to MIL-R-81294, type I, shall be poured along the upper edge of each test panel to completely cover the coating surface. After no less than 60 minutes of exposure, the loosened coating shall be brushed off, and the test panels shall be rinsed while brushing under a stream of cool water. The result shall be the average of the two panels tested. The result shall conform to 3.12.

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5. PACKAGING

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

6. NOTES

(This section contains information of a general or explanatory nature which 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. These primer coatings are formulated for the unique performance requirements of military aircraft. These requirements include adhesion to a wide variety of metals and composites, flexibility to withstand tactical maneuvers at low temperatures, corrosion resistance in a marine environment, resistance to leaking aircraft fluids, and low-infrared reflectance for stealth in combat. Type I is for general use. Type II is for use where low infrared reflectance is required. Unless a specific type or class is referenced in a contract or order, type I, class C2 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 their use is given by the engineering authority for the system or item to which the primer coatings are to be applied. For users of MIL-PRF-23377F, class 2, high-solids coating, use class C2 of this document. For users of MIL-PRF-23377G and MIL-PRF-23377H, class C, use class C2 of this document.

6.1.1 Compatibility. For some applications, and only when authorization for their use is given by the engineering authority for the system or item to which the primer coatings are to be applied, MIL-PRF-85582, Primer Coatings: Epoxy, Waterborne, may be substituted for MIL-PRF-23377. Both MIL-PRF-23377 and MIL-PRF-85582 are compatible with the following coatings: MIL-PRF-22750, Coating, Epoxy, High-Solids; MIL-DTL-64159, Camouflage Coating, Water Dispersible Aliphatic Polyurethane, Chemical Agent Resistant; and MIL-DTL-53039, Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant; MIL-PRF-85285 Coating: Polyurethane, Aircraft and Support Equipment.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of the specification.
b. Type and class required (see 1.2)
c. Quantity and kit size identification (see 1.3.1)
d. Conformance report (see 4.3)

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e. Packaging requirements (see 5.1)
f. Any formulation modifications (see 6.4.1)

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion on the Qualified Products List QPL-23377 in the Qualified Products Database. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from the Commander, Naval Air Warfare Center Aircraft Division, Code 4.9.7.2, Building 2188, Patuxent River, MD 20670-1908.

6.3.1 Storage stability, inspection, and other information. In addition to the qualification test samples, the qualifying activity will request the manufacturer to submit to the qualification activity: (a) a certified test report showing that the material conforms to the requirements of this specification; (b) one copy of the MSDS (see 6.9); (c) certification that the manufacturer's material meets the storage stability requirements (see 3.5.3).

6.3.1.1 Qualification inspection sample identification. Qualification inspection samples are to be forwarded to the laboratory designated in the letter of authorization (see 6.3) and identified as follows:

Qualification test samples.
Specification MIL-PRF-23377K, type I or II, class C1, C2, 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)

6.4 Retention of qualification. To retain qualification approval of products listed on the Qualified Products List (QPL) in the Qualified Products Database (QPD), the manufacturer will be required to 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 will be in two-year intervals from the date of original qualification. The certification action will be initiated by the qualifying activity.

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

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6.5 Conformance rejection and retest. Failure in any conformance inspection will result in the rejection of the batch from which it was obtained and constitutes justification for removal from the qualified products list. Rejected material cannot be resubmitted for acceptance without written approval from the qualification activity (see 6.3). The application for resubmission will contain all details concerning previous rejections and measures taken to correct these deficiencies.

6.6 Lot and batch formation. A lot consists of all of the primer coatings manufactured at one time from one batch, forming part of one contract or order and submitted for acceptance. A batch should consist of all primer coatings manufactured during one continuous operation.

6.7 Impact tester source. An instrument for conducting the flexibility (see 4.5.5) is the Gardco GE Universal Impact Tester, Model #172, available from the Paul N. Gardner Company, 316 NE First Street, PO Box 10688, Pompano Beach, FL 33061-6688. There may be other instruments equivalent to this unit.

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

6.9 Material Safety Data Sheet (MSDS). An MSDS must be prepared and submitted in accordance with FED-STD-313. The MSDS must also meet the requirements of 29 CFR 1910.1200. The 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. Questions pertinent to the effect(s) of these coatings on the health of personnel using them should be referred by the procuring activity to the appropriate medical service, who will act as its adviser. Contracting officers will identify the activities requiring copies of the MSDS.

6.10 Safely handling MEK solvent. To minimize exposure to MEK solvent, it is recommended that personnel conducting the solvent resistance (cure) test (see 4.5.9) 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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6.11 Thinning. If it is necessary to add thinner to this coating, use only thinner conforming to MIL-T-81772, type II or thinner supplied as component C. Do not add thinner to the primer coating if that addition will raise the VOC content to greater than 340 g/L (2.8 lb/gal).

6.12 Shelf life. This specification covers items where the assignment of a Federal shelf-life code is a consideration. Specific shelf-life requirements should be specified in the contract or purchase order, and should include, as a minimum, shelf-life code, shelf-life package markings in accordance with MIL-STD-129 or FED-STD-123. These and other requirements, if necessary, are in DoD 4140.27-M, *Shelf-life Management Manual*. The shelf-life codes are in the Federal Logistics Information System Total Item Record. Additive information for shelf-life management may be obtained from DoD 4140.27-M, or the designated shelf-life Points of Contact (POC). The POC should be contacted in the following order: (1) the Inventory Control Points that manage the item and (2) the DoD Service and Agency administrators for the DoD Shelf-Life Program. Appropriate POCs for the DoD Shelf-Life Program can be contacted through the DoD Shelf-Life Management website: https://www.shelflife.hq.dla.mil/.

6.12.1 Plastic container touchup kits. It is recommended that the plastic container touchup kits be shelf-life nonrenewable, or in accordance with DoD 4140.27-M, Type I. Code F.

6.13 Subject term (key word) listing.

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

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

Custodians:
Army - MR
Navy - AS
Air Force - 99

Preparing activity:
Navy - AS
(Project 8010-2012-003)

Review activities:
Army - AR, EA, MI
Navy - CG, MC, OS, SH
Air Force - 11, 84
Other - DS, GSA/FAS

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

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