

INCH-POUND
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MIL-DTL-0053084A (MR)

3 August 2006

USED IN LIEU OF

MIL-P-53084 (ME)

20 July 1988

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24 June 1994

## DETAIL SPECIFICATION

## PRIMER, CATHODIC ELECTRODEPOSITION, CHEMICAL AGENT RESISTANT

This specification is approved for interim use by the U.S. Army Research Laboratory. Other activities in the Department of Defense may use this interim revision or may continue using MIL-P-53084 (ME).

## 1. SCOPE

1.1 Scope. This specification covers a waterborne, cathodic epoxy electrodeposition primer formulated lead and hexavalent chrome free. The primer meets solvent emission maximums of 144 grams per liter (1.2 pounds per gallon) volatile organic compounds (VOC).

## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 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, 4, or 5 of this specification, whether or not they are listed.

Comments, suggestions, or questions on this document should be addressed to: Director, U.S. Army Research Laboratory, Weapons and Materials Research Directorate, Materials Applications Branch, Specifications and Standards Office, Attn: AMSRD-ARL-WM-MC, Aberdeen Proving Ground, MD 21005-5069 or emailed to <a href="mailto:rsquilla@arl.army.mil">rsquilla@arl.army.mil</a> . Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <a href="http://assist.daps.dla.mil/">http://assist.daps.dla.mil/</a> .
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2.2 Government documents.

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

## FEDERAL SPECIFICATIONS

TT-C-490	-	Chemical Conversion Coatings and Pretreatments for Ferrous Surfaces (Base for Organic Coatings).
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## FEDERAL STANDARDS

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.
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FED-STD-595 Color Chip Numbers	-	Colors Used in Government Procurement 26270, 26373, 26493.
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## DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-5541	-	Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
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MIL-DTL-12468	-	Decontaminating Agent, STB.
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MIL-DTL-53039	-	Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant.
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MIL-DTL-64159	-	Coating, Water Dispersible Aliphatic Polyurethane, Chemical Agent Resistant.
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(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or <http://assist.daps.dla.mil/> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

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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. (DoD adopted)
ASTM D522	-	Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings. (DoD adopted)
ASTM D523	-	Standard Test Method for Specular Gloss. (DoD adopted)
ASTM D610	-	Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces. (DoD adopted)
ASTM D1153	-	Standard Specification for Methyl Isobutyl Ketone. (DoD adopted)
ASTM D1394	-	Standard Test Methods for Chemical Analysis of White Titanium Pigments. (DoD adopted)
ASTM D1475	-	Standard Test Method for Density of Liquid Coatings, Inks, and Related Products. (DoD adopted)
ASTM D2196	-	Standard Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield type) Viscometer. (DoD adopted)
ASTM D2369	-	Standard Test Method for Volatile Content of Coatings. (DoD adopted)
ASTM D3335	-	Standard Test Method for Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy. (DoD adopted)
ASTM D3359	-	Standard Test Methods for Measuring Adhesion by Tape Test.
ASTM D3363	-	Standard Test Method for Film Hardness by Pencil Test. (DoD adopted)
ASTM D3960	-	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings. (DoD adopted)

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ASTM D4214	-	Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films. (DoD adopted)
ASTM D4399	-	Standard Test Method for Measuring Electrical Conductivity of Electrocoat Baths.
ASTM G90	-	Standard Practice for Performing Accelerated Outdoor Weathering of Nonmetallic Materials Using Concentrated Natural Sunlight.

(Copies of these documents are available from [www.astm.org](http://www.astm.org) or ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959.)

2.4 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 primer furnished under this specification shall be a product that is authorized by the qualifying activity for listing on the applicable qualified products list (QPL) before contract award (see 4.2 and 6.3). Any change in the formulation of a qualified product shall necessitate its requalification. The material supplied under contract shall be identical, within performance tolerances, to the products receiving qualification. The compositional values of the actual production line product will be established on a case by case basis by the approving coating supplier.

3.2 Materials. The materials used in the primer shall be as specified herein. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this specification.

3.3 Color and 60° Gloss. For qualification purposes, the primer shall be a gray visual match to chip number 26493 of FED-STD-595 or at most no darker than chip number 26373. For actual production, the color may darken to chip number 26270. The 60° gloss range shall be 30-70.

3.4 Composition. The primer shall be furnished in two parts: a resin feed component and a pigment feed paste component.

3.4.1 Resin feed component. The resin feed component shall consist of an epoxy or an epoxy-urethane resin combined with the necessary amounts of flow control agents and volatile solvents. The use of acrylic resins as flow control agents is restricted to less than 2.0 percent by weight. When tested as specified in 4.8, the resin feed component must meet the quantitative requirements of table I.

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**3.4.2 Pigment paste component.** The pigment paste shall consist of a resin as specified in 3.4.1, volatile solvents, titanium dioxide and siliceous extenders. The use of small amounts of tinting pigments is permissible to achieve the color as specified in 3.3. Hexavalent chromate, zinc chromate, or lead pigments shall not be used alone or as a component part of any pigment. When tested as in section 4, the pigment paste component must meet the quantitative requirements of table I.

**3.5 Mixed primer requirements.** The mixed primer shall conform to the quantitative requirements of table II when tested as in section 4.

TABLE I. Component breakdown.

<u>Characteristic</u>	<u>Resin Feed</u>	<u>Pigment Paste</u>
Total Solids, percent by weight	38.0 ± 5.0	53.0 + 2.0
Weight per gallon	8.8 ± 0.2	11.6 – 13.5
pH range	5.5 – 7.0	6.7 – 8.0
Viscosity	100 CPS (max)	5000 CPS (max)
Titanium dioxide, percent by weight of pigment	-	50 min.
Hexavalent chrome	-	Negative
Epoxy resin	Positive	Negative

TABLE II. Mixed primer quantitative requirements.

<u>Characteristic</u>	<u>Requirement</u>
Total solids, percent by weight	10.0 – 20.0
Pigment / binder	0.10 – 0.35
pH range	5.6 - 6.3
Conductivity, micromhos	1000 – 2000
Volatile organic compounds (VOC), grams per liter/pounds per gallon	144/1.2 (max)
Lead content, percent by weight of total solids	0.06 (max)

**3.6 Applied primer qualitative requirements.**

**3.6.1 Conditioner in container.** When tested as specified in 4.11.1, the resin feed component and pigment paste component shall be free from grit, seeds, abnormal thickening or livering in a freshly opened container. The pigment paste component shall show no more pigment settling or caking than can be easily and completely reincorporated to a smooth homogeneous state.

**3.6.2 Mixing properties.** When mixed as specified in 4.11.2, a smooth homogeneous mixture shall result.

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3.6.3 Electrocoating application properties. When applied as specified in 4.11.3, the primer shall electrocoat satisfactorily and shall show a continuous film after baking which conforms to the color, gloss and performance properties as specified in section 4. The baked film shall show no mottling or color separation and shall present a finish free from craters or orange peel.

3.6.4 Cure time. When tested as specified in 4.11.4, the tested area shall show no film softening when compared to an untested portion of the panel.

3.6.5 Adhesion. When tested as specified in 4.11.5, the film of the primer shall show no removal from the surface of the cross-cut area, classification 5B per ASTM D3359. The film of the primer and the topcoat shall show less than 5 percent of the area affected as described as classification 4B per ASTM D3359.

3.6.6 Knife test. When tested as specified in 4.11.6, the film of the primer shall adhere tightly to the test panel. It shall be difficult to furrow off with the knife and shall not flake, chip, or powder. The knife cut shall show beveled edges.

3.6.7 Flexibility. A film of the primer tested as specified in 4.11.7 shall withstand bending without cracking or flaking.

3.6.8 Salt spray resistance. When tested as specified in 4.11.8, the panels shall be examined immediately after removal from the test and show no more than a trace of rusting (see ASTM D610, table I, rust grade 8) and no blister larger than one millimeter in diameter. The cross-scribed area shall not exceed one-eighth inch score rust creeping on either side of the scribe line or loss of adhesion. The panels tested for cross hatch adhesion properties shall satisfy classification 3B of ASTM D3359. Upon removal of the primer, the substrate shall show no more than a trace of rusting, pitting, or corrosion.

3.6.9 Super Tropical Bleach (STB) resistance. When tested as specified in 4.11.9, a film of the coating shall show no blistering, wrinkling, or film softening when examined immediately after washing with water. Film softening shall not exceed a 2 pencil hardness difference (see ASTM D3363) from an unexposed film with identical cure history prior to Super Tropical Bleach exposure. After drying, there shall be a maximum color change of 2.5 NBS units when comparing a portion of the untested panel to that of the tested area. The Super Tropical Bleach (STB) composition shall be in accordance with MIL-DTL-12468.

3.6.10 Throw power. When tested as specified in 4.11.10, the inside face of the test panel shall plate to a dry film thickness of  $0.0001 \pm 0.00001$  inches ( $0.00254 \pm 0.000254$  mm) minimum at least 10 inches (254 mm) up the panel. A throw power below 10 inches (254 mm) is unacceptable. After removal from the salt spray cabinet, rinse the panels and examine for rusting. There shall be no more than a trace amount of rusting (see ASTM D610, table I, rust grade 8) and no blisters larger than 1 mm in diameter on the entire 10 inch (254 mm) coated surface.

3.6.11 Weather resistance. When tested as specified in 4.11.11, the panels shall show no rusting, cracking, checking, flaking or loss of adhesion. Primer that has a topcoat coating with

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Green 383, 34094 as specified in MIL-DTL-64159 type II shall show no more than light chalking (see ASTM D4214). On removal of the primer and topcoat, the panels shall show no more than a trace of rusting, pitting or corrosion (see ASTM D610, table I, rust grade 9).

3.6.12 Toxic ingredients. The primer shall contain no benzene, chlorinated solvents or acetates of ethylene based glycol ethers. The primer shall have no adverse effects on the health of personnel when used for its intended purpose.

3.6.13 User instruction marking and precaution sheet. All containers shall include the volatile organic compound content in grams per liter of coating and a printed precaution sheet with the following information:

PRECAUTION: The Surgeon General requires airline respirators to be used unless air sampling shows exposure to be below standards. Then, either chemical cartridge respirators or airline respirators are required. Avoid contact with skin and eyes. Use with adequate ventilation. For other safety recommendations, refer to the Material Safety Data Sheet. Keep containers closed.

3.6.14 Toxicity clearance. All new chemicals and materials being added to the Army supply system shall have a toxicity clearance. A toxicity clearance involves a toxicological evaluation of materials prior to introduction into the Army supply system. The Army program manager shall be responsible for identifying technically feasible materials and requesting a toxicity clearance for use of that material within their program (see 6.4).

3.6.15 Workmanship. The chemical conversion materials shall be uniform in composition and quality, and be free from impurities and other defects that impair usability and adversely affect performance. The chemical conversion materials furnished in this specification shall be identical in composition and coating characteristics to the qualification sample.

3.6.16 Material safety data sheet. A Material Safety Data Sheet shall be prepared for the primer in accordance with FED-STD-313 and forwarded to the qualifying activity (see 6.3). The material safety data sheet shall be included with each shipment of the material covered by this specification and submitted to pertinent Government agencies as stated in FED-STD-313.

#### 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 4.4).

4.2 Qualification inspection. Qualification shall be conducted by the Qualifying activity (see 6.3). The qualification test sample shall consist of four quarts of the paint. The samples shall be legibly identified (see 6.3.2). Qualification inspection shall consist of tests for all requirements specified in section 3 in accordance with table III, and examination for user instruction marking (see 3.6.13). The results of each test shall be compared with the applicable requirement in

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section 3. Failure to conform to any requirement shall be counted as a defect, and paint represented by the sample test shall not be approved for inclusion on the qualified products list (QPL) under this specification.

4.3 On-Site production tests. On a monthly basis, under production conditions, the contractor shall electrocoat and cure a standard pretreated panel. The tank operating conditions at the time of application shall be noted on the panel (date, voltage, tank temperature, line speed, dry film thickness, bake temperature, bake time). The panel, along with a gallon tank sample, shall be sent to the coating manufacturer for evaluation. The panel, test results and analyses of tank sample shall be retained by the coating supplier for one year. This data shall be presented to responsible parties in the Department of Defense upon request.

4.4 Conformance inspection. The contracting officer shall require that an appropriate sample from each production lot (see 4.4.1) be forwarded to the U.S. Army Research Laboratory, ATTN: AMSRD-ARL-WM-MC (Coatings Team), Building 4600, Deer Creek Loop, Aberdeen Proving Ground, MD 21005-5069. Conformance inspection shall consist of testing for the requirements as specified in table III. There shall be no failures (see 6.5).

4.4.1 Lot and batch formation. Unless otherwise specified in the contract or purchase description (see 6.2), a lot shall consist of all coatings of the same type, composition and color, from a single uniform batch, produced and offered for delivery at one time (see 6.3.3). Unless otherwise specified in the contract or purchase description (see 6.2), a batch shall consist of all coating material (in U.S. gallons) manufactured during one continuous operation and forming part of one contract or order for delivery (see 6.3.3). The addition of any substance to a batch shall constitute a new lot.

4.5 Sampling and inspection. Unless otherwise specified, sampling, inspection, and testing shall be in accordance with section 1000 of FED-STD-141. In addition to section 1000 of FED-STD-141, the following determinations shall be done at the primer application line:

- a. Daily tests for percent solids, pigment to binder ratio, pH and conductivity of the primer bath.
- b. Daily tests for conductivity of the deionized rinse water, post rinse before the primer bath and the anolyte.
- c. One gallon samples of the primer bath shall be evaluated on a monthly basis by the coating supplier (see 4.3).

This data shall be available for review by responsible parties in the Department of Defense.

4.5.1 Material safety data sheet. The Material Safety Data Sheet shall address all components of the primer and be in compliance with the requirements of FED-STD-313. Nonconformance to 3.6.16 shall constitute failure of this requirement.



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#### 4.6 Test methods.

4.6.1 Test conditions. The routine testing conditions shall be in accordance with section 9 of FED-STD-141 or in accordance with the appropriate ASTM method except as otherwise specified herein. Failure of any test result to fall within the ranges specified in 3.3, 3.4, 3.5 and 3.6, as applicable, shall constitute failure of the applicable test. For all tests requiring the use of the mixed primer, the resin feed component and pigment paste feed component shall be mixed in the proportions specified in 4.6.3.

4.6.2 Test panels. Steel test panels shall be pretreated with a zinc phosphate coating in accordance with TT-C-490 type I. Aluminum test panels shall be aluminum alloy 3003H14 treated with alodine 1200S to produce a coating meeting the requirements of MIL-DTL-5541.

4.6.3 Mixing and application. Unless otherwise specified (see 6.2), instructions for mixing and thinning the mixed primer shall be specified in the contract or solicitation. In preparation of the primer bath, the deionized water used for thinning and rinsing shall have a conductivity of less than 10 micromhos per centimeter and be free of bacteria. Conductivity shall be measured in accordance with ASTM D4399. After mixing the resin, pigment and deionized water, allow the bath to stir for a 24 hour period before testing. Throughout the testing period, constantly agitate the bath. The bath operations shall be held between 26-28 °C (78-82 °F). Since the electrodeposition primer is cathodic, the panel being coated is the negative electrode while the beaker or side electrodes are positively charged. Panels to be electrocoated are immersed in the bath liquid and the rectifier turned on. Voltage is increased over approximately 20 seconds to a reading necessary to provide  $0.001 \pm 0.0001$  inches ( $0.0254 \pm 0.00254$  mm) of dry film thickness. Several trial panels are necessary to define this voltage for each substrate. Generally, 150 to 300 volts are required. Normal deposition time is 90 seconds. Once coated, panels are removed from the bath and rinsed with deionized water. Curing of the deposited primer will be in convection type oven capable of reaching  $177 \pm 1$  °C ( $350 \pm 2$  °F) metal temperature for 20 minutes. Allow the cured primer to cool to room temperature 18-27 °C (65-80 °F) before testing.

4.6.4 Test procedures. The following tests (see table III) shall be conducted in accordance with FED-STD-141, the appropriate ASTM method, or specific procedures cited herein. The right is reserved to make any additional tests deemed necessary to determine that the coating meets the requirements of this specification.

4.7 Color and 60° gloss. Prepare a panel of each substrate as specified in 4.6.2 and 4.6.3. Compare the color as specified in 3.3. Determine the 60° gloss in accordance with ASTM D523 and check for compliance to 3.3. Nonconformance to 3.3 shall constitute failure of this test.

4.8 Resin component. The following tests shall be made on the resin feed component. Check for compliance with 3.4.1 and table I. Nonconformance to 3.4.1 and table I shall constitute failure of this test.

4.8.1 Total solids. Determine the total solids (nonvolatile matter) in accordance with ASTM D2369.

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4.8.2 Weight per gallon. Determine the weight per gallon in accordance with ASTM D1475.

4.8.3 pH determination. Standardize pH meter using fresh buffer solutions with pH of 4, 6, and 7 at 25 °C (77 °F). Rinse the pH probe with distilled or deionized water between each reading. Immerse the probe into the sample and take the reading after one minute with mild agitation.

4.8.4 Viscosity. Determine the viscosity in accordance with ASTM D2196 Test Method A.

4.8.5 Epoxy resin test. Determine the presence of an epoxy-based resin by placing approximately 5 mL of the well mixed resin component into a test tube. Extract the sample with 10 mL of toluene. Decant most of the top organic layer into a 25 mL beaker and evaporate to dryness on a steam bath. After cooling, add dropwise 2 mL of concentrated H<sub>2</sub>SO<sub>4</sub>. Stir, cool and add 2-3 drops of 40 percent formaldehyde solution. Allow sample to stand a few minutes. Dilute with 15 mL of distilled water added all at one time. A green to blue-green color will form immediately indicating the presence of a bisphenol type of epoxy resin. Confirmation of the resin type shall be determined by placing two drops of the organic layer extract onto a KBr plate. Remove the solvent by drying the plate in a 60 °C (140 °F) oven for 30 minutes. Identify the remaining film by infrared spectroscopy.

4.9 Pigment component. The following tests shall be made on the pigment feed component. Check for conformance with table I. Nonconformance to table I shall constitute failure of this test.

4.9.1 Total solids. Determine the total solids (nonvolatile matter) of the pigment component as specified in 4.8.1.

4.9.2 Weight per gallon. Determine the weight per gallon of the pigment component as specified in 4.8.2..

4.9.3 pH determination. Determine the pH of the pigment component as specified in 4.8.3.

4.9.4 Viscosity. Determine the viscosity of the pigment component as specified in 4.8.4.

4.9.5 Titanium dioxide. Determine the titanium dioxide (TiO<sub>2</sub>) content on the extracted pigment in accordance with ASTM D1394.

4.9.6 Hexavalent chrome. Determine the presence or absence of hexavalent chrome by using pigment extracted as in 4.9.5. Add 5 mL of 25 percent aqueous KOH to 0.5 g of the extracted pigment in a 15 mL centrifuge tube. Agitate by shaking the tube for a few minutes then centrifuge. The supernatant liquid shall be colorless. A yellow color indicates the presence of hexavalent chrome and shall constitute failure of this test.

4.9.7 Epoxy resin test. Determine the presence of an epoxy-based resin by placing approximately 5 mL of the well mixed pigment component into a test tube. Extract the sample with 10 mL of toluene. Decant most of the top organic layer into a 25 mL beaker and evaporate to dryness on a steam bath. After cooling, add dropwise 2 mL of concentrated H<sub>2</sub>SO<sub>4</sub>. Stir cool

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and add 2-3 drops of 40 percent formaldehyde solution. Allow sample to stand a few minutes. Dilute with 15 mL of distilled water added all at one time. A green to blue-green color shall form immediately indicating the presence of a bisphenol type of epoxy resin. Confirmation of the resin type shall be determined by placing two drops of the organic layer extract onto a KBr plate. Remove the solvent by drying the plate in a 60 °C (140 °F) oven for 30 minutes. Identify the remaining film by infrared spectroscopy. Nonconformance to table I shall constitute failure of the test.

TABLE III. Index.

Item	FED-STD-141 Method	ASTM Method	Test Paragraph	Requirement Paragraph or Table
Color and 60° gloss	-	D523	4.7	3.3
Resin feed component	-	-	4.8	3.4.1
Pigment paste component	-	-	4.9	3.4.2
Viscosity	-	D2196 Method A	4.8.4 & 4.9.4	Table I
Weight per gallon	-	D1475	4.8.2 & 4.9.2	Table I
Titanium dioxide	-	D1394	4.9.5	Table I
Hexavalent chromium	-	-	4.9.6	Table I & 3.4.2
Epoxy resin test	-	-	4.8.5 & 4.9.7	Table I, 3.4.1 & 3.4.2
pH range	-	-	4.8.3 & 4.9.3	Tables I & II
Conductivity	-	-	4.10.4	Table II
Total solids	-	D2369	4.8.1	Tables I & II
Volatile organic compounds (VOC)	-	D3960	4.10.5	Table II
Lead content	-	D3335	4.10.6	Table II
Pigment to binder ratio	-	-	4.10.2	Table II
Condition in container	3011.3	-	4.11.1	3.6.1
Mixing properties	-	-	4.11.2	3.6.2
Application properties	-	-	4.11.3	3.6.3
Cure time	-	D1153	4.11.4	3.6.4
Adhesion	-	D3359 Method B	4.11.5	3.6.5
Knife test	6304.2	-	4.11.6	3.6.6
Flexibility	-	D522 Method B	4.11.7	3.6.7
Salt spray resistance	-	B117	4.11.8	3.6.8
STB resistance	-	-	4.11.9	3.6.9
Throw power	-	-	4.11.10	3.6.10
Weather resistance	-	D4214	4.11.11	3.6.11
Toxic ingredients	-	-	4.11.12	3.6.12

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4.10 Mixed primer requirements. When mixed as specified in 4.6.3, the primer bath shall have the following quantitative characteristics. Check the compliance with table II. Nonconformance to table II shall constitute failure of the test.

4.10.1 Total solids. Determine the primer bath total solids as specified in 4.8.1.

4.10.2 Pigment/binder. Determine the pigment/binder value as an average of two sample test results. Precondition porcelain crucibles in an oven at  $110 \pm 5$  °C ( $230 \pm 9$  °F) for 30 minutes and store in a desiccator prior to use. Weigh the crucibles and record the weight, C. Transfer 1.0 to 1.5 g of the mixed primer bath into the crucible and bake for one hour at  $110 \pm 5$  °C ( $230 \pm 9$  °F). After cooling the sample to room temperature in a desiccators, reweigh the crucible, D. Transfer the crucible to a muffle furnace preset to 100 °C (212 °F) or less and adjust the setting in order to reach a final temperature of 660 °C (1220 °F). The sample shall remain at 660 °C (1220 °F) for 90 minutes. Remove sample from muffle furnace and allow it to return to room temperature in a desiccator. Reweigh crucible and record the weight, E. Calculate the pigment/binder as follows:

$$P/B = (E-C)/(D-E)$$

4.10.3 pH determination. Determine the pH of the mixed primer bath as specified in 4.8.3.

4.10.4 Conductivity. Determine the conductivity of the mixed primer bath with a conductivity meter with a range of 0.1 to 10,000 micromhos per centimeter and by using a cell with a constant of 1.0. Before determining the conductivity of the sample, standardize the conductivity cell by using a 0.010 normal KCL solution. With a 0.010 normal KCL solution, having a conductivity reading of 1413 micromhos per centimeter at 25 °C (77 °F), the conductivity cell K factor is obtained as follows:

$$K \text{ factor} = (1413) / (\text{Conductivity reading of KCL solution})$$

Disconnect the conductivity cup and discard the standard solution. Rinse the cup several times with deionized water and wipe dry. The test sample shall be homogeneous and at a temperature of  $25 \pm 1$  °C ( $77 \pm 1$  °F). Fill the conductivity cup with the sample, reconnect the cup to the conductivity meter and record the apparent conductivity reading, A. Calculate the bath conductivity of the sample as follows:

$$\text{Conductivity of mixed primer bath} = (K \text{ factor}) \times A$$

4.10.5 Volatile organic compounds (VOC). Determine the VOC of the mixed primer bath in accordance with ASTM D3960.

4.10.6 Lead content. Determine the lead content of the mixed primer bath by atomic absorption spectroscopy in accordance with ASTM D3335.

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4.11 Applied primer qualitative requirements.

4.11.1 Condition in container. Determine package condition in accordance with method 3011.3 of FED-STD-141 and observe for compliance with 3.6.1. On qualification testing, determine pigment settling by proceeding as specified in FED-STD-141, method 3011.3, but do not stir. Reseal and then agitate the can for 3 minutes on a paint shaker. On reexamination of the contents, the disclosure of any gel bodies or undispersed pigment indicates unsatisfactory settling properties. Nonconformance to 3.6.1 shall constitute failure of this test.

4.11.2 Mixing properties. Follow the manufacturer's instructions in preparing the primer bath. Charge the coating cell with deionized water as specified in 4.6.3 and under agitation slowly add the resin feed component. Gradually add the pigment feed under sufficient agitation to produce a homogeneous system. Check for compliance with 3.6.2. Nonconformance to 3.6.2 shall constitute failure of this test.

4.11.3 Electrocoating application properties. Deposit a film of the primer and cure as specified in 4.6.3. Check for compliance with 3.6.3. Nonconformance to 3.6.3 shall constitute failure of this test.

4.11.4 Cure time. Prepare a film of primer as specified in 4.6.3 ensuring that the primer is cured for 20 minutes at a metal temperature of 177 °C (350 °F). Allow the panel to cool to a room temperature of 18-27 °C (65-80 °F). Saturate a soft cloth or laboratory tissue with methyl isobutyl ketone conforming to ASTM D1153. Applying medium pressure with the index finger, rub the same area of the primer for a minimum of 30 strokes (movement in one direction). Examine the film of primer for loss of film and check for compliance with 3.6.4. Nonconformance to 3.6.4 shall constitute failure of this test.

4.11.5 Adhesion. Prepare two panels of each substrate as specified in 4.6.3. Perform the cross hatch adhesion test on one panel of each substrate in accordance with ASTM D3359, method B. Check for compliance with 3.6.5. The remaining steel and aluminum panels shall be topcoated with MIL-DTL-53039 or MIL-DTL-64159 to a minimum dry film thickness of 0.0018 inches (0.0457 mm) and allowed to air dry for 168 hours. Perform the cross hatch adhesion test on each topcoated panel in accordance with ASTM D3359, method B. Check for compliance with 3.6.5. Nonconformance with 3.6.5 for either tests shall constitute failure of this test.

4.11.6 Knife test. Prepare one panel of each substrate as in 4.11.5. Perform the knife test to each panel in accordance with method 6304.2 of FED-STD-141. Check for compliance with 3.6.6. Nonconformance to 3.6.6 shall constitute failure of this test.

4.11.7 Flexibility. Determine flexibility in accordance with ASTM D522, method B using a 1/4 inch mandrel. Prepare a film of primer on an aluminum panel as specified in 4.6.2 and 4.6.3. Bend the coated panels according to ASTM D522, method B. Examine the coating for cracks over the area of the bend for compliance with 3.6.7. Nonconformance to 3.6.7 shall constitute failure of this test.

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4.11.8 Salt spray resistance. Prepare five panels of each substrate as specified in 4.6.2 and 4.6.3. Two intersecting lines shall be scribed across the surface of each panel so that the bare substrate is exposed. The edges of all panels shall be sealed. The panels shall then be placed in a 5 percent salt spray cabinet for 1000 hours as described in ASTM B117. Upon removal, wash the panels gently in warm running water until free from any visible salt deposits and examine immediately for compliance with 3.6.8. One panel of each substrate shall have the cross hatch adhesion test performed in accordance with ASTM D3359, method B. Check for compliance with 3.6.8. One panel of each substrate shall be stripped down to the substrate and checked for compliance with 3.6.8. Nonconformance to 3.6.8 shall constitute failure of this test.

4.11.9 Super Tropical Bleach (STB) resistance. Prepare a film of primer on steel as specified in 4.6.2 and 4.6.3. Scribe a 1 inch diameter wax ring using a china marker on the painted surface of the panel. Place approximately 1 ml of STB agent on the panel surface. Do not cover. Allow to stand 30 minutes then thoroughly wash with water. An STB slurry mix of 40 parts STB and 60 parts water by weight shall be used. Examine for compliance with 3.6.9.

4.11.10 Throw power. In determining the throw power of the primer bath use 4 x 18 inch steel panels as specified in 4.6.2 and apply as specified in 4.6.3. Assemble a throw power box by securing the two metal panels face to face in a way that will result in a 3/8-inch gap between the panels. The panels shall be assembled along the sides using a nonconductive material with the top and bottom edges open. Submerge the throw power box into the primer bath and deposit a film of primer in accordance to 4.11.3. Application of the primer shall follow the parameters established in order to obtain a  $0.001 \pm 0.0001$  inches ( $0.0254 \pm 0.00254$  mm) dry film deposited on the outside face of the panel to be coated. Cure the panels per 4.11.4. Measure the film thickness at one inch intervals on the side of the panel which was located on the interior surface of the throw box. Seal the uncoated section and all edges of the test panel and expose the inside face to a 5 percent salt spray solution for 96 hours per ASTM B117. Upon completion of the exposure, remove the panels and wash in warm running water until they are free from any visible salt deposits. Examine immediately for compliance with 3.6.10. Nonconformance to 3.6.10 shall constitute failure of this test.

4.11.11 Weather resistance. Prepare two panels of each substrate as specified in 4.6.2 and 4.6.3. Topcoat all primed panels with Green 383, 34094 as specified in MIL-DTL-64159 type II to a dry film thickness of  $0.0020 \pm 0.0002$  inch ( $0.0508 \pm 0.00508$  mm). Allow to air dry for a minimum of 7 days and record color, 60° and 85° gloss readings for each panel. Panels shall be placed outdoors, for the equivalent of 560 MJ/m<sup>2</sup> of total UV irradiance, in an accelerated outdoor exposure according to ASTM G90. At 70 MJ/m<sup>2</sup> intervals examine the panels for compliance with 3.6.11. Determine chalking according to ASTM D4214. Wash the panels with a warm soap solution using a soft sponge or cloth, rinse, dry and examine for color change at each interval. The exposure racks shall be angled at a latitude of 33° 23' North and 112° 35' West. Nonconformance to 3.6.11 shall constitute failure of this test.

4.11.12 Toxic ingredients. The manufacturer shall certify that the primer contains no benzene, chlorinated solvents or acetates of ethylene based glycol ethers. Check for compliance with 3.6.12. Nonconformance to 3.6.12 shall constitute failure of this test.



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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 command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

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

6.1 Intended use. This specification covers a cathodic electrodeposition epoxy primer intended for use on properly cleaned and pretreated steel and aluminum. It is formulated lead and chrome free and will meet a volatile organic compound (VOC) level of 144 grams per liter (1.2 pounds per gallon).

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of the specification.
- b. Required markings (see 3.6.13).
- c. If a toxicity clearance is required (see 3.6.14).
- d. If qualification samples are required and where to send them (see 4.2 and 6.3).
- e. If conformance samples are required and where to send them (see 4.4).
- f. Lot and batch formation (see 4.4.1).
- g. If instructions are required for mixing and thinning the mixed primer (see 4.6.3).
- h. Packaging requirements (see 5.1).
- i. Whether material safety data sheets (MSDS) are required with each shipment (see 6.3.1).

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 in Qualified Products List QPL-53084, whether or not such products have actually been so listed by that date. The attention of contractors is called to this requirement and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Samples for qualified products list (QPL) testing (see 4.2) should be submitted to the U.S. Army Research Laboratory, ATTN: AMSRD-ARL-WM-MC (W. Lum), Building 4600, Deer Creek Loop, Aberdeen Proving Ground, MD 21005-5069.

6.3.1 Material safety data sheets (MSDS). The contracting activity should be provided a material safety data sheet for each part of the primer at the time of contract award. The MSDS should be

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provided in accordance with OSHA section 1910.1200, 29 CFR Chapter XVII and found as part of FED-STD-313. OSHA section 1910.1200 requires reporting threshold criteria for known or suspected human carcinogens on MSDS 0.1 percent or greater, and 1 percent or greater for other health hazards. The MSDS should be included with each unit of issue of material covered by the specification, when specified (see 6.2). Contracting officers will identify those activities requiring copies of completed material safety data sheets prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313.

6.3.2 Sample identification for qualification inspection. Samples for qualified products list (QPL) testing are to be identified in a cover letter with the following information:

- Manufacturer's name and product number.
- Submitted by (name and date).
- Specify the number of samples.
- Specify the reason for submitting the samples.
- Specify the specification number MIL-DTL-0053084A (MR).
- Provide a copy of the material safety data sheet (MSDS).
- Provide a copy of the statement of composition.
- Provide a copy of the technical data sheet.
- Provide a copy of the test report.

6.3.3 Conformity to qualified sample. All lots of coatings supplied under this specification must be manufactured using the same formulation, raw materials and supplier(s) of raw materials, methods of manufacture, equipment, and geographic location as the qualification sample, unless changes have been approved by the qualifying activity.

6.4 Toxicity request. Department of the Army Regulation (AR) 40-5, Preventive Medicine, (AR) 70-1, Acquisition Policy, and Department of the Army Pamphlet 70-3, Acquisition Procedures, require a toxicity clearance. Army toxicity questions and/or a toxicity clearance request should be addressed to: Commander, US Army Center For Health Promotion And Preventive Medicine (MCHB-TS-T), 5158 Blackhawk Road, Aberdeen Proving Ground, MD 21010-5403.

6.5 Conformance rejection and retest. Failure in any conformance inspection will result in the rejection of the batch from which it was obtained. Rejected material cannot be resubmitted for acceptance without written approval from the qualification activity (see 4.4). The application for resubmission will contain all details concerning previous rejections and measures taken to correct these deficiencies.

6.6 Detail specification. MIL-DTL-53072, Chemical Agent Resistant Coating (CARC) System Application Procedures and Quality Control Inspection, is available for application procedures and quality control inspection of this coating.



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6.7 Subject term (key word) listing.

Aircraft  
Camouflage  
CARC  
Colors  
Electrodeposition primer  
Epoxy primer  
Pigment

6.8 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.

CONCLUDING MATERIAL

Custodian:  
Army - MR

Preparing activity:  
Army - MR

Project 8010-2006-010

Review activities:  
Army – AR, AT, CR, EA, MD1, MI

Civil agency:  
GSA/FSS – 6FEE

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 <http://assist.daps.dla.mil/>.