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DETAIL SPECIFICATION

CHEMICAL AGENT RESISTANT COATING (CARC) SYSTEM APPLICATION PROCEDURES AND QUALITY CONTROL INSPECTION

Comments, suggestions, or questions on this document should be addressed to: Director, U.S. Army DEVCOM Army Research Laboratory (ARL), Weapons and Materials Research Directorate, Specifications & Standards Office, Attn: FCDD-RLW-MC, Aberdeen Proving Ground, MD 21005-5069. 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/.

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

1. SCOPE

1.1 Scope. This document covers the requirements for application and inspection of the CARC systems used on military equipment. It is required for use in the selection process of the appropriate materials and procedures for the surfaces to be painted, and provides additional application, inspection, and quality control information for the below referenced cleaning, pretreating, and coating specifications. This document does not alleviate the need for proper consideration of corrosion prevention and control (e.g., material selection, system design, manufacturing processes, maintenance, and other considerations during vehicle development and maintenance).

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, 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-P-28	-	Paint, Aluminum, Heat Resisting.
TT-C-490	-	Chemical Conversion Coatings And Pretreatments For Metallic Substrates (Base for Organic Coatings).

COMMERCIAL ITEM DESCRIPTIONS

A-A-59503	-	Nitrogen, Technical.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-5541	-	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-PRF-8625	-	Anodic Coatings for Aluminum and Aluminum Alloys.
MIL-DTL-12468	-	Decontaminating Agent, STB.
MIL-A-18455	-	Argon, Technical.
MIL-PRF-14105	-	Paint, Heat-Resisting (for Steel Surfaces).

MIL-PRF-22750	-	Coating, Epoxy, High-Solids.
MIL-PRF-23377	-	Primer Coatings: Epoxy, High-Solids.
MIL-PRF-32348	-	Powder Coating, Camouflage Chemical Agent Resistant Systems.
MIL-PRF-32440	-	Coatings, Chip-, Impact-, Wear-, and Abrasion-Resistant
MIL-DTL-32459	-	Coatings, Anodic for Magnesium and Magnesium Alloys.
MIL-PRF-32550	-	Metal-Rich Primer.
MIL-DTL-53022	-	Primer, Epoxy Coating, Corrosion Inhibiting Lead and Chromate Free.
MIL-DTL-53030	-	Primer Coating, Epoxy, Water Based, Lead and Chromate Free.
MIL-DTL-53039	-	Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant.
MIL-DTL-53084	-	Primer, Cathodic Electrodeposition, Chemical Agent Resistant.
MIL-DTL-64159	-	Camouflage Coating, Water Dispersible Aliphatic Polyurethane, Chemical Agent Resistant.
MIL-DTL-81706	-	Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys.
MIL-DTL-81772	-	Thinner, Aircraft Coating.
MIL-PRF-85582	-	Primer Coatings: Epoxy, Waterborne.
MIL-DTL-85891	-	Plastic Media, for Removal of Organic Coatings.

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

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications 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.

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

TM 43-0139	-	Painting Instructions for Army Materiel
TM-43-0242	-	Chemical Agent Resistant Coating Spot Painting for Army Ground Equipment
TM-1-1500-344-23	-	Cleaning and Corrosion Control Vol II
TM-1-1500-345-23	-	Aircraft Painting and Marking of Army Aircraft

(Copies of this document are available online at https://www.logsa.army.mil).

US MARINE CORPS TECHNICAL PUBLICATION

TM-4750-15	-	United States Marine Corps Technical Manual Painting, Coating, Underbody and Registration Marking for Marine Corps Combat and Tactical Equipment

(Copies of this document are available online at https://mceits.usmc.mil/sites/pubs/).

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 A109/A109M	-	Standard Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold Rolled.
ASTM A1008/A1008M	-	Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High Strength Low Alloy, High Strength Low Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
ASTM A380	-	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
ASTM A967	-	Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
ASTM B117	-	Standard Practice for Operating Salt Spray (Fog) Apparatus.
ASTM B244	-	Standard Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments.
ASTM B499	-	Standard Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Non-Magnetic Coatings on Magnetic Basis Metals.
ASTM D1193	-	Standard Specification for Reagent Water.
ASTM D1640	-	Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings.
ASTM D1654	-	Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
ASTM D3330/D3330M	-	Standard Test Method for Peel Adhesion of Pressure Sensitive Tape.
ASTM D3359	-	Standard Test Methods for Measuring Adhesion by Tape Test.
ASTM D5895	-	Standard Test Methods for Evaluating Drying or Curing During Film Formation of Organic Coatings Using Mechanical Recorders.

(Copies of these documents are available from https://www.astm.org).

GENERAL MOTORS ENGINEERING STANDARDS

GMW 14872	-	Cyclic Corrosion Laboratory Test.

(Copies of this document are available from https://global.ihs.com).

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA-T1	-	Processing and Treatment Standard.

AWPA-P5 - Standard for Waterborne Preservatives.

(Copies of these documents are available from https://awpa.com).

SAE INTERNATIONAL STANDARDS / Aerospace Material Specifications

SAE-AMS-STD-595	-	Colors Used in Government Procurement.
SAE-AMS-M-3171	-	Magnesium Alloy, Processes for Pretreatment and Prevention of Corrosion On.
SAE-AMS-QQ-P-416	-	Plating, Cadmium (Electrodeposited).
SAE-AMS-2700	-	Passivation of Corrosion Resistant Steels.

(Copies of these documents are available from https://www.sae.org).

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Rule 102	-	Definition of Terms.
Rule 1107	-	Coating of Metal Parts and Products.

(Copies of these documents are available from http://www.aqmd.gov/).

THE ASSOCIATION FOR MATERIALS PROTECTION AND PERFORMANCE

SSPC-SP2	-	Hand Tool Cleaning.
SSPC-SP3	-	Power Tool Cleaning.
SSPC-SP5	-	White Metal Blast Cleaning.
SSPC-SP10	-	Near White Blast Cleaning.

(Copies of these documents are available from https://www.ampp.org/).

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

3. REQUIREMENTS

3.1 Definition. Application of the CARC system consists of four distinct steps, each of which is critical to the performance of the overall system. The steps are cleaning, pretreating, priming, and topcoating. To ensure CARC system adhesion, all pretreatment chemical reactions shall be complete prior to applying primer and topcoat. The primers are primarily corrosion inhibiting epoxies. All of the coatings in the CARC system are Qualified Products Database (QPD) items. For the pretreatment coatings, refer to TT-C-490 for the various types and those that require QPD. In addition, each batch of polyurethane topcoat shall be checked by the specification's qualifying activity for validation of the spectral and specular reflectance (camouflage properties) and Super Topical Bleach (STB) resistance. The STB composition shall be in accordance with MIL-DTL-12468. The local safety office, preventative medicine activity, and local medical support facility shall be consulted prior to applying the CARC system. For miscellaneous requirements, see

section 3.9. Pertinent CARC material specifications are listed in table I. The choice of the coating system belongs to the government and this document is not intended to allow users to circumvent the system specified in the system requirements. Refer to manufacturer recommendations for application process. New products are being introduced and application processes can vary. Missing a step can result in failure of an entire coatings system.

TABLE I. The CARC system.

Process	Ferrous Metal	Aluminum and Aluminum Alloys
Cleaning	TT-C-490	MIL-DTL-5541 / TT-C-490
Pretreating	TT-C-490, type I zinc phosphate and pretreatments for ferrous substrates qualified to types III, IV, and VIII, class A or C	MIL-DTL-5541 (chemical conversion process) MIL-DTL-81706 (chemical conversion materials) 1/ MIL-A-8625 (anodize) TT-C-490 pretreatments for aluminum substrates qualified to types III, IV class B or C
Priming	MIL-PRF-32550 MIL-DTL-53022 MIL-DTL-53030 MIL-DTL-53084 MIL-PRF-23377, type I and II, 2/, 3/ MIL-PRF-32348, type I and II	MIL-PRF-23377, type I and II, 2/ MIL-DTL-53022 MIL-DTL-53030 MIL-DTL-53084 MIL-PRF-85582, type I and II,2/, 4/ MIL-PRF-32348, type I and II
Topcoating	MIL-PRF-22750 (interior only) MIL-DTL-53039 MIL-DTL-64159 MIL-PRF-32348, type III and IV	MIL-PRF-22750 (interior only) MIL-DTL-53039 MIL-DTL-64159 MIL-PRF-32348, type III and IV

1/ Use of type II conversion coating (non-hexavalent chromium) preferred, if approved for application.
2/ The use of MIL-PRF-23377 and MIL-PRF-85582, class C and class N primers are approved for aviation assets.
3/ May be used for mixed metal applications. Specific approval from the engineering authority for the system shall be obtained for use on ferrous substrates.
4/ MIL-PRF-85582, shall not be used on iron or bare carbon steel, nor for the wet installation of fasteners or faying surfaces.

3.2 Cleaning. Meticulous cleaning prior to pretreatment and painting operations is critical to meeting the requirements of this specification. Improperly cleaned surfaces can interfere with paint film formation and adhesion, which can cause paint defects and premature paint peeling during service. Unless otherwise specified, surfaces shall be cleaned according to TT-C-490. Surface oxides, rust, weld spatter, oil, grease, and all other organic and inorganic contaminants shall be removed prior to pretreatment. The cleaning method shall be determined by the base material properties, the nature of the soil(s), the degree of contamination, and the part geometry. The following TT-C-490 methods shall be used singly or in combination to produce a clean surface:

Method I	Mechanical or abrasive blast cleaning, sanding, and grinding.
Method II	Solvent cleaning by immersion, spray, vapor or hand wiping.
Method III	Detergent cleaning by immersion, spray, ultrasonic, hot alkaline or electrolytic methods.
Method IV	Emulsion cleaning, with or without added water.

Method V	Derusting by chemical means.
Method VI	Phosphoric acid cleaner (detergent or solvent type with detergent).
Method VII	Steam cleaning, with or without assisted pressure washing.

After cleaning, all surfaces shall be kept free from dirt, dust, finger marks, moisture, and other contaminants until treated as specified. If the CARC system cannot be applied immediately after cleaning, then the parts shall be protected from flash rusting, moisture and from contamination. Flash rusting shall be delayed through controlling environmental conditions and the use of a pretreatment qualified to TT-C-490. Prior to applying the CARC system, the parts shall be re-inspected and cleaned, as required, and pass the water break test (see 4.2.3.1.1). The water break test is performed on substrate surfaces after cleaning and prior to the application of the pretreatment. Accumulations of materials such as sand, metal shavings, or other debris appearing in the paint coating shall be cause for rejection if the contaminant degrades the adhesion of the paint, causes functional or safety problems, or is clearly an indication of poor workmanship. Minor inclusions such as lint, sand particles, and weld spatter that do not affect function are acceptable.

3.2.1 Abrasive blasting of ferrous metal surfaces. Unless otherwise specified, ferrous metal surfaces to be painted shall be cleaned in accordance with 3.2. When abrasive blasting is used to remove mill scale, products of corrosion, dirt, casting sand, slag, and other foreign substances, then follow the procedure in the Society for Protective Coatings specification SSPC-SP5/NACE No. 1 or SSPC-SP10/NACE No. 2, unless otherwise specified. Abrasive blasting shall always be preceded by cleaning methods most appropriate for the application to ensure the substrate is water break free clean. Using clean water, for example, distilled, deionized (DI), reverse osmosis purified or filtered water in an atomizing sprayer works well in this method for determining the results as described in 4.2.3.1.1. The blast media and maintenance of the abrasive blasting system shall be such that a consistent surface profile is maintained throughout the process and subsequent abrasive blast cleaning. Surface profile measurements shall not exceed the recommended range for the coating system applied and is recommended to be 1.0 ± 0.5 mils, unless otherwise specified by the coating manufacturer so as to maintain the performance for coating adhesion and corrosion resistance. When minimum DFT requirements have been established for the organic coatings, it is necessary to compensate for the coating that is anchored into the blasted substrate. For example, if a minimum surface profile of 1.5 mils is established and the actual profile measured is 2 mils, a reciprocal increase in the DFT of 0.5 mils is necessary to compensate for the excess surface profile. This compensation can be easily tracked by using a magnetic mean surface-measuring device to account for the surface profile that is hidden by the organic coatings applied after abrasive blasting (see 6.10). Ferrous media or media contaminated with ferrous spoils from previous abrasive blasting shall not be used on non-ferrous metallic substrates. Blast cleaned surfaces shall be coated within four hours with an approved pretreatment material. Applied pretreatment shall be dried as per manufacturer recommendations. If more than four hours pass before pretreatment, the blasted surface shall be inspected and found free of corrosion or foreign matter, and pass the water break test (see 4.2.3.1.1) prior to pretreatment and priming. When the use of hexavalent chromium is restricted by contractual requirements, one of the following shall be used as the alternative pretreatment system on abrasive blasted ferrous substrates: TT-C-490 type I with hexavalent chrome-free rinse, TT-C-490 type III, IV or VIII (QPD approved to class A or C) or metal-rich primers conforming to MIL-PRF-32550. Approval from the contracting officer shall be received prior to use of metal-rich primers on blasted ferrous substrates. The requirement for primer dry film thickness (see 4.2.3.3) over a blasted profile is based upon film build over the peaks of the surface profile.

3.2.1.1 Exemptions from abrasive blasting. Abrasive blasting shall not be used on surfaces that could be damaged, such as machine parts and sheet metal thinner than 16 gauge (0.0625 inches or 1.5875 mm). Blasting is optional, on components painted for protection during limited storage, where the paint wears off as soon as the equipment is placed in use. Component examples are track assemblies, track roller assemblies (including mounting frames), interiors of weld-type box sections, bulldozer components (including rippers, scarifies, ejectors, push plates, blades, bowls, and buckets), scrapers and crane shovels, interiors of cement mixer drums, and interiors of aggregate driers. However, these surfaces shall be cleaned using one of the methods described in 3.2 and shall be free from oil, grease, dirt, and rust. All surfaces shall be dry prior to painting.

3.2.1.2 Vehicles. Ferrous metal surfaces of vehicles shall be cleaned for painting in accordance with 3.2.1, except as specified herein. Surfaces that cannot be cleaned by blasting shall be cleaned to base metal by alternate means such as three dimensional/abrasive cleaning, chipping, powered wire brushing, or grinding in accordance with SSPC-SP11. Sheet metal and sheet metal parts of 8 gauge (0.164 inches or 4.166 mm) and thinner shall be cleaned to bare metal by method V of TT-C-490 or a combination of hand tool or power tool cleaning in combination with cleaning with detergent or solvent to achieve a clean water break free surface. Chemical cleaning shall not be approved for use on assemblies which entrap acid/alkali or when for any reason chemical cleaning is considered inadvisable. Wire brushes used to clean ferrous surfaces shall be either steel or stainless steel. Brass brushes shall not be used, as there is a possibility of depositing brass particles on the steel surface, potentially accelerating corrosion of steel surfaces. Hand tool cleaning shall be in accordance with SSPC-SP2 and power tool cleaning shall be in accordance with SSPC-SP11.

3.2.2 Zinc surfaces. Zinc surfaces, including zinc-coated substrates, shall be cleaned and activated with a light abrasive blast (<0.1 mil), scouring with an abrasive pad, or TT-C-490 method VI prior to being pretreated for painting as specified in 3.3.

3.2.3 Aluminum and aluminum alloy surfaces. Aluminum and aluminum alloys shall be cleaned in accordance with 3.2, followed without delay by deoxidation and treatment as specified in 3.3 and according to manufacturer's instructions. Aluminum thicker than 1/8th inch and fabricated from 5000 series armor grade aluminum shall be abrasive blasted.

3.2.4 Magnesium alloy surfaces. Prior to painting, magnesium alloy surfaces shall be cleaned and pretreated in accordance with one of the following processes detailed in MIL-DTL-32459, Coatings, Anodic for Magnesium and Magnesium Alloys, AMS-M-3171, or with an approved magnesium alloy pretreatment in the QPD in accordance with TT-C-490. Components previously treated per MIL-DTL-32459 shall be re-coated per the same specification requirements. Unless permitted by contract or the procuring officer, no materials containing hexavalent-chrome shall be used. Treated surfaces that become scratched in handling shall be touched up with a pretreatment that does not contain hexavalent chromium. To maintain a system that is free of hexavalent chromium, touch-up repairs shall be in accordance with the procedures detailed in MIL-DTL-32459 or a commercial product recommended by the manufacturer and approved by the Program Manager. For further information on pretreatments for magnesium and magnesium alloys, contact U.S. Army DEVCOM Research Laboratory, Attn: FCDD-RLW-MC, Coatings & Corrosion Team, 6300 Rodman Road, BLDG 4600, APG, MD 21005-5066.

3.2.5 Cadmium surfaces. Cadmium surfaces shall be cleaned in accordance with SAE-AMS-QQ-P-416, followed without delay by treatment as specified in 3.3.

3.2.6 Cleaning of aviation assets. For the cleaning of aviation surfaces, refer to TM-1-1500-344-23, Cleaning and Corrosion Control Vol II Aircraft.

3.2.6.1 Steam cleaning and pressure washing of aviation surfaces. Steam cleaning shall not be used on the following items removed from aircraft/missiles: honeycomb bonded structure, sealant, fiberglass composites, acrylic windows, or electrical wiring. No equipment which produces more than 175 psi nozzle pressure shall be used for aircraft cleaning purposes unless specifically authorized by the parent service organization. High-pressure cleaning processes can erode paint, drive lubricants out of bearings, drive water into hidden areas, damage electrical insulation, damage honeycomb bonded structure and composite surfaces, and damage sealant.

3.2.7 Abrasive blasting of aviation substrates. Plastic Media Blasting type selections in MIL-P-85891 will be based on the substrate being stripped and determined by the applicable Depot Maintenance Work Requirement or technical data provided by the cognizant authority for each platform.

3.2.7.1 Composite substrates. New composite substrates shall be solvent wiped using the solvent recommended by the manufacturer, then scuffed with 220 grit sand paper or fine grit abrasive pad to remove surface glaze and "fuzz", unless otherwise contraindicated by the manufacturer. After scuff sanding, substrate shall be solvent wiped with isopropyl alcohol (IPA) or appropriate exempt solvent as designated by the manufacturer to remove all mold release agents, loose and Petroleum Oil Lubricant (POL) contaminants, dust, and debris. No pretreatment other than thorough cleaning is required on composites prior to application of the CARC coating system (primer and topcoat). When authorized, previously coated composite substrates may be cleaned by abrasive blast processes with appropriate plastic media at reduced pressures to remove existing coatings prior to re-application of the CARC system. To best prevent fibrillation (fuzzing) or any type of fiber damage, remove only the topcoat, leaving as much of the primer on the surface as possible. When stripping Composite surfaces, speed of coating removal shall take secondary precedence over substrate protection. At least a light "primer haze" shall remain on all composite surfaces while media blasting during removal of organic coatings. Leaving a "primer haze" or some appearance of remaining primer will assist with preventing damage to the composite substrate. Blasting can be done to a primer haze or down to the substrate, if repair is required. Caution: When stripping composite substrates, use caution to avoid damage to the top strands and seal coating over the composite materials. If possible, reduce blast air pressure and increase stand-off distances to minimize potential to damage the composite materials. If abrasive blasting is performed, no additional scuff sanding will be required unless repairs are made to the substrate in order to feather the repaired area into the existing substrate. When a conductive coating is stripped and re-applied to the composite substrate, special care shall be exercised to ensure the old conductive coating is completely removed without damage to the underlying primer and substrate. A solvent wipe with IPA or other approved exempt solvent will be accomplished prior to CARC system application. No pretreatment is required on composite substrates.

3.3 Pretreating. Chemical surface treatments for metallic substrates provide improved adhesion for subsequent coatings and temporary protection from corrosion. For best results, the pretreatment shall be applied as soon as possible after proper cleaning (see 3.2). The three most common pretreatments are chromate/chromium, phosphate and organic/inorganic-modified conversion coatings. For aviation assets, refer to TM-1-1500-344-23 for the requirements for application and use of pretreatment coatings.

3.3.1 Ferrous metal, zinc or cadmium surfaces. These surfaces shall be treated without delay after cleaning as specified in 3.2 with one of the following:

a. Zinc phosphate conforming to TT-C-490, type I.

b. Pretreatments qualified under TT-C-490, including organic and inorganic pretreatments, and pre-primer coatings conforming to types III, IV, and VIII, class A or C. The QPD for TT-C-490 makes accessible to the applicator approved emerging hexavalent-free pretreatment technologies. Pretreatment types III and IV may be used interchangeably provided the end use is in accordance with the directives of this document and the QPD for TT-C-490 for metallic substrates and the use is not contraindicated by the contract or purchase order for the product. Pretreatments that have been tested, validated and qualified to the type IV pretreatment for immersion application on ferrous substrates may be used as an alternative to type I zinc phosphate. If there are questions to the above or further clarifications, contact U.S. Army DEVCOM Research Laboratory, Weapons and Materials Research Directorate, ATTN: FCDD-RLW-MC, Coatings and Corrosion Team, APG, MD 21005-5069.

3.3.1.1 Organic pretreatments TT-C-490 type III. The organic pretreatments in 3.3.1 b are applied to clean metal surfaces to prepare for a more permanent protective corrosion inhibiting primer. Although type III pretreatments afford some protection for up to 24 hours, they are not intended for permanent protection and these surfaces shall be overcoated with epoxy primer as soon as practical, however no more than 24 hours after pretreatment application. After more than 24 hours following application, the pretreatment shall be stripped and the finishing process started again. The pretreatment is sufficiently dry for priming one hour after application under preferred atmospheric conditions of 60 to 90º F (16 to 32º C). The pretreatment shall not be applied to visibly wet surfaces or where the surface temperature is less than 50° F (10° C). The dry film thickness shall be 0.3 to 0.5 mils (7.5 to 12.5 microns). All organic pretreatments are to be applied as per the manufacturer's recommendations.

3.3.2 Aluminum surfaces. Aluminum surfaces shall be treated without delay after cleaning as specified in 3.2 with one of the following:

a. Anodized aluminum and aluminum alloy castings in accordance with MIL-PRF-8625. Minimum thickness of 0.0007 inches (0.018 mm) is required for wrought aluminum and 0.0004 inches (0.010 mm) is required for castings. Type and class of the anodic coating to be applied shall be specified in the contract.

b. Chemical conversion conforming to MIL-DTL-5541 with materials approved under MIL-DTL-81706. When applying primer over MIL-DTL-81706 aluminum conversion coating, a minimum 24 hour delay is normally required to ensure the applied conversion coating has completely dehydrated. If recoating is less than 24 hours, consult with the manufacturer of the conversion coating for minimum air dry recoatability limits of the pretreatment. If elevated temperatures are used to accelerate the drying, consult with manufacturer of conversion coating for minimum recoat times. A delay of over 168 hours is acceptable if the conversion coated substrate is properly protected from external contamination prior to primer application. Areas must be visually inspected for defects and/or debris prior to being coated.

c. Pretreatments qualified under TT-C-490, including organic and inorganic pretreatments and pre-primer coatings conforming to types III and IV, class B or C.

3.3.3 Magnesium alloy surfaces. Refer to paragraph 3.2 4 for the pretreatment of magnesium and magnesium alloys surfaces.

3.3.4 Wood surfaces. Unless otherwise specified (see 6.2), wood shall be pressure treated and marked in conformance with AWPA-T1 for above ground, or AWPA-P5 for ground contact installations. Wood shall be dried to the specified moisture content appropriate for the size, species, and ultimate service conditions, but in no case greater than 20 percent. Wood painted with CARC shall first be sealed with an epoxy or polyurethane-based sealer.

3.3.5 Stainless steel surfaces. These surfaces shall be treated/passivated without delay after cleaning as specified in 3.2 or by one of the alternative methods described in ASTM A380, ASTM A967, SAE AMS 2700 (for Aviation systems and components), or stainless steel alloy pretreatments as detailed in TT-C-490 if the surface is still active. When approved by the procuring authority, the use of abrasive blasting eliminates the need to apply additional pretreatment. A minimum of 0.5 mil surface profile (SP) shall be achieved using aluminum oxide or other non-ferrous abrasive blasting media prior to painting.

3.3.6 Blasted steel armor. On blasted ferrous armor substrates that have Rockwell C hardness (HRC) 39 or greater, pretreatments containing phosphoric acid shall not be used unless qualified to the TT-C-490 QPD. This is due to the risk of hydrogen embrittlement from the phosphoric acid. TT-C-490 type I, pretreatments qualified to TT-C-490 types III, IV, and VIII or metal-rich primer conforming to MIL-PRF-32550 shall be used as the pretreatment. Refer to 3.2.1, abrasive blasting of ferrous metal surfaces, for alternatives to hexavalent chromium containing pretreatments. For blasted ferrous substrates greater than HRC 42, prior approval from the contracting officer shall be received before zinc-rich or other metal-rich primers are used as an alternative. Refer to TT-C-490 for embrittlement testing and stress relief for steel alloys at Rockwell C hardness (HRC) 39 or greater. Applying metal-rich primer to ferrous substrates with a hardness rating greater than HRC 42 is prohibited unless the contractor submits a request for deviation and receives approval.

3.4 Priming. The primer shall be applied to a clean, dry surface within 24 hours of applying pretreatments conforming to TT-C-490. For the application of primer to aluminum conversion coating conforming to MIL-DTL-81706, see 3.3.2.b. For the application of primer to pretreatments qualified to TT-C-490, consult with the manufacturer. The preferred temperature range for the application of these primers shall be 60 to 90º F (16 to 32º C). If priming is done outside of this range, then all quality control checks shall be done (see 4.2.3) to verify film integrity. The paint and surface shall be approximately the same temperature and not less than 50° F (10° C). When surface temperature or air temperature is < 5º F above dew point, the coating is adversely affected. At relative humidity in excess of 50%, a dew point calculation may be necessary to avoid the formation of moisture on the substrate to be coated. No organic coatings shall be applied unless the surface temperature of the substrate is a minimum of 5º F above the dew point at the point of application. Application shall be by brush or spray, depositing a continuous, adherent film which is smooth, uniform, and free from runs, sags, or other defects that might interfere with the application and adhesion of subsequent coatings (see 4.2.3.8). The film thickness requirement of each primer is specified in table V. If paint heaters are used to assist in application, the substrate to be coated shall be at a minimum temperature of 60º F (16º C). Dipcoating or spin coating are not recommended application methods for CARC primers. The

corrosion inhibiting primers are primarily epoxies and two component products. The powder coating primers are epoxies, but are one component materials. The metal-rich primers are either epoxies, moisture cured urethanes or inorganic resin types. They are applied to metal substrates to provide corrosion resistance and a surface to which the CARC coating system firmly adheres. The two component products dry by a two stage process of solvent evaporation and chemical crosslinking, and they have a finite pot life, typically 6-8 hours. Environmental conditions, particularly temperature and relative humidity, can affect pot life, curing, and adhesion. In areas where air quality regulations restrict volatile emissions, do not add thinner to the coating material if that addition causes the regulatory limit to be exceeded. If thinner needs to be added, consult with the manufacturer of the primer for the appropriate thinner to stay within the regulatory limits. The specific application and handling information below for the seven primers is summarized in table II. If a contract requires the use of metal-rich primer conforming to MIL-PRF-32550, then MIL-DTL-53022 or MIL-DTL-53030 shall be applied over the metal-rich primer as a barrier coat between the metal-rich primer and the topcoat. The only exception is when metal rich powder conforming to MIL-PRF-32550, type III is used. A barrier primer shall not be applied prior to the application of a powder topcoat. Liquid primers shall not be used when applying powder CARC topcoats conforming to MIL-PRF-32348. The only primers authorized for use when applying powder topcoats are those that comply with MIL-PRF-32348, MIL-PRF-32550 type III or MIL-DTL-53084. In addition to the liquid primers, there is also an epoxy corrosion resistant powder coating primer (MIL-PRF-32348) that can be used in the CARC paint system. When a contract specifies the use of either MIL-DTL-53022 or MIL-DTL-53030, alternative primers MIL-DTL-53084 or MIL-PRF-32348 are authorized for use only with the approval of the contracting officer.

TABLE II. General application guidelines for primers. 1/ 2/

Specification	Mixing	Reduction	Application
MIL-PRF-23377	Slowly add component B to component A. Preferred temperature range 60 to 90° F (16 to 32° C) prior to mixing as specified by the manufacturer.	Stir and strain. Set 30 minutes before use. Alterations only as specified by the manufacturer.	Spray with one full coat. Wait 4-6 hours prior to topcoating. Use within 8 hours. Apply at a dry film thickness (DFT) of 0.6-0.9 mils. Alterations only as specified by the manufacturer.
MIL-PRF-32348, type I and II	Adhere to process as specified by the manufacturer.	Reduction does not apply, since these products are powder coatings and do not use solvents.	Adhere to process as specified by the manufacturer.

1/ Always add component B to component A, never in reverse.
2/ Time duration prior to topcoating are based on 70° F (21° C) ambient temperature. Note: Increase or decrease in temperature may influence drying rates and final cure times.

TERMS: 1 mil = 25 microns.

TABLE II. General application guidelines for primers [1/] [2/] - Continued.

Specification	Mixing	Reduction	Application
MIL-DTL-53022	One part component B to four parts component A or as specified by manufacturer. Add B to A. Preferred temperature range 60 to 90º F (16 to 32º C) prior to mixing. Alterations only as specified by the manufacturer.	If necessary and allowed, reduce with MIL-DTL-81772 type IV, or supplied by the manufacturer, not to exceed VOC limits where applicable. Stir and strain. Set 30 minutes before use. Alterations only as specified by the manufacturer.	Spray with one full coat. Wait 30-60 minutes prior to topcoating. Use within 4-6 hours. DFT: 2.0 ± 0.5 mils. Alterations only as specified by the manufacturer.
MIL-DTL-53030	Mix component A until uniform. 1 part component B to 4 parts component A for type II. Add B to A. Preferred temperature range 60 to 90º F (16 to 32º C). Alterations only as specified by the manufacturer.	Using DI water, reduce according to manufacturers' instructions. Use mechanical mixer and add water slowly. Mix and strain. Stir and strain. Set 30 minutes before use. Alterations only as specified by the manufacturer.	Spray with one full coat. Wait 30-60 minutes before topcoating. Use within 6 hours. DFT: 2.0 ± 0.5 mils. High humidity retards dry, low humidity accelerates dry. Make sure surface is free of water prior to topcoating. Alterations only as specified by the manufacturer.
MIL-DTL-53084	Adhere to process as specified by the manufacturer.	Reduce with deionized water.	Adhere to process as specified by the manufacturer.
MIL-PRF-32550	Mix and agitate pigmented component thoroughly. Mix as specified by the manufacturer. Preferred temperature range 60 to 90º F (16 to 32º C) prior to mixing. Alterations only as specified by the manufacturer.	Reduce, if necessary, by manufacturers' specifications. Set 30 minutes before use for epoxy type. Alterations only as specified by the manufacturer.	Dry times and recoat times based upon manufacturers' specifications. Protect moisture cure from moisture for extended pot life. Epoxy type use within 4-6 hours. DFT: 2.5-3.5 mils. The use of an agitator pressure pot is recommended. Alterations only as specified by the manufacturer.

[1/] Always add component B to component A, never in reverse.
[2/] Time duration prior to topcoating are based on 70º F (21º C) ambient temperature. Note: Increase or decrease in temperature may influence drying rates and final cure times.

TERMS: 1 mil = 25 microns.

TABLE II. General application guidelines for primers 1/ 2/ - Continued.

Specification	Mixing	Reduction	Application
MIL-PRF-85582	Thoroughly mix component A. Slowly add component B to component A as specified by the manufacturer. Preferred temperature range 60 to 90º F (16 to 32º C) prior to mixing. Alterations only as specified by the manufacturer.	Use DI water. Stir and strain. Set 30 minutes before use. Alterations only as specified by the manufacturer.	Spray with one full coat. Wait 30-60 minutes prior to topcoating. Use within 4 hours. DFT: 0.8-1.2 mils.3/ Apply at 60-100º F (16-38º C). High humidity retards dry, low humidity accelerates dry. Make sure surface is free of water prior to topcoating. Alterations only as specified by the manufacturer.

1/ Always add component B to component A, never in reverse.
2/ Time duration prior to topcoating are based on 70º F (21º C) ambient temperature. Note: Increase or decrease in temperature may influence drying rates and final cure times.
3/ DFT for aluminum-steel assemblies. If aluminum only, 0.6 - 0.9 mil DFT is acceptable.

TERMS: 1 mil = 25 microns.

3.4.1 MIL-PRF-23377 (Primer Coatings: Epoxy, High-Solids).

3.4.1.1 Description. This specification covers the requirements for corrosion inhibiting, chemical and solvent resistant, solvent-borne, epoxy primer coatings that have a maximum volatile organic compound (VOC) content of 2.8 pounds/gallon (lbs/gal) (340 grams/liter (g/l)). The specification contains formulations that allow for standard pigments (type I) and low infrared reflective pigments (type II). It also differentiates between two classification systems, class C and class N. Class C contains either barium chromate or strontium chromate based corrosion inhibitors and class N contains non-chromate based corrosion inhibitors.

3.4.1.2 Use. This primer is intended for use on pretreated aluminum alloy surfaces as a corrosion inhibitive, chemical resistant primer. It is compatible with CARC topcoats. Type II shall not be used as a CARC primer, except on aircraft, and where specifically required (see 6.6).

3.4.1.3 Preparation. Thoroughly mix and stir component A prior to admixing. While slowly pouring component B into component A, continue to stir until the manufacturer's specified volume mixing ratio is achieved. Each component shall be properly metered to ensure correct mixing ratios. Reduction of the admixed material shall be according to the manufacturers' instructions. Component B shall always be added to component A and this procedure shall never be reversed. The preferred temperature range of each component shall be 60 to 90º F (16 to 32º C) before mixing.

3.4.1.4 Reduction. Reduce the viscosity of the admixed primer if necessary with MIL-DTL-81772 type II, MIL-DTL-81772 type IV or thinner recommended by the manufacturer, but do not exceed the VOC limit of 2.8 lbs./gal (340 g/l) or local regulatory limit depending on which is the more stringent requirement. The reduced primer shall be continuously stirred to allow thorough mixing and to counter pigment settling. Strain through a 60 mesh minimum paint filter or equivalent. Let stand at room temperature for 30 minutes to allow primer adequate time to induct or follow the manufacturers' instructions.

3.4.1.5 Application. All surfaces to be painted shall be thoroughly cleaned as specified in 3.2 and pretreated as specified in 3.3. To ensure a chemically clean surface, perform the test in 4.2.3.1.1 prior to the pretreatment application. Failure to comply with 4.2.3.1.1 is sufficient cause to do additional cleaning. The primer shall be applied to the specified film thickness. Refer to manufactures' recommendations for appropriate cure times prior to applying the topcoat. Times vary depending upon environmental conditions and the manufacturers' recommendations. The admixed primer shall be used within 4 hours after mixing to ensure performance. The DFT shall be between 0.6 and 0.9 mils (15 and 22.5 microns) for aluminum and between 0.8 and 1.2 mils (20 and 30 microns) for aluminum-steel assemblies. The largest factor affecting cure is temperature. Refer to manufacturers' recommendations for dry to touch and cure times.

3.4.1.6 Comments. The primer furnished under this specification shall be products that are authorized by the qualifying activity for listing in the QPD (see 6.4).

3.4.2 MIL-DTL-53022 (Primer, Epoxy Coating, Corrosion Inhibiting, Lead and Chromate Free).

3.4.2.1 Description. This specification covers an air drying, corrosion inhibiting epoxy primer for ferrous and nonferrous metals. It is formulated lead and chromate free. Type II and III were canceled for use on all systems with the exception of missile systems that require specialized flight testing for replacement. Types IV and VI coatings are hazardous air pollutants-free (HAP-free) and have a maximum VOC content of 2.8 lbs. /gal (340 g/l) and 2.08 lbs/gal (250g/l) for classes L and U respectively. Type IV is an enhanced corrosion performance technology and shall be used as replacement for type II and type III materials that have been cancelled. A type V coating is furnished in self-contained portable kits. These kits contain the type IV or type VI corrosion inhibiting epoxy primer in a touch-up system. The specification is a two package system consisting of a pigmented epoxy resin (component A) and a polyamine-epoxy catalyst (component B).

3.4.2.2 Use. This primer is intended for use on properly cleaned and pretreated ferrous and nonferrous surfaces. It is an acceptable primer system to use with CARC topcoats.

3.4.2.3 Preparation. The component A shall be thoroughly mixed and stirred prior to admixing. Mix one part of component B to four parts of component A by volume and stir until well blended. Allow the admixed material to stand according to the manufacturer's recommended induction time. The preferred temperature range of each component shall be 60 to 90° F (16 to 32° C) before mixing.

3.4.2.4 Reduction.

3.4.2.4.1 Types IV and VI primers. The types IV and VI primers shall use MIL-DTL-81772 type IV to maintain HAP-free material for application. If needed and local environmental regulations permit, then other thinners under MIL-DTL-81772 may be used. The thinned primer shall be thoroughly stirred, strained through a 60 mesh minimum paint filter or equivalent and allowed to sit according to the manufacturer's recommended induction time prior to use and shall continue to be stirred throughout the primer application. Mechanically mixing with an air agitator shortens the induction time. Consult with manufacturer for reduced induction time.

3.4.2.5 Application. All surfaces to be painted shall be thoroughly cleaned as specified in 3.2 and pretreated as specified in 3.3. To ensure a chemically clean surface, perform the test in 4.2.3.1.1 prior to the pretreatment application. Failure to comply with 4.2.3.1.1 is sufficient cause to do additional cleaning. After completion of the 30 minute induction period, when required, the primer

shall be sprayed to achieve a DFT of 2.0 ± 0.5 mils (50 ± 12.5 microns). The primer needs only to be dry to touch at this film thickness before applying the topcoat. This is usually between 30 and 60 minutes in accordance with ASTM D5895, depending on conditions. The primer material shall be used within 4-6 hours. Pot life is shortened at higher temperatures. The largest factor affecting cure is temperature. At 70º F (21º C), the dry to touch time is between 30-60 minutes. Dry to handle time is 90 minutes to 4 hours depending on the coating type. The use of plural proportioning equipment, if approved by the manufacturer, eliminates the requirement to have an induction period of the mixed primer before application.

3.4.2.6 Comments. The primers furnished under the specification shall be products which are authorized by the qualifying activity for listing on the QPD (see 6.4).

3.4.3 MIL-DTL-53030 (Primer Coating, Epoxy, Water Based, Lead and Chromate Free).

3.4.3.1 Description. This primer is a water based, air-drying, and corrosion inhibiting epoxy primer. It is a two component system with a pigmented polyamide (component A) and a clear to milky epoxy catalyst (component B). The primer is formulated HAP-free, lead and chromate free and contains no more than 2.8 lbs/gal (340 g/l) VOC as applied, in accordance with Rule 1107 of the South Coast Air Quality Management District. The primer is furnished in coating types II and III. Type II is enhanced corrosion performance, water dispersible technology. Type III is self-contained portable kits. The kits contain the type II coating epoxy primer in a touch-up system.
3.4.3.2 Use. The primer is intended for use on pretreated ferrous and nonferrous substrates and is compatible with CARC topcoats. The MIL-DTL-53030 epoxy primer shall not be applied directly to pretreatments containing phosphoric acid, such as those that are classified as wash primers. Other pretreatments, as referenced in 3.3, are acceptable.

3.4.3.3 Preparation. Thoroughly agitate and mix component A until uniform. If necessary, use a paint shaker to disperse any settled pigment in component A. Mix one volume of component B with four volumes of component A for a type II coating until a smooth homogeneous mixture is achieved. The preferred temperature range of each component shall be 60 to 90º F (16 to 32º C) before mixing. Component B shall be added to component A under constant agitation. Allow the admixed material to stand according to the manufacturer's recommended induction time.

3.4.3.4 Reduction. Reduce the viscosity of the admixed primer with DI water conforming to ASTM D1193 type IV in accordance with manufacturers' recommendations. Water shall be added under constant agitation. The thinned primer shall be strained through a 60 mesh minimum paint filter or equivalent and allowed to stand for 30 minutes prior to use or according to manufacturers' recommendations. Mechanical mixing may shorten the induction time. Consult with the manufacturer for these times. The use of plural proportioning equipment, if approved by the manufacturer, eliminates the requirement to have an induction period of the mixed primer before application.

3.4.3.5 Application. All surfaces to be painted shall be thoroughly cleaned as specified in 3.2 and properly pretreated as specified in 3.3. To ensure a chemically clean surface, perform the water break test in 4.2.3.1.1 prior to the application of the pretreatment. Failure to comply with 4.2.3.1.1 is sufficient cause to do additional cleaning. After completion of the 30 minute induction period, the primer shall be sprayed to achieve a DFT of 2.0 ± 0.5 mils (50.0 ± 12.5 microns). The primer needs only be dry to touch (ASTM D5895) before applying the topcoat. This is usually between 30 to 60 minutes depending on conditions. The admixed primer shall be used within 6 hours to

ensure performance. The largest factor affecting cure is temperature. At 70° F (21° C), the dry to touch time is 30 to 60 minutes and the dry to handle time about 2 hours. Due to the fact that the primer is a water based system, a high relative humidity retards the dry time while a low relative humidity accelerates the process. Temperature increase shortens pot life.

3.4.3.6 Comments. The primer furnished under this specification shall be a product authorized by the qualifying activity for listing on the QPD (see 6.4). Since the sprayed primer contains water, care shall be taken to ensure that the primer surface is dry to touch before application of MIL-DTL-53039. Premature topcoating leads to compromised adhesion properties.

3.4.4 MIL-DTL-53084 (Primer, Cathodic Electrodeposition, Chemical Agent Resistant).

3.4.4.1 Description. This primer is a waterborne, cathodic epoxy electrodeposition primer formulated lead and hexavalent chrome free. It meets solvent emission maximums of 1.2 lbs. /gal (144 g/l) VOC.

3.4.4.2 Use. This primer is intended for use on properly cleaned and pretreated ferrous and nonferrous metal surfaces and is compatible with CARC topcoats. It is applied with an immersion-type procedure and cured by baking. Substrates coated shall be evaluated for their ability to withstand the baking temperatures required in accordance with the manufacturers' recommendations prior to coating. Caution: elevated bake temperatures may alter material properties of certain substrates.

3.4.4.3 Preparation. The manufacturer shall provide instructions for mixing and thinning. Prepare the primer bath by mixing resin feed and pigment paste components, or single-component blended feed with pure DI water that is free of bacteria (conductivity less than 10 micro-ohms/centimeter). After mixing components, allow bath to be stirred and agitated for at least a one (1) hour period to facilitate thorough mixing and reduction.

3.4.4.4 Reduction. After preparation of the bath, allow it to stir for at least one hour prior to use. Continuous agitation, even while coating, is necessary after preparation to maintain homogeneity of the diluted electrodeposition primer bath.

3.4.4.5 Application. All surfaces to be painted shall be thoroughly cleaned as specified in 3.2 and pretreated as specified in 3.3, except that when abrasive blasting or mechanical cleaning is used, the measured surface profile (SP) shall be no greater than 1.0 mil. To ensure a chemically clean surface, perform the water break test in 4.2.3.1.1 prior to pretreatment. Failure to comply with 4.2.3.1.1 is sufficient cause to do additional cleaning. Since the primer is applied via cathodic electrodeposition, the substrate to be coated is the negative electrode, while the side electrodes are positive. Coat and cure as recommended by the coating manufacturers' instructions.

3.4.4.6 Comments. The primer furnished under this specification shall be products which are authorized by the qualifying activity for listing on the QPD (see 6.4). If a black electrocoat primer is used, the minimum topcoat dry film thickness shall be 2 mils (50 microns) to ensure reflectance requirements of the topcoat are met. In production situations where abrasive cleaning or grit-blasting is used to remove mill scale, the profile of the metal shall be no greater than 1 mil (25 microns). To achieve the required 1,000 hour salt spray resistance on ferrous substrates, the electrodeposition primer DFT shall be equal to or greater than the average blasted profile of the substrate.

3.4.5 MIL-PRF-85582 (Primer Coatings: Epoxy, Waterborne).

3.4.5.1 Description. This specification covers the requirements for corrosion inhibiting, chemical and solvent resistant, waterborne, epoxy primer coatings that meet a maximum VOC of 2.8 lbs/gal (340 g/l). The specification contains formulations that allow for standard pigments (type I) and low infrared reflective pigments (type II). It also differentiates between systems with barium chromate (class C1), strontium chromate (class C2), and non-chromate (class N) based corrosion inhibitors.

3.4.5.2 Use. The primer is intended primarily for use on pretreated nonferrous substrates and is compatible with CARC topcoats. Type II shall not be used as a CARC primer, except on aircraft, and where specifically required (see 6.6).

3.4.5.3 Preparation. The epoxy primer shall be prepared by first thoroughly mixing or agitating component A. Component A is the pigmented base component of epoxy resin solution, and component B is the curing agent. The two components are then mixed in the volume ratio specified by the manufacturer. The preferred temperature range of each component shall be 60 to 90 ºF (16 to 32 ºC) before mixing.

3.4.5.4 Reduction. Reduce the viscosity of the admixed primer with DI water conforming to ASTM D1193 type IV, or according to the manufacturer's recommended procedure. The thinned primer shall be stirred thoroughly, strained through a 60 mesh minimum paint filter or equivalent and allowed to stand for 30 minutes prior to use. Continuously stir the reduced primer throughout the coating application.

3.4.5.5 Application. All surfaces to be painted shall be thoroughly cleaned as specified in 3.2 and properly pretreated as specified in 3.3. To ensure a chemically clean surface, perform the water break test in 4.2.3.1.1 prior to pretreatment. Failure to comply with 4.2.3.1.1 is sufficient cause to do additional cleaning. After completion of the 30 minute induction period, the primer shall be sprayed to achieve a DFT between 0.6 and 0.9 mils (15 and 22.5 microns) for aluminum and between 0.8 and 1.2 mils (20 and 30 microns) for aluminum-steel assemblies. The primer needs only be dry to touch conforming to ASTM D5895 before applying the topcoat. This is usually between 30 minutes and 1 hour depending on conditions. The admixed primer shall be used within 4 hours to ensure performance. The largest factor affecting cure is temperature. At 70° F (21º C), the dry to touch time is within one hour and the primer is dry to handle within 6 hours. The effect of decreasing the temperature within a facility's painting area doubles the cure time for each 18° F (10° C) drop in temperature under 70° F (21º C). Due to the fact that this is a water-reducible system, a high relative humidity retards the cure time while a low relative humidity accelerates the process.

3.4.5.6 Comments. The primer furnished under this specification shall be products which are authorized by the qualifying activity for listing on the QPD (see 6.4). Since the sprayed primer contains water, care shall be taken to ensure the surface is dry to touch before application of urethane topcoats. Premature topcoating leads to an undesirable reaction between the water evaporating from the primer and the catalyst component of the urethane being applied.

3.4.6 MIL-PRF-32550 (Metal-Rich Primers).

3.4.6.1 Description. These VOC compliant, metal-rich primers are designed for direct application to blasted ferrous surfaces in place of other pretreatments. These coatings are either epoxies,

moisture cured polyurethanes or inorganic resins, depending upon the type in the specification. These primers shall conform to MIL-PRF-32550, Metal-Rich Primers. Except for type III powder primers, the metal-rich primers shall be subsequently overcoated with MIL-DTL-53022 or MIL-DTL-53030 prior to the application of the CARC topcoat at a minimum DFT of 1 mil (25 microns). For interior use, MIL-PRF-22750, type III may be used as the overcoat for the metal rich primers. These metal-rich primers shall conform to the VOC content as specified in the designated class.

3.4.6.2 Use. These primer coatings are designed for enhanced corrosion resistance providing cathodic protection and self-healing properties. These products shall be used with CARC. Epoxy primer MIL-DTL-53022 or MIL-DTL-53030 shall be applied at a minimum of 1.0 dry mils (25 microns) as a barrier coat for types I and II between the metal rich primer and the CARC topcoat.

3.4.6.3 Preparation. For types I and II, the pigment portion of the coating shall be thoroughly mixed prior to use or admixing. Follow instructions specified by the manufacturer. Constant agitation shall be used to prevent settling of the pigment. The polyurethane moisture cured type is a single component and does not require any admixing. The epoxy two component types shall be mixed following the manufacturers' specifications.

3.4.6.4 Reduction. If necessary and allowed due to environmental regulations, the metal-rich primer shall be reduced according to the manufacturer's recommended procedure. The single component, moisture cured metal-rich primer does not require any induction time, but the two component epoxy type requires a 30 minute induction time.

3.4.6.5 Application. All surfaces to be painted shall be thoroughly cleaned as specified in 3.2. Constant agitation shall be used during application to prevent settling of the pigment. To ensure a chemically clean surface, perform the water break test in 4.2.3.1.1 prior to coating application. The metal-rich primer shall be applied directly to blasted ferrous metal for maximum performance. The coating shall be sprayed to achieve a dry film thickness no less than 2.5 dry mils (62.5 microns) or as recommended by the manufacturer. If not specified, the recommended DFT range is between 2.5 - 3.5 mils (62.5 - 87.5 microns). Dry times and recoat times are as specified by the manufacturer. The pot life of the moisture cured urethane type is unlimited, if kept free from moisture contamination. The pot life of the epoxy types is 4 - 6 hours at 70º F (21º C).

3.4.6.6 Comments. The primer furnished under this specification shall be products which are authorized by the qualifying activity for listing on the QPD (see 6.4).

3.4.7 MIL-PRF-32348 (Powder Coating, Camouflage, Chemical Agent Resistant Systems).

3.4.7.1 Description. This specification covers powder coatings for use on metallic substrates as a corrosion resistant primer with CARC topcoats, as well as a camouflage and non-camouflage CARC topcoat for use as a finish coat on military combat equipment. Type I is a corrosion inhibiting epoxy primer for ferrous and nonferrous metals. For interior application, the type II powder primer can be used to replace the two coat system of epoxy primer and MIL-PRF-22750 topcoat. The powder primer shall have prior approval from DEVCOM ARL in the specific topcoat color. The type III powder covers camouflage CARC for use as finish coats on military equipment. The type IV powder covers ammunition container CARC. Types I, II, and III can be used on all tactical military equipment, which includes ground, aviation, and related support assets. Because powder coatings do not require solvents, these coatings shall be VOC-free and volatile organic hazardous air pollutant-free (VOHAP-free).

3.4.7.2 Use. The type I and II powder primers are intended for use on properly cleaned (see 3.2) and pretreated (see 3.3) ferrous and nonferrous metal surfaces. Organic pretreatments conforming to type III of TT-C-490 shall not be used as a pretreatment when applying powder primers without verification that the elevated temperatures to cure powder coatings will not affect the performance of the pretreatment. These powder primers are formulated lead and chromate free and are compatible with all CARC topcoats. The type III powder coating is applied over approved type I powder primers, but not type II primers (unless also approved as a type I material). The type IV powder coating is applied directly to properly cleaned and pretreated metal. Since these products are electrostatically applied and require baking for cure, these materials are designed primarily for small and component parts. Parts shall be evaluated for their ability to withstand the baking temperatures required in accordance with the manufacturers' recommendations prior to coating. Caution: elevated bake temperatures may alter material properties of certain substrates. The type III powder coating is applied over approved type I powder primers or e-coat conforming to MIL-DTL-53084. Powder coatings should not be applied over liquid primers.

3.4.7.3 Preparation. The manufacturer shall provide instructions for application preparation.

3.4.7.4 Reduction. Since this is a powder coating and does not use solvent, reduction does not apply.

3.4.7.5 Application. All surfaces shall be properly cleaned and pretreated before application to steel, aluminum or other substrates. To ensure a chemically clean surface, perform the water break test in 4.2.3.1.1 prior to coating application. The powder coatings are applied and cured using the powder coat process specified by the manufacturer. This is generally an electrostatic application of the powder material, where the part is electrically connected to an earth ground and the powder is positively or negatively charged during application. Be sure to read and follow all safety instructions provided by the manufacturer with the powder equipment to avoid injuries associated with electrical current flow.

3.4.7.6 Comments. The primers and topcoats furnished under this specification shall be products which are authorized by the qualifying activity for listing on the QPD. The powder coatings shall be stored under environmentally controlled conditions having a maximum temperature of 80° F (27° C) and maximum relative humidity of 50%. The coatings in storage shall be kept away from direct sunlight.

3.5 Topcoating. The four CARC topcoats provide chemical agent resistance and color for the system. In addition, the polyurethanes (exterior surfaces) provide camouflage, durability and survivability properties. The epoxy (interior surfaces) provides a smooth, easily-cleaned surface which is resistant to wear. These coatings also offer improved performance and prolonged service life. It is best to apply the topcoat to a freshly primed substrate within 24 hours. Application of the topcoat shall occur within the minimum time allowed (specified by the primer material) and a maximum of 168 hours for MIL-DTL-53022 and MIL-DTL-53030 and 24 hours for MIL-PRF-23377 and MIL-PRF-85582 after the primer application or as specified by the manufacturer of the primer. Dip coating or spin coating is not recommended for the CARC topcoats (see 3.4). If topcoating proceeds after 168 hours or 24 hours respectively, either scuff sanding followed by a solvent wipe or a primer mist coat is required (see 4.2.3.2). Adhesion testing (see 4.2.3.6) shall be used to monitor intercoat adhesion. As with CARC primers, application shall be by brush or spray. The paint and substrate shall be approximately the same temperature, and ambient temperature shall be between 60 and 90° F (16 and 32° C) at application and for a period of time after application

sufficient to ensure adequate cure prior to exposure to adverse conditions. When surface temperature or air temperature is < 5º F above dew point, the coating is adversely affected. When relative humidity is in excess of 50%, a dew point calculation may be necessary to avoid the formation of moisture on the substrate to be coated. Application beyond these parameters is not recommended and the applicator assumes all risks. In areas where air quality regulations restrict volatile emissions, do not add thinner to the coating material if that addition causes the regulatory limit to be exceeded. Environmentally acceptable solvents or solvent blends shall be used for reduction. The specific information below for the different topcoats is summarized in table III.

TABLE III. Application characteristics for CARC topcoats.

Specification	Mixing	Reduction	Application
MIL-DTL-53039	Stir or agitate until uniform. Paint containing grit, seeds, skins, abnormal thickening or excessive pigment settling shall not be used.	If necessary and allowed, reduce with MIL-DTL-81772 type IV or supplied by the manufacturer, not to exceed VOC limits where applicable. Stir and strain.	Coating is water sensitive, so don't let water come into contact with the coating. High humidity accelerates dry and cure times, and promotes blistering. Once opened, use within 8 hours unless protected by a nitrogen or argon blanket[1/]. Apply a DFT of 2.5 ± 0.5 mils. Cure time increases with low temperature and low humidity, and decreases with higher temperature and higher humidity.
MIL-DTL-64159	After component A is thoroughly stirred or agitated to redisperse settled pigments then add 1 part by volume of component B to 2 parts by volume of component A and mix well with a mechanical mixer.	If necessary, reduce to sprayable viscosity 3 parts by volume admix with up to 1 part by volume of water or in accordance with manufacturer's directive (start at minimum recommendations and incrementally add water as needed for sprayability) using a mechanical mixer. Stir and strain.	Use the admixed coating within 4 hours. Apply a DFT of 2.5 ± 0.5 mils. Cure and dry times increase with low temp and high humidity, and decrease with higher temp and lower humidity.
MIL-PRF-32348, type III and IV [2/]	Follow the instructions from the manufacturer for preparation and application.	Reduction does not apply, since these products are powder coatings and do not use solvents.	Follow the instructions from the manufacturer.

[1/] See 3.5.1.5 for nitrogen and argon requirements.
[2/] MIL-PRF-32348 is both a primer and CARC topcoat specification. Refer to section 3.4.7.

TERMS: 1 mil = 25 microns.

TABLE III. Application characteristics for CARC topcoats - Continued.

Specification	Mixing	Reduction	Application
MIL-PRF-22750 (interior top coat use only)	Component A shall be thoroughly mixed. Component B shall be added to component A as specified by the manufacturer.	If necessary and allowed, reduce types II and III coatings with MIL-DTL-81772 type IV, or supplied by the manufacturer, not to exceed VOC limits where applicable. Type I coating may also be reduced with MIL-DTL-81772, type I or II. Stir and strain. Let stand 30 minutes.	Apply in one or two coats, as specified by the manufacturer, to a total DFT between 1.7 - 2.3 mils. Use within 8 hours.

TERMS: 1 mil = 25 microns.

3.5.1 MIL-DTL-53039 (Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant).

3.5.1.1 Description. This specification covers both camouflage and non-camouflage, chemical agent resistant, aliphatic polyurethane coatings for use as a finish coat on all tactical military equipment, which includes ground, aviation and related support assets. It is a single component, moisture cured finish which is lead and chromate (hexavalent) free, and has VOC ranging from 0 - 3.5 lbs./gal (0 - 420 g/l) depending upon the type of coating as packaged. This specification only encompasses formulations that are flattened with polymeric flattening agents. Each type has VOHAP-free formulations.

3.5.1.2 Use. MIL-DTL-53039 is intended for all tactical and support equipment. It can be applied over any of the corrosion inhibiting primers described in 3.4, or to a CARC basecoat which is at least dry to touch, as in camouflage pattern painting, or aged and thoroughly cleaned, as in rework. If rework takes place, refer to 3.7.2.3. It shall not be applied over an existing alkyd or lacquer finish. As a camouflage topcoat, it shall be applied to exterior surfaces and interior surfaces routinely visible from the outside, such as door ramps and hatches.

3.5.1.3 Preparation. Thoroughly mix by stirring or agitation to a smooth, homogeneous state. Care shall be exercised to redisperse any pigment which settles to the bottom of the container. Any package which shows evidence of grit, seeds, skins, abnormal thickening or excessive pigment settling shall not be used.

3.5.1.4 Reduction. If necessary for spray application and allowed by VOC regulations, reduce MIL-DTL-53039 with thinner specified in 3.8.1, thinner recommended by the manufacturer or MIL-DTL-81772, type I to a maximum ratio of four parts by volume of the coating to one part by volume of the solvent. To maintain a VOHAP-free material upon application, use MIL-DTL-81772 type IV or follow the manufacturers' recommendations for thinning. MIL-DTL-53039 (except colors Aircraft Green, 34031 and Interior Aircraft Black, 37031) shall be strained through a paint filter to remove any impurities. Thinning is not necessary for brush application, however, for spray application, the coating can be reduced as described above, if required. MIL-DTL-81772, type II solvent shall never be used with this CARC topcoat, as it affects the curing of this coating.

3.5.1.5 Application. For adequate camouflage properties, it is necessary to apply the coating to a minimum DFT of 2.0 mils (50 microns). Under certain temperature and humidity conditions, for more uniform results, apply two coats of a minimum DFT of 1.0 mils (25 microns) each. The CARC topcoats are especially sensitive to moisture. Moisture in the compressed air used to atomize the topcoats, the ambient moisture in the air, and the subsequent drying conditions shall all be monitored to make sure that these measures fall within the limits established by the coating manufacturer. High humidity conditions shorten the dry and cure times, and may cause blistering, especially when wet film thicknesses are excessive. Under conditions where high humidity is a concern, caution shall be taken to control the thickness of the application and the environment of the application site to eliminate the possibility of blistering. Blisters in the cured topcoat are not acceptable. Once opened, MIL-DTL-53039 shall be used within eight hours unless stored in a pressure pot or container under a dry, oil free nitrogen or argon blanket, or in a sealed dry air/airless container. The nitrogen shall conform to A-A-59503, type I, grade A, class I and the argon shall conform to MIL-A-18455, type I. At temperatures of 70° F (21° C) and above, MIL-DTL-53039 dries within the specification requirements in accordance with ASTM D5895 (dry to touch in approximately 15 minutes, dry hard in three hours, dry through in four hours, and within seven days, is ready to be evaluated or placed into service). At 52° F (11° C), MIL-DTL-53039 requires twice as long to cure. Do not apply to items attaining temperatures in excess of 400° F (204° C), such as manifolds, exhaust pipes, or mufflers. Use MIL-PRF-14105 or TT-P-28, as applicable. Do not apply MIL-DTL-53039 to a surface which is contaminated with moisture.

3.5.1.6 Comments. MIL-DTL-53039 is a QPD item, and procurement shall be from an approved supplier. In addition, there is a batch validation requirement which specifies that a sample from every batch shall be approved for visible and near infrared reflectance properties (see 6.4). This coating, when applied as packaged or reduced with exempt solvent, is suitable where VOC regulations limit solvent emissions to 3.5 lbs/gal (420 g/l) or lower. To avert undesirable reactions, spray lines used for epoxy paints shall not be used for polyurethanes without complete flushing and cleaning with solvents. All lines and hoses shall be blown dry following cleaning and flushing to ensure that there is no adverse reaction with potential moisture or solvents in the lines. MIL-DTL-53039 is often applied under camouflage pattern painting (CPP) guidelines in 3-color patterns containing Green 383, 34094, Brown 383, 30051, and Black, 37030. In desert applications, Tan 686A, 33446 is available. For further information on patterns, contact U.S. Army DEVCOM Research Laboratory, Weapons and Materials Research Directorate, ATTN: FCDD-RLW-MC, Coatings and Corrosion Team, APG, MD. For aviation assets, contact Program Executive Office – Aviation (PEO-AVN) or Program Office for aircraft patterns.

3.5.2 MIL-DTL-64159 (Camouflage Coating, Water Dispersible Aliphatic Polyurethane, Chemical Agent Resistant).

3.5.2.1 Description. This specification covers water-dispersible, chemical agent resistant, aliphatic polyurethane coatings for use as a finish coat on all tactical military equipment, which includes ground, aviation and related support assets. The materials are VOHAP-free, free of inorganic HAPS, other than cobalt and non-hexavalent chromium, and have a maximum VOC content of 1.8 lbs/gal (220 g/l) as packaged. The material is available in two coating types. Type II contains polymeric flattening pigments. Type III is furnished in self-contained portable kits. The kits contain the type II CARC in a touch-up system.

3.5.2.2 Use. MIL-DTL-64159 coatings are intended for all tactical and support equipment. It can be applied over any of the primers listed in table I and described under 3.4, or to a CARC basecoat

which is at least dry to touch, as in camouflage pattern painting, or to a completely cured and thoroughly cleaned existing finish, as in rework. If rework takes place, refer to 3.7.2.3. It shall not be applied over an existing alkyd or lacquer finish. Substrates and regulatory requirements determine which epoxy primer is to be selected as the undercoat for this CARC application.

3.5.2.3 Preparation. The material is furnished in two components. Component A consists of a hydroxyl functional polyurethane dispersion that is formulated with prime and extender pigments, additives, and solvents. Component B consists of an aliphatic isocyanate prepolymer that is dispersible in water. The composition mixing ratio for the components is a two to one by volume mixing ratio of component A to component B. Component B is very water sensitive and caution shall be taken to ensure that water or high humidity does not come in contact with the component at any time prior to admix. Mix and agitate component A to fully disperse all pigments, and then add 1 part by volume of component B to 2 parts by volume of component A under constant agitation. Apply vigorous mechanical agitation to the combined components with a high shear mixer. The combined material shall be mixed for about 3 minutes with the high shear mixer. The admixed material noticeably thickens as it is being mixed. The mixer shall be a high speed air drill with a vortex cage mixer attachment. Do not hand mix or use a paint shaker to mix the two components together.

3.5.2.4 Reduction. Reduce the coating by adding up to one part by volume of DI water (ASTM D1193, type IV) to three parts by volume of the admix coating or as specified by the manufacturers' instructions for spray application. Reduction with water shall occur while the material is being mechanically agitated to ensure proper incorporation with the other components. The same equipment used to combine the two components shall be used during the addition of water phase. Do not over thin the admixed material.

3.5.2.5 Application. For adequate camouflage properties, it is necessary to apply the coating to a minimum DFT of 2.0 mils (50 microns). Under certain temperature and humidity conditions, for more uniform results, it is advisable to apply two coats of a minimum DFT of 1.0 mils (25 microns) each. Drying time increases with lower temperatures or higher humidity, and decreases with higher temperature or lower humidity. At temperatures of 70° F (21° C) and above, MIL-DTL-64159 dries within the specification requirements in accordance with ASTM D5895 (dry to touch in approximately 60 minutes, dry hard in 6 hours, dry through in eight hours, and within 7 days for type II, is ready to be evaluated or placed into service). At 52° F (11° C), MIL-DTL-64159 requires twice as long to cure. Do not apply MIL-DTL-64159 to a surface which is contaminated with moisture. Do not apply to items attaining temperatures in excess of 400° F (204° C), such as manifolds, exhaust pipes, or mufflers. Use MIL-PRF-14105 or TT-P-28, as applicable.

3.5.2.6 Comments. MIL-DTL-64159 is a QPD item, and procurement shall be from an approved supplier. In addition, there is a batch validation requirement which specifies that a sample from every batch shall be approved for visible and near infrared reflectance properties (see 6.4). This coating, when applied as packaged or reduced with water, is suitable where VOC regulations limit solvent emissions to 1.8 lbs. /gal (220 g/l). To avert undesirable reactions, spray lines used for epoxy paints shall not be used for polyurethanes without complete flushing and cleaning with solvents. All lines and hoses shall be blown dry following cleaning and flushing to ensure that there is no adverse reaction with potential moisture or solvents in the lines. The spray lines shall also be flushed with water prior to application to remove any undesirable solvents in the lines. MIL-DTL-64159 is often applied under camouflage pattern painting (CPP) guidelines in 3-color patterns containing Green 383, 34094, Brown 383, 30051, and Black, 37030. In desert

applications, Tan 686A, 33446 is available. For further information on patterns, contact U.S. Army DEVCOM Research Laboratory, Weapons and Materials Research Directorate, ATTN: FCDD-RLW-MC, Coatings and Corrosion Team, APG, MD 21005-5069. For aviation assets, contact PEO-AVN or Program Office for aircraft patterns.

3.5.3 MIL-PRF-22750 (Coating, Epoxy, High-Solids).

3.5.3.1 Description. This specification covers the requirements for a two-component, high-solids epoxy coating with a maximum VOC content of 2.8 lbs./gal (340 g/l) and which is formulated to be free of cadmium, chromium, and lead. A coating kit is available for use.

3.5.3.2 Use. MIL-PRF-22750 is intended to provide an interior topcoat for all tactical and support equipment. It can be applied over any of the primers described in 3.4, or to CARC basecoat which is at least dry to touch or which is completely cured and thoroughly cleaned, as in rework. If rework takes place, the previous paint finish shall be scuff sanded and cleaned prior to this coating being applied. It shall not be applied over an existing alkyd or lacquer finish. Since epoxy-polyamide paint films are sensitive to ultraviolet radiation and tend to chalk upon exposure to sunlight, MIL-PRF-22750 shall be applied only to interior surfaces. The type II coating is a direct replacement for type I, which has been cancelled and can be used in lieu of the type I material.

3.5.3.3 Preparation. Prior to combining the two components together, component A shall be thoroughly mixed by stirring or agitation to a smooth homogeneous state. Care shall be exercised to redisperse any pigment which settles to the bottom of the container. Material which contains evidence of pigment flotation, coarse particles, or objectionable settling, which cannot be readily dispersed, shall not be used. Components from different manufacturers shall not be mixed, nor shall components from different color kits be mixed. After combining the two components, the coating compound shall be thoroughly mixed into a smooth, homogeneous state. After combining the two components, the mixed material shall be allowed to sit for a 30 minute induction time. The use of plural metering spray equipment eliminates the requirement to have a 30 minute induction period before application.

3.5.3.4 Reduction. The type II and III epoxy topcoats shall use only MIL-DTL-81772 type IV or a reducer recommended by the manufacturer to maintain the HAP-free material for application. Caution shall be taken when thinning so as not to exceed the maximum VOC content of 2.8 lbs. /gal (340 g/l) or local regulatory limit depending on which is the more stringent requirement in areas where air pollution regulations are enforced. The reduced paint shall be thoroughly stirred and strained through a minimum 60 mesh paint filter to remove any impurities, and allowed to stand at room temperature for 30 minutes before using.

3.5.3.5 Application. The application of the mixed coating shall be applied in one full coat to the required DFT 1.7 to 2.3 mils (42.5 to 57.5 microns) or two coats, each being about 1 mil (25 microns) DFT to help prevent blistering and gloss variations. Another option to help prevent bleeding, blistering or gloss variations is after completion of the 30 minute induction period, spray a mist coat of the MIL-PRF-22750 over the primer and allow to dry for 30 minutes. It shall be thin, discontinuous, and translucent (not full hiding). Follow this step with a full wet coat to a DFT of 1.3 to 1.7 mils (32.5 to 42.5 microns). For aircraft, apply two coats to a total DFT of 2.0 to 2.4 mils (50 to 60 microns). Mixed coating shall be used within 8 hours. Pot life is shortened by higher temperatures. Curing time increases with lower temperature and decreases with higher temperature. At temperatures of 70° F (21° C) and above, MIL-PRF-22750 dries within

specification requirements in accordance with ASTM D5895 (dry to touch in four hours, dry hard in eight hours, and complete cure in seven days).

3.5.3.6 Comments. MIL-PRF-22750 is a QPD item, and procurement shall be from an approved supplier. To avert undesirable reactions, spray lines used for both epoxy and polyurethane paints shall be completely flushed or thoroughly cleaned before switching. MIL-PRF-22750 is the CARC topcoat for interior surfaces. This coating is supplied in many colors referenced in SAE-AMS-STD-595, such as color numbers 17925, 24533, and 26307. For further information contact U.S. Army DEVCOM Research Laboratory, Weapons and Materials Research Directorate, ATTN: FCDD-RLW-MC, Coatings and Corrosion Team, APG, MD.

3.5.4 MIL-PRF-32348 (Powder Coating, Camouflage, Chemical Agent Resistant Systems). For description, use, preparation, reduction, application and comments for type III and IV topcoats, see 3.4.7.

3.6 MIL-PRF-32440 (Coatings, Chip-, Impact-, Wear-, and Abrasion-Resistant).

3.6.1 Description. This specification covers the requirements for a high build polyurea (HBP) two-component, high-solids, high build resin system with an amine resin and isocyanate components furnished under specification MIL-PRF-32440. When mixed and applied in accordance with the manufacturer's instructions, the HBP shall produce a chip-impact, wear, and abrasion-resistant coating that satisfies all of the requirements contained within the specification. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this specification. Coatings shall consist of a resin component and an isocyanate component. The two components cure through an exothermic reaction to form an elastomeric barrier coating which shall meet the zero volatile organic compound (VOC) requirements.

3.6.2 Use. MIL-PRF-32440 may be used as an interior or exterior coating when applied over any of the epoxy primers or CARC topcoats listed in MIL-DTL-53072. Newly applied base coatings shall be cured under ambient conditions or force cured and care shall be taken to avoid premature application of the HBP to avoid solvent outgassing of the base coatings. HBP may be applied over an existing CARC system provided the substrate is sound and thoroughly cleaned. HBP must be topcoated with a material described in 3.5 to be part of the CARC system. It shall be topcoated in accordance with manufacture's recommendations. HBP shall not be applied over an existing alkyd, acrylic emulsion, or lacquer finish.

3.6.3 Classification. Chip-, impact-, wear-, and abrasion-resistant coatings are of the following classes as specified.

3.6.3.1 Class I. For use with temperature controlled, plural component spray equipment.

3.6.3.2 Class II. For use with pneumatic cartridge application equipment, or with a suitable hand applicator.

3.6.4 Coating Preparation.

3.6.4.1 Class I plural spray systems. Prior to combining the two components together or energizing the spray equipment, component B shall be thoroughly mixed by stirring or agitation to a smooth homogeneous state to evenly disperse settled materials using mechanical means; drum or pail

mixers, or tumblers. Do not use shakers/agitators that will induce air into the material. A and B components shall be brought to application temperatures in accordance with the manufacturer's recommendations. Materials beyond the expiration date shall be disposed of or, if still viable, shall be recertified in accordance with the manufacturer's recommendations. Components from different manufacturers shall not be mixed, nor shall components from different color kits be mixed. There is no induction time for plural spraying of HBP. The materials are mixed within the integrator in the application gun at the volume produced by the drum or pail hydraulic pumps and controlled by the proportioner at the required 1:1 ratio.

3.6.4.2 Class II hand cartridge applicator/pneumatic systems. Prior to setting up the plural gun applicator, condition the A and B cartridges in accordance with the manufacturer's recommendations. Different manufacturers may require a range of elevated conditioning temperatures prior to setup. Materials beyond the expiration date shall be disposed of or recertified in accordance with the manufacturer's recommendations. Components from different manufacturers shall not be inter-mixed, nor shall components from different color kits be mixed. There is no induction time for plural spraying of HBP because the materials are mixed within the disposable static mixer at the required 1:1 ratio. Using a new disposable static mixer for each application will assure that the required 1:1 ratio for mixing is obtained.

3.6.5 Reduction. None. These are 100 percent solids materials. No solvent of any type shall be added to either component A or B prior to use.

3.6.6 Application. Dry film thickness - The cured application thickness shall be as described on the part drawing or the engineering design finishing procedure for the asset. In no case shall it exceed the design requirements set by the HBP coating manufacturer. Typical applications range from 50-200 mils DFT or greater depending upon the engineering drawings and design usage. Curing - HBP shall be cured in accordance with the manufacturer's recommendations including humidity control. Overcoating with epoxy primer or CARC topcoat may proceed after the HBP has been properly cured in accordance with the manufacturer's recommendations. Adhesion of HBP shall be in accordance with MIL-PRF-32440.

3.6.7 Comments. MIL-PRF-32440 is a QPD item, and procurement shall be from an approved supplier. For further information contact U.S. Army DEVCOM Research Laboratory, Weapons and Materials Research Directorate, ATTN: FCDD-RLW-MC, Coatings and Corrosion Team, APG, MD.

3.7 Touch up and repair. When touching up damaged areas or applying CARC topcoat to an existing CARC topcoat, the procedure to be followed depends upon the type and condition of the existing finish. Items previously coated with alkyds, lacquers or vinyl shall be stripped down to the epoxy primer if present, or to the substrate if not. For rework, polyurethane and epoxy topcoats shall only be applied over previously painted epoxy or polyurethane topcoats that are free of defects, deterioration and/or corrosion. If coating over existing epoxies or polyurethanes aged more than 168 hours, refer to 3.7.2.2. When using touch-up kits for repair, only those kits that are listed in the QPD for the respective specification shall be used. Products not listed shall not be used.

3.7.1 Surface preparation. Scratches or other light damage to polyurethane or epoxy topcoats shall require scuff sanding at the immediate blemish area. Damage or corrosion extending to the substrate shall require sanding or abrasive blasting and repriming. All traces of corrosion shall be

removed from the substrate. The surface immediately surrounding exposed substrate shall then be sanded, sing a feathering-in technique which requires sanding away damaged paint film (primer and/or topcoat) so that the thickness of the film is smoothly tapered across the repair area to the top of the paint film. An area around the tapered section shall be scuff sanded to allow for over coating with a suitable CARC topcoat. Sanding of any type shall be followed by wiping down the exposed area to be painted using an environmentally acceptable procedure that removes all loose sanding debris, mill scale, grease, oil (including fingerprints), and diesel/gasoline residue. This procedure shall be performed in a well ventilated area while wearing gloves to prevent skin contact with cleaning solvents. Consult safety personnel to determine appropriate gloves and protective clothing, and to determine if respiratory protection is needed. All steel areas sanded down to bare metal shall be pretreated with chromate free pretreatments qualified to TT-C-490. All aluminum areas sanded to bare metal shall be pretreated with pretreatments qualified to MIL-DTL-81706, or chromate free pretreatments qualified to TT-C-490 and allowed to dry. The maximum area allowed for touch-up shall be agreed upon for each contract between the Government and the applicator.

3.7.2 Repair procedures. The surface temperature and ambient conditions during application of CARC shall be between 60º F (16º C) and 90º F (32º C). The dew point shall be a minimum of 5º F above application temperature as described in (3.5). Application outside these parameters could result in issues with curing, blistering, sagging, and other coating anomalies resulting in a rejection. Additionally, it is important to maintain these conditions during drying of the coating prior to exposure to adverse conditions and achieve finish as described in 4.2.3.8.

3.7.2.1 Primer. Choose the appropriate primer and prepare in accordance with 3.4. Apply evenly in one coat over the pretreated substrate and apply over portions of the exposed original primer coat using blend-in technique which is tapering off quantity applied to a thin edge. Allow epoxy primer to dry a minimum of 1 hour or until dry to touch before topcoating. For MIL-DTL-53030 and MIL-PRF-85582, all water must be evaporated from the coating prior to topcoating. If the primer has dried more than 168 hours or 24 hours depending upon the primer (see 3.5), it may be necessary to lightly scuff sand and solvent wipe the surface to promote intercoat adhesion.

3.7.2.2 CARC topcoat guidelines. Ensure that the surface to which the topcoat is applied is clean and dry. Application of CARC topcoats to surfaces previously painted with CARC as in the typical case of repair of light topcoat damage or overlapping painting on difficult to reach areas may proceed while the original coating is still curing. Polyurethane, which has been fully cured, shall be properly cleaned and prepared to ensure good intercoat adhesion. It is recommended to consult with the coating manufacturer to ensure that the surface is prepared correctly to obtain the proper adhesion of a freshly applied CARC topcoat to a cured CARC topcoat finish. In some cases this may require a light scuff sanding followed by a solvent wipe to promote intercoat adhesion. All surfaces shall be thoroughly cleaned of absorbed/deposited carbon, salt, fuel, oil, hydraulic/transmission fluid, fingerprints, and wax. It is recommended that a mist coating of additional primer be applied to promote better adhesion over fully cured epoxy primer when primer has been allowed to stand past manufacture's recoat window. CARC topcoats shall be cured within 168 hours. The speed with which CARC will cure is dependent upon type, coating thickness, ambient conditions, and the methods in which the coating was prepared for use. CARC shall be considered cured sufficiently for adhesion testing (4.2.3.6.1) or exposure to adverse conditions when the coating passes the solvent wipe test (4.2.3.2). Coating not sufficiently cured within the 168 hour timeframe to pass the solvent wipe test and the adhesion test shall be rejected. In any case, preproduction test surfaces (see 4.2.2) shall be maintained as Objective Quality Evidence

(OQE) to account for the varied conditions encountered during production painting. These, along with the guidelines above, will help to ensure a sound CARC application. Do not apply CARC topcoats to surfaces subjected to temperatures in excess of 400º F (204º C), such as exhaust systems or turbochargers. The type III powder coating is applied over approved type I powder primers or e-coat conforming to MIL-DTL-53084.

3.7.2.3 Application methods. Rework (application of CARC topcoats to sound existing topcoat) shall use the conventional techniques of spraying or brushing. For touchup, suggested procedures include brushing (see appropriate application section of primer and topcoat descriptions) or sponging/wiping. Use good quality equipment with proper technique for spray application by conventional techniques. Small self-pressurized spray kits are also available for use in CARC touch-up procedures. Do not use spray cans that are not officially qualified CARC, as specified in TM 43-0242, Chemical Agent Resistant Coating Spot Painting for Army Ground Equipment. They are a visual color match to CARC, but they do not have CARC properties or approval. They shall not be used for CARC touch-up. The only touch-up kits that shall be used are those approved by DEVCOM ARL. They contain the appropriate CARC and they are supplied in various packaged forms such as spray cans, cartridges, and touch-up kits. These products are supplied in both MIL-DTL-53039 and MIL-DTL-64159 and are listed in the QPD.

3.7.2.4 Dry film thickness. The total dry film thickness (DFT) of previous coatings shall be checked prior to reworking. Limitations on maximum DFT to be top coated shall be determined by an adhesion test on the existing coating in accordance with 4.2.3.6. It is recommended not to exceed a total of 20 mils (500 microns). For aircraft, the coating DFT (existing plus rework) shall not exceed 8 mils (200 microns) on metallic substrates and 10 mils (250 microns) on composites. Aviation asset inspection criteria can be found in TM-1-1500-345-23. The maximum DFT shall be 9 mils (225 microns) on a porous, cast. Coating thickness above the recommended range can result in adhesion failure and coating fissures. Cracking (fissuring) of the topcoat due to too thick a film is subtle and difficult to find (magnification is often necessary) but is cause for rejection due to porosity and permeability.

3.8 CARC process notes.

a. Mix thoroughly. The 55 gallon closed head drums shall be put on a drum tumbler or drum roller for at least 6 hours before use. Other CARC supplied in open head drums shall be mixed using agitators. A paint shaker for smaller sized containers saves time and eliminates stirring with a paddle or mixer, which prevents moisture contamination and extends pot life.
b. Keep moisture away from MIL-DTL-53039 and from component B in MIL-DTL-64159, either by the use of very dry (-32º F (-36º C) dew point air dryer) air, desiccant air dryer on air-line, or nitrogen or argon blanket.
c. Use a separate piece of equipment for epoxy primer and for the urethane topcoat, or thoroughly flush all lines used for both coatings when switching. Do a final flush with the solvent that is compatible with the CARC topcoat.
d. Clean equipment thoroughly and in accordance with manufacturers' instructions for use, and before prolonged storage.
e. Rotate inventory of material first in, first out. CARC has a guaranteed shelf life of 12 months from the date of manufacture.
f. Be sure to remove all thinner from coiled hoses and the pumping system before storage. Since thinner dries out pumping system gaskets, a good grade of light oil that is approved by the coating and equipment manufacturers shall be used to prevent this occurrence.

g. When automated equipment such as robotics are used, be sure to use meter mixing equipment, strict viscosity control, material quality control, and total system supervision shall be maintained.
h. Store material in a clean, dry, temperature controlled, OSHA approved storage facility (see 3.9.9).
i. Insist on operator training in operation, maintenance and storage of equipment.
j. Do not use material directly from the container unless thoroughly agitated and mixed.
k. Do not apply the coating to a surface which is contaminated with moisture or the surface temperature is less than 5° F (3° C) above the dew point.
l. Do not allow thinner to stand in the material hoses. The epoxy and the polyurethane material residue reacts, even though thinner or solvent is present, and blocks up mixed material hoses.
m. Do not spray in unventilated areas without proper EPA and OSHA approved spray equipment. For appropriate equipment, contact your environmental safety and health coordinator.
n. Do not spray epoxy primer or CARC on a dirty surface. Remove all surface rust, oil, dirt, and loose paint before applying epoxy primer or CARC.
o. Do not leave component A or B of polyurethane topcoat in air-operated pumps for more than two hours without recirculation.
p. To prevent solidification, do not leave mixed materials in hoses, cups, or pumps for longer than 2 hours when not in use, unless a recirculation system is used.
q. Use of commercially available chemical accelerators is strictly prohibited. CARC topcoat accelerators provided by the manufacturer specifically formulated by the CARC manufacturer for use with their topcoat are acceptable, if used in accordance with technical information provided by the paint vendor and provided that all quality control measures are met.
r. Where Aircraft Black, color #37038, or Aircraft Interior Black, color #37031, are specified for use, Black, color #37030 is authorized as an alternative replacement.
s. The effects of decreasing temperature within a facility's painting area doubles the cure time for each 18º F (10º C) drop in temperature under 70º F (21º C).
t. A heated atmosphere accelerates cure time.
u. Use of pot or cup agitation equipment is strongly encouraged to minimize the potential for the solids to settle during spraying application (and necessary for metal-rich primers).
v. Induction time is measured after all paint components are mixed together, including solvent, if required.
w. For two or more component coatings, never mix components from different vendors.

3.8.1 HAP-free thinner. DEVCOM ARL has developed a HAP-free, low VOC thinner blend to be used as an alternative to MIL-DTL-81772, types I and II. This solvent blend can be used with the CARC epoxy and polyurethane coatings to maintain a HAP-free coating for application. This material is listed under MIL-DTL-81772 type IV. Each supplier shall provide a certificate of conformance and analysis with each shipment.

3.8.2 CARC post-add non-slip. When specified in the contract or allowed by procuring authority, coarse polymeric beads (300-800 nm mean particle size) shall be used in the CARC topcoat to achieve a non-slip surface. Polymeric bead material, composed of polyethylene or polypropylene, is a post-add product that is mixed into the CARC topcoating (MIL-DTL-53039 or MIL-DTL-64159) at the following ratio: Nominal mix ratio 1.5 pounds of the polymeric beads shall be blended into 1 gallon of mixed and ready-to-apply CARC. Smaller units of application shall follow

this ratio as practical. It is recommended that no more than 2 lbs of the non-slip beads per 1 gallon of CARC shall be used to prepare the coating for application. The addition of more beads may lead to adhesion loss and improper surface coverage of topcoat creating visual defects. The polymeric beads shall be added incrementally while stirring the CARC to achieve a homogenous blend. When using MIL-DTL-64159, the CARC coating shall be mixed at the appropriate ratio, allowed to stand for 5-10 minutes prior to adding the polymeric beads. While blending in the polymeric beads a pneumatic or electric paddle mixer shall be used. For making smaller quantities of the non-slip mixture (1 quart or less), a wooden paint stirrer should be adequate. Once the polymeric beads/CARC have been thoroughly mixed, decant an appropriate quantity into a roller pan or pail for the user. Ensure that the mixed CARC non-slip is frequently re-blended in the mixing container using a wooden paddle, power mixer etc. to minimize any settling of the beaded material in the CARC top coat. The bead/CARC blended non-slip shall also be regularly mixed while in the roller tray or paint bucket during application by the artisan applying the coating. The non-slip shall be applied by brush or roller to a freshly primed surface. (Note: refer to the primer manufacturer's technical data sheet regarding proper recoat times.) Once applied, allow for appropriate cure per the CARC type (MIL-DTL-53039 or MIL-DTL-64159) before removal of any masking materials. As this non-slip is mixed into a standard CARC top coating, there is no requirement to apply an additional CARC top coat application to meet CARC specifications. Allow the CARC/non-slip to fully dry prior to removal of the masking materials. Due to the nature of application, film builds will be higher in areas that use polymeric beads for non-slip surfaces and shall not be a sole reason for rejection.

3.9 Miscellaneous requirements.

3.9.1 Camouflage (exterior). Unless otherwise specified, all material except aircraft shall have a base topcoat of the color Green 383, 34094 for the three color woodland pattern. The system used shall be compatible with and provide good adhesion for subsequent coatings used to provide the camouflage pattern. Tan 686A, 33446 is the base coat for desert application and black CARC component parts shall be indicated on end item drawings or as specified in the contract. CARC shall be top coated only with CARC.

3.9.2 Surfaces not requiring paint. Fabrics, plastics, rubber working parts of machinery, lubrication fittings, and other surfaces not normally painted shall not be painted, unless required by the specification for the end item. Such surfaces shall be masked or protected during treatment and painting to prevent damage to them. If the paint does not interfere with their function, incidental overspray is allowed.

3.9.3 Engines and other heated areas. Engines shall be cleaned and treated as specified herein and painted in accordance with the applicable engine specification. When cleaning and painting of exhaust manifolds, exhaust pipes, mufflers, and other parts subject to high temperatures in excess of 400° F (204° C) is specified in the applicable engine specification, the paint shall conform to MIL-PRF-14105 or TT-P-28, as applicable.

3.9.4 Sealing. Unless otherwise specified in the end item specification, sealing of the interiors of gear cases or similar compartments and reservoirs shall be in accordance with the applicable sealant specification. The sealer shall be applied prior to assembly and shall withstand immersion in lubricating oil, hydraulic fluids, and cutting compounds for the operating temperatures and atmospheric conditions specified for the end item, without wrinkling, blistering, peeling, or loss of adhesion.

3.9.5 Electrical components. Electrical components of equipment not otherwise governed by applicable specifications shall be treated and painted in accordance with the contractor's standard practice.

3.9.6 Aluminum alloys and components. When an aluminum part, component or specimen is processed, the corrosion resistance test described for primer applied to steel specimens outlined in paragraph 4.2.3.7 is applicable, except the corrosion testing parameters for non-ferrous specimens shall be based upon the requirements specified for aluminum substrates in the primer specification corresponding to the material and type used. The frequency of testing shall be as specified in 4.2.3.7.

3.9.7 Use of steel wool. Steel wool shall not be used in lieu of emery or garnet abrasives to clean aluminum or magnesium alloy surfaces.

3.9.8 Welding, soldering and brazing. Unless otherwise specified, welding, soldering and brazing shall not be permitted on an assembly after it has been painted with CARC finishes. If necessary to perform one of these procedures after an item is coated, the finish shall be completely removed to the substrate at least four inches in all directions from the work area and in all areas that reach 400° F (204° C) and above, including the backside if it is CARC painted. A lesser radius for removal of the CARC system is practical provided that the weld or repair procedure can verify that the heat affected zone has not exceeded 250° F (121° C). Three recommended methods for removal are the use of plastic media blasting at approximately 40 lbs. /in^2 (2.812 kg/cm^2), the use of a suitable chemical paint remover or the use of a hand-held portable sander/grinder equipped with a wire brush. After the procedure is finished, the stripped surfaces shall be cleaned, pretreated and repainted (see 3.7)

3.9.9 Handling and storage. Keep CARC components away from heat, sparks, and open flame. Store in tightly closed containers and protect from moisture and foreign materials. Ideal storage temperature for paint materials is 70-75° F (21-24° C). To prevent moisture contamination, freezing or degradation of the coatings, storage temperatures between 40° F (4° C) and 95° F (35° C) shall be maintained. Paint materials shall be brought to 60-90° F (18-32° C) prior to use. At a maximum storage temperature of 122° F (50° C), material slowly undergoes chemical changes without hazard and results in components not being usable. CARC components, which are stored at temperatures below the minimum cited above are not degraded, but they shall be returned to usable temperatures cited above prior to use. For powder coatings conforming to MIL-PRF-32348, refer to 3.4.7.6 for storage requirements. Guaranteed shelf life is 12 months from date of manufacture at 77° F (25° C). CARC materials stored outside the indicated temperature range shall not be used unless retested and certified by the coatings manufacturer.

3.9.9.1 Shelf life. If CARC is received from Defense Logistics Agency, General Services Administration or through the supply system after the labeled shelf life expiration date, do not accept it. If a unit accepts CARC that is expired it shall submit a report of discrepancy (ROD) to the appropriate agency immediately. Contact the installation environmental office for guidance on proper disposal of expired materials.

3.9.9.2 Heat, light moisture. If container of material is exposed to heat, it can pressurize and burst. If moisture enters a container of MIL-DTL-53039 or component B of MIL-DTL-64159, the contents react to produce carbon dioxide, which results in pressure building up inside the container. Do not reseal if contamination is suspected. If the paint reaches minimum temperatures of 32° F

(0° C) or below, it thickens however, upon rewarming it is usable. The temperature range specified 60 - 90 °F (16 - 32° C) shall be attained throughout the paint before mixing and applying.

4. VERIFICATION

4.1 Inspection conditions/documentation. Unless otherwise specified, all inspections shall be performed in accordance with test conditions specified in applicable test method document or applicable paragraph(s) in the specification and a historical record of the results shall be maintained as OQE.

4.2 Examination. The end item treatment and painting shall be examined for the defects specified in table IV.

TABLE IV. Examination.

Item Number	Defect	Reference Paragraph
101	Cleaning not as specified.	3.2
102	Ferrous metal surfaces to be painted not prepared as specified.	3.2.1
103	Surfaces that are not components exempted from abrasive blasting not prepared for painting as specified.	3.2.1.1
104	Ferrous metal surfaces of vehicles not cleaned for painting as specified.	3.2.1.2
105	Zinc surfaces not cleaned as specified.	3.2.2
106	Aluminum surfaces not cleaned as specified.	3.2.3
107	Aluminum alloy surfaces not cleaned as specified.	3.2.3
108	Magnesium alloy surfaces not cleaned as specified.	3.2.4
109	Cadmium surfaces not cleaned as specified.	3.2.5
110	Pretreatment not applied after cleaning as specified.	3.3
111	Ferrous metal surfaces not treated as specified.	3.3.1
112	Zinc surfaces not treated as specified.	3.3.1
113	Cadmium surfaces not treated as specified.	3.3.1
114	Aluminum surfaces not treated as specified.	3.3.2
115	Magnesium alloy surfaces not treated as specified.	3.3.3
116	Wood surfaces not treated as specified.	3.3.4
117	Stainless steel surfaces not treated as specified.	3.3.5
118	Primer coatings not prepared as specified.	3.4
119	Primer coatings not reduced as specified.	3.4
120	Primer coatings not applied as specified.	3.4
121	Topcoats not prepared as specified.	3.5
122	Topcoats not reduced as specified.	3.5
123	Previously painted surfaces not treated as specified.	3.7
124	Base topcoat not Green 383, 34094 as specified (except for aircraft).	3.9.1
125	Surfaces not requiring paint shall not be painted unless required by the specification for the end item.	3.9.2
126	Engines not cleaned and treated as specified.	3.9.3
127	Sealing not as specified.	3.9.4
128	Electrical components of equipment not otherwise governed by applicable specifications not treated and painted as specified.	3.9.5
129	Steel wool usage not as specified.	3.9.7
130	Welding not as specified.	3.9.8

TABLE IV. Examination - Continued.

Item Number	Defect	Reference Paragraph
131	Soldering not as specified.	3.9.8
132	Brazing not as specified.	3.9.8
133	Handling of CARC components not as specified.	3.9.9
134	Storage of CARC components not as specified.	3.9.9

4.2.1 Test specimens. Where practical, test specimens/coupons shall be prepared from actual production items or parts thereof, or if size is prohibitive, from scrap parts of the same kind and finish (from the same manufacturing lot if possible) which have been rejected for causes other than phosphating, material composition, heat treatment or any combination thereof. Specimens/coupons need not be identical in shape or size but shall be stamped, etched, or otherwise indelibly marked for identification as a test specimen/coupon. When parts are not available, use standard specimens/coupons not less than 4 x 6 x 0.0312 inches in size. Standard steel specimens/coupons such as cold rolled SAE 1010 steel, shall be used when authorized by the contracting officer. These specimens/coupons shall conform to ASTM A109/A109M or ASTM A1008/A1008M. Standard aluminum specimens/coupons of Al2024-T3 shall be used when authorized by the contracting officer. For zinc coated surfaces, the specimens/coupons shall be made of the same coated material as specified in the contract. When coated steels are used, the standard test specimens/coupons shall be made of the same material as that specified in the contract. All test specimens/coupons shall be processed through all the cleaning, pretreating, painting, and drying steps along with the items being processed. Test specimens/coupons shall not be reused.

4.2.2 Pre-production test surfaces. Determine daily, prior to actual painting, the suitability of the coating mixes with prevailing application parameters such as atmospheric conditions, painting techniques and equipment, thinning and mixing ratios. Determine daily, prior to actual painting, the adequacy of production procedures and practice surfaces (with the specified pretreatment). Separate surfaces shall be prepared (coated) for each coating operation, that is pretreatment plus primer and pretreatment plus primer plus topcoat. Test surfaces either on actual steel parts or representative steel panels approximately 4 x 6 inches (10.16 x 15.24 cm) for each coating shall be prepared. Alternate dimensions and substrates can be used as agreed upon between the contractor and the pre-production approval authority or as described in section 4.7.2 of TT-C-490. These surfaces shall be coated with the 4 inch (10.16 cm) dimension positioned vertically and the 6 inch (15.24 cm) dimension positioned horizontally. They shall be observed for blushing, sagging, blisters, improper wet film thickness or other in-process defects detectable during or shortly after application and appropriate adjustments/corrections made. The final successfully coated test surface used to validate each batch/block of production coating application shall be evaluated and recorded.

4.2.3 Coating validation. All primers and topcoats in the CARC system are QPD items. Certification from the primer or topcoat manufacturer shall include a copy of all quality conformance tests as well as a copy of the Army's validation for the topcoat of the spectral and specular reflectance characteristics of the paint lot when required by the applicable specification. Conformance inspection requirements for epoxy primers MIL-DTL-53022 and MIL-DTL-53030 and any newly published or revised specification, including MIL-PRF-32348 and MIL-DTL-53084, requires the submission from each production lot a batch validation letter detailing the batch number, manufacturer’s code, specification and type number, QPD number and batch

volume to U.S. Army DEVCOM Research Laboratory, Weapons and Materials Research Directorate, ATTN: FCDD-RLW-MC, Coatings and Corrosion Team, APG, MD 21005-5069.

4.2.3.1 Application validation. Whenever there is a change in the type of pretreatment, primer, topcoat, specification, or manufacturer used, application validation testing shall be performed prior to a new coating application to ground support and aviation major end items, such as helicopters and vehicles. This testing is to confirm that any changes in the coating previously used on the military equipment shall not promote adverse surface imperfections, as described in 4.2.3.8, which would require removal of the new coating. Testing shall be done on non-production metal exhibiting complex surfaces to determine acceptable application criteria. As specified in the primer or topcoat specification, for spray application, the metal surface area shall be large enough to satisfy all requirements of the spray characteristics. Once the application properties of the new coating are verified and validated, component parts shall be coated and validated before application of the coating to the equipment or the airframe. Once validation is completed, the complete coating system shall be applied to a major end item and approved prior to final acceptance of application procedures.

4.2.3.1.1 Condition of surface. Immediately prior to pretreatment and painting, the surface shall be subjected to a water break test. When using a chemical conversion coating for aluminum, per MIL-DTL-5541, the water break test is performed after the cleaning and deoxidizing step and prior to the application of the aluminum conversion coating. The water break test shall be conducted by subjecting the surface to a mist of fresh tap, RO or DI water by means of a convenient small atomizing device. If the water droplets tend to coalesce into large lenses lasting for 25 seconds, (without a sudden flash out), the surface shall be considered as having satisfactorily passed the water break test. If the water gathers into droplets within 25 seconds (if the surface shows a “water break” within that time), the surface shall be considered as having failed the test. If the water forms a continuous film by flashing out suddenly over a large area, this shall be considered as evidence of the presence of an impurity on the surface such as free alkali or residual detergent, and the surface shall be considered as having failed the test. Failure to support an unbroken water film shall be sufficient cause to do additional cleaning. At least two specimens/coupons after a max of every 4 hours of production. If more than four hours have passed since performing the water break test, re-examine the surface for corrosion, foreign matter or oily residues and repeat the water break test prior to pretreatment or coating. Cleaning materials which may be effective against one type of contaminant may be ineffective against others. Multiple cleaning procedures may be required to provide the required water break free surface.

4.2.3.2 Solvent wipe. The solvent wipe test shall be performed to establish that the CARC finish coats are properly prepared and adequately cured to withstand adverse storage. Topcoat solvent wipe test shall be performed after a minimum of 72 hours air drying. If the temperature of the test item drops below 60° F (16° C), additional time shall be allowed before performing the test. Thoroughly wet a lint free rag with acetone or methyl ethyl ketone (MEK) and briskly rub the painted surface for ten seconds to remove any dry spray or overspray. Wet another clean dry rag with acetone or MEK and briskly rub the same area with 20 strokes approximately six inches (15.24 cm) in length. Evidence of paint removal down to the previous coated surface is evidence of an unacceptably prepared topcoat or an uncured film. If there is evidence of paint removal down to the previous coated surface, then the test shall be repeated every 24 hours to a maximum total of 168 hours. Various conditions; such as paint thickness, application conditions, ambient curing temps, etc., may slow the cure cycle and take longer to obtain the solvent resistance required. After 168 hours, these items shall be rejected and reworked in accordance with 3.7. The

tested area shall be reworked in accordance with 3.7 to repair any areas of coating removal. This test shall be performed in a well ventilated area while wearing solvent resistant gloves to prevent skin contact with the solvents. This test is also utilized to identify whether a previously coated substrate will accept the CARC coating system. If the previously coated surface fails this solvent wipe test, then the previous coating must be removed to the substrate before the CARC coating system is applied. Using accelerated curing methods per the coating manufacturer's recommendations and the applicable specifications, such as convection ovens, IR, or other approved engineering methods, will accelerate the cure sufficiently to apply the solvent wipe test within 24 hours or less. When accelerated temperatures are used for drying, consult with the coating manufacturer to determine when the solvent wipe test shall be performed. The solvent wipe test shall not be performed until the substrate has returned to room temperature. For the solvent wipe test to be applied within 24 hours, evidence of Objective Quality Evidence (OQE) shall be supported by appropriate process checks (thickness, application conditions, ambient curing temps, etc.). Evidence of passing the adhesion test (see 4.2.3.6) must accompany the results of the solvent wipe test.

4.2.3.3 Dry film thickness (DFT). The upper limits on DFT are not mandatory for surface areas on which such limits are impractical to maintain; for example, contoured areas. However, DFT shall be controlled in these areas, to prevent excessive deposition of paint. DFT tests shall be performed on uniform coated surfaces. DFT testing shall be performed using a conventional nondestructive measuring device such as a magnetic tester in accordance with ASTM B499, an eddy current tester in accordance with ASTM B244, or other acceptable standard methods. DFT requirements for CARC primers and topcoats are listed in table V. Previously applied coatings to the test area shall be identified prior to topcoating, such as repair or rework areas. These previous coatings shall be measured and recorded in sequence to accommodate each progressive coating DFT determination. Unless otherwise specified, rejection shall not be made based solely upon the DFT upper limit of table V, but on subsequent performance failure of another quality assurance provision of section 4. The minimum DFT shall be achieved with each individual coat (i.e., a thin primer coat cannot be “made up for” by a thicker topcoat). The total minimum film thickness shall be maintained and is the cumulative thickness of the current and all subsequent coats (e.g., for a blasted steel substrate painted with a metal rich coating and subsequently MIL-DTL-53022, the minimum thickness is 3.8 mils). Primer DFT requirements are subject to the manufacturers’ instructions. An excessive primer DFT affects dry and recoat times and ultimately cure times. Adhesion problems occur with excessive primer DFT.

TABLE V. Acceptable dry film thicknesses by specification.

Specification	DFT (mils)
MIL-PRF-22750	1.7 - 2.3
MIL-PRF-23377	0.6 - 0.9 1/
MIL-PRF-32348	1.8 - 2.2
MIL-DTL-53022	1.5 - 2.5
MIL-DTL-53030	1.5 - 2.5
MIL-DTL-53039	2.0 - 3.0
MIL-DTL-53084	1.0 - 1.2
MIL-PRF-32550	2.5 - 3.5
MIL-DTL-64159	2.0 - 3.0
MIL-PRF-85582	0.6 - 0.9 1/

1/ Except for ground assets, then 0.8-1.2 mils.

TERMS: 1 mil = 25 microns.

4.2.3.3.1 Dry film thickness measurements on composites. Nondestructively measuring DFTs on plastics and composite materials are performed by using ultrasonic film thickness gauges. These compact devices have the capability to measure multilayer coating systems and differentiate individual layers of primer and topcoat within the coating system. Thickness measurements shall be performed by taking several measurements in the same general location and averaging the results. This procedure shall be performed multiple times on larger parts or surfaces to achieve a good representation of the overall DFT. These gauges require couplants to assist in the measurement process. Water may be used as a couplant on smooth horizontal substrates but generally a heavier-bodied glycol-based couplant is needed. These couplants are supplied by the gauge manufacturers. Couplants fill the voids between the probe and the coating to assist the ultrasonic pulse to enter the coating. Ultrasonic measurement of coating thickness works by sending an ultrasonic vibration into a coating using a probe with the assistance of a couplant applied to the surface. When finished taking measurements, clean the area with a lint-free cloth and distilled water.

4.2.3.4 Marring. Marring and surface lightening due to handling is characteristic of camouflage coatings and does not impede the properties of MIL-DTL-53039 or MIL-DTL-64159. This is typical of low gloss and low sheen coatings, and is especially prevalent in dark colors. It is not grounds for re-work, unless the film has been damaged down to the previous coat or the substrate.

4.2.3.5 Camouflage requirements and batch validation. Only suppliers approved and listed on the applicable QPD for MIL-DTL-53039 or MIL-DTL-64159 and for MIL-PRF-32348 under type III and type IV coatings are authorized to supply CARC. For every batch manufactured, except for MIL-PRF-32348, type IV, the spectral reflectance, gloss, and STB resistance are verified with batch validation by U.S. Army DEVCOM Research Laboratory, Weapons and Materials Research Directorate, ATTN: FCDD-RLW-MC, Coatings and Corrosion Team, APG, MD 21005-5069. The paint manufacturer initiates the process prior to shipment. A copy of the certification from DEVCOM ARL shall be made available to inspectors for each batch of paint applied. Slight visual color differences occur between manufacturers or batches yet are not grounds for equipment rejection as long as a batch certification is on hand from DEVCOM ARL and there are no film defects such as blushing or hazing. Improper mixing or application can cause a dry film color that is not as specified. These batch certifications are supplied to the manufacturer on each batch of CARC topcoat that is manufactured.

4.2.3.6 Adhesion. Unless otherwise specified, a minimum of two test specimens/coupons from each day's production shall be made and tested for the overall adhesion of the CARC system, primer to substrate and intercoat. Where possible, testing shall be performed daily on a production item or test coupon of the same substrate in an area of uniform film thickness (see 4.2.3.3), after a minimum of 168 hours drying time or force-curing according to the requirements of the applicable specification. Verification of adhesion is considered after a full week of production samples deemed passing. If actual parts are used, the precise location for the adhesion test shall be in an obscure location and be acceptable to the cognizant Government quality assurance representative. The dry adhesion test shall be the default procedure.

4.2.3.6.1 Dry adhesion. Perform the adhesion test in accordance with ASTM D3359, method B, cross cut tape adhesion, using the 6-line pattern and 2 mm (0.079 inch) spacing. Any commercially available tape (1 inch width) that will yield a minimum of 80 oz. of adhesive resistance over the tested coating when tested in accordance with ASTM D3330/D3330M shall be used. The assessment of the adhesion of the coating film shall be determined by its ability to not peel when

tested in accordance with ASTM D3359. The resultant test rating shall be classified as scale 4B or better based upon the average of a minimum of 3 readings with no ratings below 3B. Where CARC dry film thickness has exceeded 5 mils (125 microns), method A of ASTM D3359 shall be used, if permitted by the procuring authority. The resultant test rating, if using method A shall be classified as scale 4A or better based upon the average of a minimum of 3 readings with no reading below 3A. The scribed area shall be repaired in accordance with the procedure established in 3.7.1 and 3.7.2. Rejected items shall be reworked in accordance with 3.7. For a current listing of approved adhesion test tapes: Contact the DoD CARC Commodity Item Manager at U.S. Army DEVCOM Research Laboratory, Attn: FCDD-RLW-MC, Coatings & Corrosion Team, 6300 Rodman Road, BLDG 4600, APG, MD 21005-5066.

4.2.3.6.2 Wet tape adhesion. (When required by the procuring authority) Test area on the substrate to be tested shall be covered with cheese cloth and saturated with distilled water. A plastic cover shall be taped in place to form a poultice to prevent evaporation for 24 hours. If test panels are permitted by the procuring authority, they shall be immersed in distilled water for 24 hours at room temperature. After 24 hours, remove the poultice from the substrate and dry with a soft cloth. Or, if using test panels, remove the test panels from the water and wipe dry with a soft cloth. Within 3 minutes after drying, 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 a "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 as per ASTM D3359 and examine for coating damage. Examine the coating for conformance to ASTM D3359, Method A. 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 based upon the average of a minimum of 3 readings when examined in accordance with ASTM D3359 with no rating lower than 3A. Any commercially available tape (1 inch width) that will yield a minimum of 80 oz. of adhesive resistance over the tested coating when tested in accordance with ASTM D3330/D3330M shall be used. The tape shelf life is typically one year from date of manufacture. For a current listing of approved adhesion test tapes: Contact the DoD CARC Commodity Item Manager at U.S. Army DEVCOM Research Laboratory, Attn: FCDD-RLW-MC, Coatings & Corrosion Team, 6300 Rodman Road, BLDG 4600, APG, MD 21005-5066.

4.2.3.6.3 Force dry of liquid CARC topcoat. The drying of CARC topcoats is normally performed at room temperature or force dried in a paint booth at temperatures up to 120º F (49º C). Higher temperatures are used when small and component parts are put onto a conveyor line to expedite the process. When CARC topcoats are dried and cured at temperatures of 180º F (82º C) or greater, caution shall be taken to ensure that the CARC can be recoated with itself. In cases as this, the CARC topcoat shall first be validated to ensure that the higher temperatures do not affect the ability of the coating to be recoated. A representative part or sample panels shall be coated with the CARC system that is used in production and processed through the production line under the same conditions that are used to coat production parts. After the parts or panels have been exposed to the elevated temperatures, they shall be left to sit for 24 hours. They shall then be topcoated with the same CARC topcoat and air dried for 168 hours. Dry tape adhesion tests, as described in 4.2.3.6 and 4.2.3.6.1, shall be performed to check the intercoat adhesion. If the adhesion tests pass, then production shall start with the CARC that was evaluated. This testing shall be done whenever a production line starts up using elevated temperatures of 180º F (82º C) or greater to dry, or

whenever a change of CARC topcoat is made under the conditions of elevated temperatures for drying.

4.2.3.7 Corrosion resistance. Witness panels shall be used for initial production validation and continued production validation. The witness panels, unless permitted by the procuring authority shall be the same substrate alloy as parts being coated and will be used as well as the accelerated corrosion resistance test specified in TT-C-490. Corrosion resistance is demonstrated on witness panel specimens (representative 4 x 6 inch (10.16 x 15.24 cm) panels) after application of the full coating system. The minimum test frequency for continued production validation shall be in accordance with the technical data package or every 60 days, if the test frequency is not specified in the technical data package. Coat the edges and uncoated metal surfaces of the witness panels with a suitable CARC coating prior to testing. Tape, wax, and chromated coatings are unacceptable for edge and back coatings. Corrosion in excess of a trace of rusting of no greater than 5% of the total area or more than five scattered blisters, none larger than 1 mm (0.039 in) in diameter visible to the unaided eye on the panel or actual parts shall be cause for rejection. The scribed areas of test panels shall have ratings in accordance with ASTM D1654, Procedure A of not less than 6 for steel or 8 for aluminum panels. The painted specimen/coupons are to be "X" scribed using a tungsten carbide scribing tool as described in ASTM D1654-08. The "X" scribe is made by scribing two intersecting lines from one corner to its opposite corner across the face of the specimen/coupon. The scribe shall initiate/terminate no closer than 0.5 in (12mm) to the edge of the specimen/coupon. When cyclic corrosion testing according to GMW 14872 is required, based upon the primer used and requirements of TT-C-490, the panel is evaluated using ASTM D1654 Procedure A shall have a rating of not less than seven (7). Blisters shall cover no more than 5% of the exposed area, none larger than 1 mm (0.039 in) in diameter. Failure within 0.5 in (12 mm) of edges and other sharp corners shall not be cause for rejection. The corrosion testing for application validation of metal-rich primers conforming to MIL-PRF-32550 shall be in accordance with GMW14872. Failure to meet the corrosion resistance requirement shall be cause for rejection of parts coated since the last successful test period, followed by a return to the conditions of the initial production validation. CARC product formulations are now capable of more vigorous corrosion resistance testing procedures (see 6.5) for a test protocol under consideration.

4.2.3.7.1 Initial production validation. The initial production validation condition shall be followed for all new production runs, changes in process and/or coatings or after a failed continued production validation test. After complete curing (168 hours at 70º F (21º C) or equivalent), the witness panels shall be subjected to a 5 percent salt spray test in accordance with ASTM B117 or the cyclic corrosion test in accordance with GMW14872 as specified based upon the specification primer (e.g., MIL-DTL-53022) and type used. Primers conforming to MIL-PRF-32550 specify only GMW14872.

4.2.3.7.2 Continued production validation. Following a successful initial production validation (4.2.3.7.1), test frequency and duration shall be reduced to accommodate production schedules. In lieu of witness panels of the same substrate alloy as parts being coated, cold rolled steel panels or appropriate aluminum alloy may be used when panels that match the substrate are unavailable. Test frequency for enhanced performance primers (1,008 hour salt spray or greater) shall be in accordance with the technical data package or every 60 days if the test frequency is not specified in the technical data package. For testing end item hardware and/or witness panels on contracts using primer specification materials requiring a 504 hour or greater salt spray resistance, only 504 hour salt spray result will be required for this test. Due to the accelerated nature of this test, a

scribed rating of not less than 7 as per ASTM D1654 Procedure A will be acceptable. For testing end item hardware and/or witness panels on contracts using primer specification materials conforming to MIL-PRF-32550, 21 cycles will be required for this test unless greater duration is required by the procuring authority. Due to the accelerated nature of this test, a scribe rating of not less than 8 will be acceptable.

4.2.3.8 Workmanship. When visually inspected, the coating shall be a smooth, continuous, adherent film which is free of such surface imperfections as runs, sags, blisters, blushing, streaks, craters, blotches, brush marks, fish eyes, seediness or pinholes. Orange peel shall not be criteria for rejection as long as the cured coatings conform to the appropriate dry film thickness, gloss and sheen requirements of the coating specification. To assist in a resolution to paint application and surface imperfection problems, refer to TM-1-1500-345-23 tables 4.2 (High Pressure or HVLP Paint Gun Problems), 4.3 (Spray Coating Troubles, Possible Causes, and Remedies-Primers), and 4.4 (Spray Coating Troubles, Possible Causes, and Remedies-Topcoats). Although this is an aircraft painting technical manual and the primers referenced are aircraft primers, the surface imperfections and resolutions would also apply to CARC spray primers.

5. PACKAGING

5.1 Packaging. This section is not applicable to this specification.

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 CARC system of cleaners, pretreatments, primers, and topcoats is designed for use on the exterior and interior of tactical military equipment. It may also be used where severe exposure situations require a coating with excellent durability and corrosion resistance.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, revision letter, and date of this specification.
b. Type of finish as defined in 3.1 to include specifications for cleaning, pretreating, priming and topcoating for surfaces to be finished with the CARC system.
c. When blast cleaning required (see 3.2.1).
d. When wood surfaces will not be pressure treated (see 3.3.4).
e. Color of topcoat if other than those in the 3-color pattern (see 3.5).
f. Camouflage painting and marking of Army materiel conforming to AR 750-1 (see 3.5.1.6 and 3.5.2.6).
g. Other finishes used including Chip and Abrasion Resistant Coatings, High Heat Coatings, Non-Slip additives and other specialty finishes.
h. List of Testing, Quality Control, Verification and Workmanship in accordance with MIL-DTL-53072.
i. Reference NSN of coatings
j. Health and safety issues including facilities, worker safety procedures and equipment, toxic and hazardous waste management, and occupational health requirements (see 3.8 i and 3.8 m)

6.3 Color chips. Color chips for CARC finishes are available from two sources. Chips for the camouflage colors in MIL-DTL-53039 and MIL-DTL-64159 are obtained from U.S. Army DEVCOM Research Laboratory, Weapons and Materials Research Directorate, ATTN: FCDD-RLW-MC, Coatings and Corrosion Team, APG, MD, and are intended to be used by paint manufacturers in calibrating their instruments. These calibrated chips from DEVCOM ARL are not intended to be used for visual color inspections, but to assist paint formulators in color development work. Camouflage colors specified in the CARC topcoat specifications have a batch validation requirement and eliminate the need for inspection. If color inspection becomes a concern, request a copy of the batch validation letter. For appearance information only, color chips can be obtained by using the five digit color number of SAE-AMS-STD-595. The non-camouflage colors found in MIL-DTL-53039, MIL-DTL-64159, MIL-PRF-32348, and MIL-PRF-22750 should match the appropriate color chips from SAE-AMS-STD-595. In the event of a conflict between requirements in the CARC topcoat specifications and the references in SAE-AMS-STD-595, the text of the CARC topcoat specifications takes precedence.

6.4 Qualifying activity responsibility. The qualifying activity responsible for MIL-PRF-23377, MIL-DTL-5541, MIL-PRF-85582, and MIL-DTL-81706 is the Commander, Naval Air Systems Command, Systems Standardization Division, Code 4L8000B120-3, Highway 547, Lakehurst, NJ 08733-5100. The qualifying activity responsible for MIL-DTL-53022, MIL-DTL-53030, MIL-DTL-53084, MIL-PRF-32440, MIL-PRF-32550, MIL-PRF-32348, MIL-PRF-22750, MIL-DTL-53039, MIL-DTL-64159, and TT-C-490 is U.S. Army DEVCOM Research Laboratory, Weapons and Materials Research Directorate, ATTN: FCDD-RLW-MC, Coatings and Corrosion Team, Aberdeen Proving Ground, MD 21005-5066.

6.5 Experimental program. DEVCOM ARL conducts an Experimental Products Program (EPP) to evaluate performance-based alternatives to specification products. These materials generally offer benefits such as environmental acceptability or improved performance that is not currently available in the specification. These products may be used prior to appearing on the applicable QPD with approval from the appropriate program office. These products will be issued an EPP approval letter prior to being included into an appropriate QPD. Subsequent revision of the specification allows the EPP products to be converted to normal QPD listings. Confirmation of EPP approval can be obtained from U.S. Army DEVCOM Research Laboratory, Attn: FCDD-RLW-MC, Coatings & Corrosion Team, 6300 Rodman Road, BLDG 4600, APG, MD 21005-5066.

6.6 Coating characteristics. The coatings and their characteristics are listed in the following table.

TABLE VI. Coating characteristics.

Specification	Primer Category		Toxic Metals	VOC Category		
	Pre-treated ferrous	Pre-treated non-ferrous	Lead and chromate free	Federal 3.5 lbs./gal (420 g/l)	SCAQMD Rule 1124 2.9 lbs./gal (348 g/l)	SCAQMD Rule 1107 2.8 lbs./gal (340 g/l)
MIL-PRF-23377	N/A	X	class N 1/	X	X	X
MIL-DTL-53022	X	X	X	X	X	X
MIL-DTL-53030	X	X	X	X	X	X
MIL-DTL-53084	X	X	X	X	X	X
MIL-PRF-85582	N/A	X	class N 1/	X	X	X
MIL-PRF-32550	X	X	X	X	X	X
MIL-PRF-32348	X	X	X	N/A	N/A	N/A
MIL-PRF-22750	N/A	N/A	X	X	X	X
MIL-DTL-53039	N/A	N/A	X	X	X	X
MIL-DTL-64159	N/A	N/A	X	X	X	X

1/ In accordance with Memorandum, AMSAM-EN-EV, 29 January 2009, Subject: Implementation of Non-Hexavalent Chromium Coating System on Army Aircraft, class N (type I or II) is approved for use as a primer on Army Aviation Systems exterior mold lines. Use of class N primers for interior applications must be approved by the item Program Manager or cognizant engineering authority. The type II is only approved as a CARC primer on aviation assets.

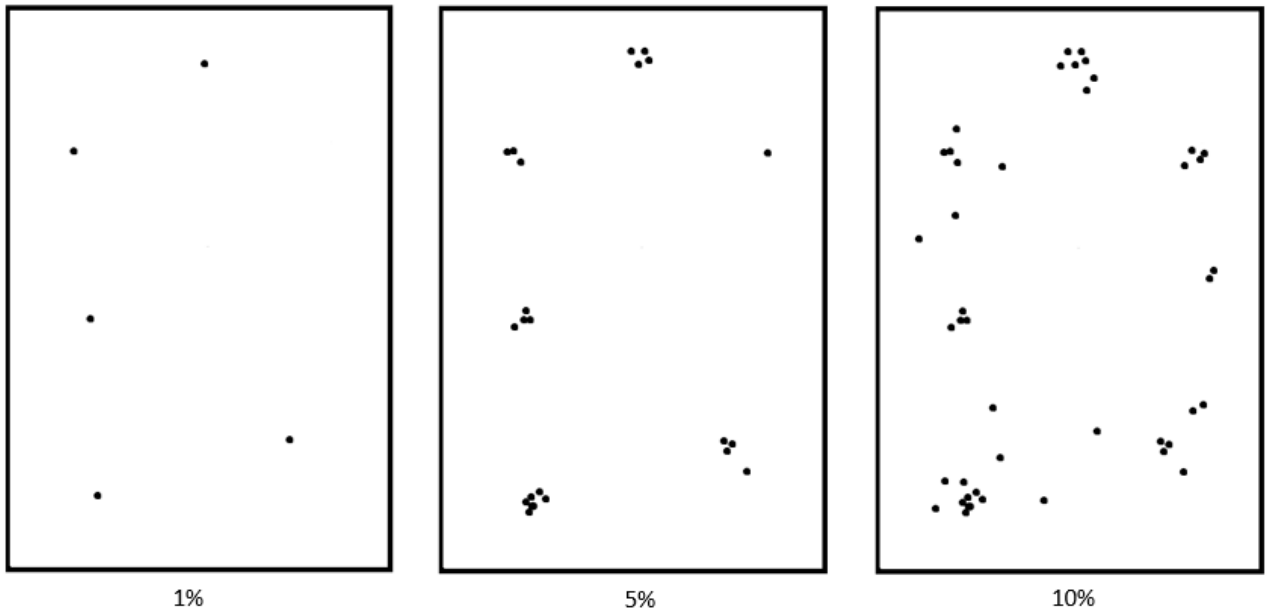
6.7 Touch-up kits. Only authorized and approved touch-up kits are allowed for the repair, touch-up or stenciling of existing CARC coatings. These are supplied in various forms and are approved with QPD numbers by DEVCOM ARL. For further information, contact U.S. Army DEVCOM Research Laboratory, Weapons and Materials Research Directorate, ATTN: FCDD-RLW-MC, Coatings and Corrosion Team, APG, MD. Spray cans that are designed specifically for a color match and not previously approved by DEVCOM ARL cannot be used.

6.8 New heavy metal-free pretreatments. Novel corrosion inhibitors, pretreatments, primers, and topcoats are being developed and evaluated as alternatives to zinc phosphate, chromate conversion coatings and wash primers for inclusion in the CARC system. For further information on products being tested and approved, contact U.S. Army DEVCOM Research Laboratory, Weapons and Materials Research Directorate, ATTN: FCDD-RLW-MC, Coatings and Corrosion Team, APG, MD, or the contracting agency.

6.9 Blast profile. The following chart provides minimum additional primer film thicknesses for a range of surface profiles.

Surface Profile	Minimum Additional DFT
1-1.9 mils	0.5
2-3 mils	1.4

6.10 Blistering in field. The following figures are provided as guidance for determining percent area corroded through blistering.



6.11 Subject term (key word) listing.

Aircraft
Equipment
Guide
Powder
Pretreatments
Surfaces
Thinner
Topcoat

6.12 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

Custodians:
Army – MR
Navy - SH
Air Force – 20

Review activities:
Army - MD1, MI, AV
Navy - AS, CG, MC

Civil agency:
GSA/FAS

Preparing activity:
Army - MR

(Project 8010-2020-003)

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/.