

INCH-POUND

MIL-PRF-32550  
11 August 2016

## PERFORMANCE SPECIFICATION

### METAL-RICH PRIMER

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

#### 1. SCOPE

1.1 Scope. This specification governs the performance of metal-rich primers used in corrosion protection of abrasive blasted steel substrates. These primers use metallic and/or metal-rich particles that make up part of the pigment content to provide sacrificial cathodic protection to abrasive blasted steel substrates. The primers are lead and chromate free and meet air pollution requirements for solvent emissions. The metal-rich primers are compatible with the epoxy primers and topcoats that are used in the Chemical Agent Resistant Coating (CARC) System.

1.2. Types. The primer coating will be furnished in the following types as specified (see 6.2). For volatile content requirements, see 3.4.2.

Type I – Organic metal-rich primer. This type may be formulated as a two component epoxy or single component moisture cured polyurethane.

Type II – Inorganic metal-rich primer.

Type III – Metal-rich powder primer.

Type IV – Self-contained portable kits. The kits contain the type I or II metal-rich primer in a touch-up system.

Comments, suggestions, or questions on this document should be addressed to: Director, U.S. Army Research Laboratory, Weapons and Materials Research Directorate, Materials Manufacturing Technology Branch, Specifications and Standards Office, ATTN: RDRL-WMM-D, Aberdeen Proving Ground, MD 21005-5069 or emailed to [richard.j.squillacioti.civ@mail.mil](mailto:richard.j.squillacioti.civ@mail.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil/>.

AMSC N/A

FSC 8010

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

1.2.1 Forms. The metal-rich primers are provided in the following forms:

Form A – Zinc-rich pigment based.

Form B – Aluminum-rich pigment based.

Form C – Mixed metal-rich pigment based where the primary pigment is comprised of something other than zinc or aluminum.

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

Class S - Standard formulation with maximum volatile organic compound (VOC) content of 3.5 pounds/gallon (lbs/gal) (420 grams/liter (g/l)) as packaged.

Class L - Volatile organic hazardous air pollutants-free (VOHAP-free) formulation to meet 2.8 lbs/gal (340 grams/liter (g/l)) maximum VOC content as packaged.

Class U - Volatile organic hazardous air pollutants-free (VOHAP-free) formulation to meet lower volatile content requirements of 2.1 lbs/gal (250 grams/liter (g/l)) maximum VOC content as packaged.

1.3 Part or identifying number (PIN) definitions. Use the following example to create the PINs to be used for coatings acquired to this specification. When other container sizes are required, change the designator accordingly, such as 001Q for 1 Quart or 025P for 25 Pounds.

<u>M32550</u>	-X	-X	-X	-XXXX	-XXXXX
Specification Identifier	Coating Type Designator	Form Designator	Class Designator	Container Size Designator	Color Designator / FED-STD-595 Color Chip Number
	Type I = 1	Form A = A	S	1 gal = 001G	
	Type II = 2	Form B = B	L	5 gal = 005G	
	Type III = 3	Form C = C	U	50 lb = 050P	
	Type IV = 4			100 lb = 100P	

## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are referenced in sections 3 or 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 or 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-C-490 - Chemical Conversion Coatings and Pretreatments for Metallic Substrates (Base for Organic Coatings).

## FEDERAL STANDARDS

- FED-STD-595 - Colors Used in Government Procurement.

## DEPARTMENT OF DEFENSE (DoD) SPECIFICATIONS

- 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-64159 - Camouflage Coating, Water Dispersible Aliphatic Polyurethane, Chemical Agent Resistant.

(Copies of these documents are available online at <http://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.

## UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA Method 311 - HAPs in Paints & Coatings.

(Copies of this document are available online at <http://www.epa.gov/ttn/emc/>.)

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 D522/  
D522M - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
- ASTM D562 - Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer.

- ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
- ASTM D1654 - Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- ASTM D1849 - Standard Test Method for Package Stability of Paint.
- ASTM D3271 - Standard Practice for Direct Injection of Solvent-Reducible Paints Into a Gas Chromatograph for Solvent Analysis.
- ASTM D3330/  
D3330M - Standard Test Method for Peel Adhesion of Pressure-Sensitive Tape.
- ASTM D3335 - Standard Test Method for Low Concentrations of Lead, Cadmium and Cobalt in Paint by Atomic Absorption Spectroscopy.
- ASTM D3359 - Standard Test Methods for Measuring Adhesion by Tape Test.
- ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test.
- ASTM D3718 - Standard Test Method for Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy.
- ASTM D3924 - Standard Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials.
- ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.
- ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- ASTM F519 - Standard Test Method for Mechanical Hydrogen Embrittlement Evaluation of Plating/Coating Processes and Service Environments.
- ASTM G50 - Standard Practice for Conducting Atmospheric Corrosion Tests Metals.

(Copies of these documents are available from <http://astm.org>.)

#### GENERAL MOTORS ENGINEERING STANDARDS

- GMW 14872 - Cyclic Corrosion Laboratory Test.

(Copies of this document are available from <http://ihs.com>.)

#### INTERNATIONAL ORGANIZATION FOR STANDARDIZATION Publications AMERICAN NATIONAL STANDARDS INSTITUTE

- ISO 9000 standards - Quality Management Systems - Fundamentals and Vocabulary.
- ISO/IEC17025 directives - General Requirements for the Competence of Testing and Calibration Laboratories.

(Copies of this document are available from <http://www.iso.ch>.)

#### NATIONAL AEROSPACE AND DEFENSE CONTRACTORS ACCREDITATION PROGRAM

NADCAP National Aerospace and Defense Contractors Accreditation Program,  
(Society of Automotive Engineers International Aerospace Standard AS7003 / Aerospace Quality System AC7004)

Performance Review Institute

(Copies of these documents are available from <http://p-r-i.org>.)

Occupational Safety & Health Administration Regulations - Hazardous Communication Standard - 29 CFR 1910.1200

(Copies of these documents are available from [www.OSHA.gov](http://www.OSHA.gov).)

SSPC: THE SOCIETY FOR PROTECTIVE COATINGS  
NACE International Standard Practices

SSPC-SP-10/ Near-White Blast Cleaning.  
NACE No.2

(Copies of these documents are available from <http://sspc.org>.)

(Copies of these documents are available from FirstService Department at [firstservice@nace.org](mailto:firstservice@nace.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 Qualification. The coatings furnished under this specification shall be products that are authorized by the qualifying activity for listing in the applicable qualified products list before contract award (see 4.2 and 6.4). Any change in the formulation or processing of a qualified product shall necessitate its requalification. The material supplied under contract shall be identical, within manufacturing tolerances, to the product receiving qualification.

3.2 Materials. The primer components furnished under this specification, when mixed and applied in accordance with the manufacturer's instructions, shall produce a metal-rich primer that satisfies all of the requirements of this specification. The composition of the coatings or compounds furnished under this specification shall be the responsibility of the manufacturer, except as limited by this specification.

3.3 Color and gloss characteristics. There are no color or gloss requirements for these primers.

3.4 Composition. The type I primer shall be a two component epoxy or single component moisture cured polyurethane. The type II shall be an inorganic metal-rich primer. The type III shall be a powder primer. The pigments may be incorporated into the resin component or packaged as a separate entity.

3.4.1 Pigment. The pigment portion of these primers shall be primarily of metal-rich types, such as zinc, magnesium and aluminum. Hexavalent chromium shall not be present in any type.

Pigments contained in these primers shall be free of hazardous air pollutants (HAPs) and regulated toxic metals. Pigments shall not contain compounds of antimony, arsenic, beryllium, cadmium, cobalt, chromium, cyanide, lead, manganese, mercury, nickel, and selenium. Silica flattening pigments and tinting pigments are permissible.

3.4.1.1 Lead content. The lead content shall not exceed 0.05 percent by weight of total nonvolatile content upon analysis as specified in table I.

3.4.2 Volatile content. The VOC and VOHAP volatile content of the mixed primer shall conform to the following requirements when tested as specified in 4.6.2.

3.4.2.1 Type I. The VOC content for class S shall not exceed 3.5 lbs/gal (420 g/l) as packaged. The class L shall have a VOC not to exceed 2.8 lbs/gal (340g/l). The class U shall have a maximum VOC not to exceed 2.1 lbs/gal (250 g/l).

3.4.2.2 Type II. The VOC content shall not exceed 0.25 lbs/gal (30.0 g/l) as packaged.

3.4.2.3 Type III. The VOC content shall be 0.00 lbs/gal (0.00 g/l).

3.4.2.4 Volatile organic hazardous air pollutants free (VOHAP-free). Types I, class L and U, II and III primers shall be VOHAP-free when tested in accordance to 4.6.2.1.

3.5 Qualitative requirements.

3.5.1 Condition in container.

3.5.1.1 Type I component A, type II and single component moisture cured polyurethane. When tested as specified in 4.6.3.1, primer coating shall be free from grit, seeds, skins, abnormal thickening or livering in a freshly opened container and shall show no more pigment settling or caking than can be completely reincorporated to a smooth homogeneous state.

3.5.1.2 Type I epoxy catalyst component B. When tested as specified in 4.6.3.2, component B shall be clear and free from sediment and suspended matter when examined by transmitted light. It shall show no livering, curdling, gelling or skinning in a freshly opened full container.

3.5.2 Storage stability.

3.5.2.1 Accelerated storage stability (moisture cured), type I. When tested as specified in 4.6.4.1, the admixed coating shall show no curdling or hardening, and any sedimentation or material separation shall be mixed back into a smooth homogeneous state. After the specified conditioning period, the admixed coating shall meet the requirements of the specification with no more than a 10 Krebs units (KU) increase in viscosity.

3.5.2.2 Full container storage stability, types I and II. When tested as specified in 4.6.4.2, the individual components of the final product shall show no curdling or hardening, and any sedimentation or material separation shall be mixed back into a smooth homogeneous state. After the specified conditioning period, the admixed coating shall meet all the requirements of this specification.

3.5.2.3 Type III powder primer. When tested as specified in 4.6.4.3, the powder shall meet all the requirements of this specification.

3.5.3 Mixing properties for multi-component products. When tested as specified in 4.6.5, a smooth homogeneous mixture shall result. The primer shall be free from grit, seeds, skins, or lumps. After aging, as specified in 4.6.5, the primer shall show no signs of gelation.

3.5.4 Spraying properties. When tested as specified in 4.6.6, the primer shall spray satisfactorily and shall show no running, sagging, or streaking. The dried film shall show no dusting, mottling, or color separation and shall present a consistent finish free from seeds.

3.5.5 Flexibility. A film of the coating tested as specified in 4.6.7 shall withstand bending without cracking or flaking.

3.5.6 Adhesion.

3.5.6.1 Dry adhesion tape pull. Adhesion testing on the painted test specimens/coupons shall be performed after the complete paint finish (see 4.6.1) has fully cured for a minimum of 168 hours at ambient conditions or by force-curing for powder primers. Each sample shall be tested using ASTM D3359, method B, as specified in 4.6.8.1, using 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. The assessment of the adhesion of the coating film shall not be less than scale 4B with any layer of the system. Where the dry film thickness has exceeded 5 mils (125 microns), method A of ASTM D3359 shall be used with a resulting rating of not less than 4A.

3.5.6.2 Pull-off adhesion. The assessment of the pull off adhesion of the primers shall have a minimum of 650 pounds per square inch (psi) pull strength when tested in accordance with ASTM D4541, as specified in 4.6.8.2.

3.5.7 Embrittlement testing. Materials and other coatings described within this specification shall not contribute to hydrogen embrittlement issues for high strength steels (at Rockwell C hardness (HRC) 39 or greater) or other materials susceptible to embrittlement. Testing to validate that the materials to be processed or the procedures do not contribute to hydrogen embrittlement shall be performed prior to the process for qualification of the supplier's coating materials by Army Research Laboratory (ARL), (see 4.6.9).

3.5.8 Compatibility. When tested as specified in 4.6.10, coating of a dried film of the primer shall produce no lifting, softening, or other film irregularity. Dry adhesion tape pull and pull off adhesion testing shall also be conducted on these panels and conform to the requirements as specified in 3.5.6.1 and 3.5.6.2.

3.5.9 Water resistance. A film of primer, tested as specified in 4.6.11, shall show no wrinkling or blistering immediately after removal of the panel from the water. The primer shall show no lifting, softening, or other film irregularities when examined 2 hours after removal. After 24 hours air drying, the portion of the panel which was immersed shall be the same with regard to adhesion, color, and gloss as compared to the portion which was not immersed. Film softening

shall not exceed a difference of 2 pencil hardness units (see ASTM D3363) from an unexposed film with identical cure history prior to water exposure. Additional panels shall be prepared as specified in 4.6.12 and tested for water resistance. Dry adhesion tape pull and pull-off adhesion testing shall also be conducted on these panels and conform to the requirements as specified in 3.5.6.1 and 3.5.6.2.

3.5.10 Hydrocarbon fluid resistance. A film of primer, tested as specified in 4.6.12, shall show no blistering or wrinkling after drying. There shall be no more than a maximum of 2.0 Delta ( $\Delta$ ) E color change using L a b values under a D65 illuminate at a 10° observation angle when comparing a portion of the untested panel to that of the tested area. This is commonly observed as a slight yellow to beige color change. Upon removal from the fluid, slight softening is acceptable. After 2 hours air drying, the portion of the panel which was immersed shall be the same with regard to hardness, adhesion, color, and gloss as compared to the portion which was not immersed. Film softening shall not exceed a difference of 2 pencil hardness units (see ASTM D3363) from an unexposed film with identical cure history prior to hydrocarbon fluid exposure. Additional panels shall be prepared as specified in 4.6.12 and tested for hydrocarbon fluid resistance. Dry adhesion tape pull and pull-off adhesion testing shall also be conducted on the immersed portion of these panels and conform to the requirements as specified in 3.5.6.1 and 3.5.6.2.

3.5.11 Corrosion resistance.

3.5.11.1 Cyclic corrosion test. A film of the coating system tested as specified in 4.6.13.1 and evaluated using ASTM D1654 method Procedure A shall have minimum creepage rating of six (6). Blisters shall cover no more than 5 percent of the exposed area, none of which shall be larger than 1mm in diameter.

3.5.11.2 Atmospheric corrosion resistance. A film of the coating system tested as specified in 4.6.13.2 shall show no blistering or loss of adhesion of the paint from the scribe mark (a minimum rating of 8, ASTM D1654 Procedure A). Blisters shall cover no more than 5 percent of the exposed area, none of which shall be larger than 1 millimeter in diameter.

3.5.12 Toxic ingredients. Other than parachlorobenzotrifluoride (PCBTf), the primer shall contain no benzene (benzol), chlorinated solvents, or ethylene based glycol ethers and their acetates (see 4.6.14). The metal-rich primer shall have no adverse effects when using required personal protective equipment (PPE) and applied in the appropriate manner.

3.6 User instruction marking and precaution sheet. All primary containers shall be legibly marked or labeled with the VOC content and VOHAP content in lbs/gal or g/l of coating. For multiple component kits, all primary containers shall be marked or labeled with the component (A, B or C) and the content (resin component, catalyst component or zinc or type of metal pigment), as applicable with the mixing and thinning instructions. In addition, a printed precaution sheet will be supplied with the following information:

**PRECAUTION For Painting Operations:** The Surgeon General requires airline respirators to be used unless air sampling shows exposure to be below minimum standard limits. Then, either chemical cartridge respirators or airline respirators are required. Avoid contact with skin and eyes. Use with adequate ventilation. For other safety recommendations, refer to the Safety Data

Sheets (SDSs). Keep containers closed.

3.7 MSDS/SDS. The manufacturer shall comply with the requirements set forth by the Hazardous Communication Standard, 29 CFR 1910.1200. The requirement for a Material Data Safety Sheet (MSDS) has been replaced by the SDS and shall be prepared for the coating in accordance with 3.7.1 and forwarded to the qualifying activity (see 6.4.3). The SDS shall be included with each shipment of the material covered by this specification.

3.7.1 Safety Data Sheets (SDS). SDS has been phased into the system as of June 1, 2015. As of June 1, 2016 the MSDS is no longer used and you must ensure that each hazardous chemical in your workplace has an SDS and only an SDS as specified in the OSHA Brief - <https://www.osha.gov/dsg/hazcom/> and as specified in Appendix D of 29 CFR 1910.1200 (see: [http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=standards&p\\_id=10103](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10103)).

3.8 Toxicity clearance. All new chemicals and materials being added to the DoD supply system shall have a toxicity clearance. A toxicity clearance involves a toxicological evaluation of materials prior to introduction into the Defense supply system. The DoD program manager shall be responsible for identifying technically feasible materials and requesting a toxicity clearance for use of that material within their program (see 6.7).

#### 4. VERIFICATION

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

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

4.2 Qualification inspection. Qualification shall be conducted by the qualifying activity (see 6.4). The qualification test sample shall be as specified by the qualifying activity. The samples shall be legibly identified (see 6.4.4). Qualification inspection shall consist of tests for all requirements specified in section 3 and table I. Qualification inspection shall examine for user instruction markings (see 3.6). The results of each test shall be compared with the applicable requirement in section 3. Failure to conform to any requirement shall be counted as a defect and paint represented by the sample test shall not be approved for inclusion in the QPD under this specification.

4.3 Conformance inspection. The manufacturer shall forward from each production lot (see 4.3.1) a batch validation letter detailing the batch number, manufacturer's code, specification and type number, Qualified Products List number and batch volume to U.S. Army Research Laboratory (ARL), ATTN: RDRL-WMM-C, Organic Coatings Team, Building 4600, Deer Creek Loop, Aberdeen Proving Ground (APG), MD 21005-5066. The manufacturer shall perform conformance inspection testing on each production lot and have these test results on file when requested by the contracting officer. Conformance inspection for individual lots shall test for VOC, condition in container, mixing properties, spraying properties, and drying time. There shall be no failures (see 6.5).

4.3.1 Lot and batch formation. Unless otherwise specified in the contract or purchase description

(see 6.2), a lot shall consist of all coatings of the same type, composition and color, from a single uniform batch, produced and offered for delivery at one time (see 6.4.2). Unless otherwise specified in the contract or purchase description (see 6.2), a batch shall consist of all coating material (in U.S. gallons or in U.S. pounds for powder) manufactured during one continuous operation and forming part of one contract or purchase order for delivery (see 6.4.2). The addition of any substance to a batch shall constitute a new lot.

4.4 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with ASTM D3924. Also, unless otherwise stated in the test method or paragraph, room temperature shall be  $73 \pm 4$  °F ( $23 \pm 2$  °C) and a 40 - 70 percent relative humidity.

4.5 SDS. The SDS shall address all individual components as they are supplied and be in compliance with 3.7.1. Noncompliance to 3.7.1 shall be cause for rejection.

4.6 Test methods.

4.6.1 Test condition. Unless otherwise specified in the test method or paragraph, laboratory test conditions shall be in accordance with ASTM-D3924. For types I and II, a dry film thickness of 2.5 - 3.5 mils (63.5 – 88.9 microns) shall be used whenever film thickness is requested in any test, unless otherwise required by the test or specified by the manufacturer. For type III, a dry film thickness of  $2 \pm 0.2$  mils ( $50 \pm 5$  microns) shall be used whenever film thickness is requested in any test, unless otherwise required by the test or specified by the manufacturer. Failure of any test result to fall within the specified ranges in section 3 shall constitute failure of the applicable test. For all tests requiring the use of the mixed primer, the various components shall be mixed in the proportions as specified by the manufacturer.

4.6.1.1 Test panels. Unless otherwise specified, metal panels used for test purposes shall be of the following types:

Steel test panels shall be SAE 1010 steel conforming to ASTM A109/A109M or ASTM A1008/A1008M, abrasive blasted to Society for Protective Coatings (SSPC) SP-10 / NACE No. 2 (near white metal blast cleaning) with a surface profile of 1 to 2 mils. For pull off adhesion testing only, test panels shall have a minimum thickness of 0.125 inch.

Steel, 0.024-0.026 inches thick, shall be used for flexibility only.

4.6.1.2 Test procedures. Tests shall be conducted in accordance with table I. The right is reserved to include any additional tests deemed necessary to determine that the coating conforms to the requirements of this specification.

4.6.1.3 Epoxy primer. When an epoxy primer is required by the test method, apply epoxy primer conforming to MIL-DTL-53022, type IV. For the compatibility test (see 4.6.10), apply MIL-DTL-53030, type II to a second set of panels. Apply the epoxy primer to a total dry film thickness of  $1.5 \pm 0.2$  mils ( $37.5 \pm 5$  microns).

4.6.1.4 Polyurethane topcoat. When a topcoat is required by the test method use a polyurethane coating conforming to either MIL-DTL-53039 or MIL-DTL-64159, Tan 686A, color number 33446 of FED-STD-595, Colors Used in Government Procurement. Apply the coating to a total

dry film thickness of  $2 \pm 0.2$  mils ( $50 \pm 5$  microns). If applied in two coats, allow the first coat to air dry for 60 minutes prior to application of the second coat. After application of the topcoat to the required thickness and prior to testing, allow the coating to air dry for not less than 168 hours.

TABLE I. Index of tests.

Item	ASTM Test Method	Test Paragraph	Requirement Paragraph
Hexavalent chromium	D3718	-	3.4.1
Lead Content	D3335	-	3.4.1.1
VOC determination	D3960	4.6.2	3.4.2
VOHAP 1/	D3271	4.6.2.1	3.4.2.4
Condition in container			
Component A	-	4.6.3.1	3.5.1.1
Component B	-	4.6.3.2	3.5.1.2
Storage stability			
Accelerated storage viscosity	D562	4.6.4.1	3.5.2.1
Full container storage	D1849	4.6.4.2	3.5.2.2
Type III powder	-	4.6.4.3	3.5.2.3
Mixing properties	-	4.6.5	3.5.3
Spraying properties	-	4.6.6	3.5.4
Flexibility	D522	4.6.7	3.5.5
Dry adhesion tape pull	D3359	4.6.8.1	3.5.6.1
Pull off adhesion	D4541	4.6.8.2	3.5.6.2
Embrittlement testing	F519	4.6.9	3.5.7
Compatibility	D3359	4.6.10	3.5.8
Water resistance	-	4.6.11	3.5.9
Hydrocarbon fluid resistance	-	4.6.12	3.5.10
Cyclic corrosion resistance 2/	-	4.6.13.1	3.5.11.1
Atmospheric corrosion	G50	4.6.13.2	3.5.11.2

1/ EPA Method 311.

2/ General Motors Engineering Standard: GMW 14872.

4.6.2 Solvent analysis for VOC determination. Determine the VOC content in accordance with ASTM D3960. Check for compliance with 3.4.2.

4.6.2.1 VOHAP content of coatings. Hazardous solvent content of each individual coating shall be determined in accordance with ASTM D3271 or EPA Method 311, as applicable. Check for compliance with 3.4.2.4.

#### 4.6.3 Condition in container.

4.6.3.1 Type I component A, type II and single component moisture cured polyurethane. Upon opening a full, previously unopened container, the condition of the contents shall be examined for compliance with 3.5.1.1. Reseal, then agitate the container for ten (10) minutes on a paint shaker and/or mechanical agitation for 5 minutes and examine for compliance with 3.5.1.1. On reexamination of the contents, the disclosure of any gel bodies or undispersed pigment indicates unsatisfactory settling properties.

4.6.3.2 Type I epoxy catalyst component B. Upon opening a full previously unopened container, the condition of the contents shall be examined for compliance with 3.5.1.2.

#### 4.6.4 Storage stability.

4.6.4.1 Accelerated storage stability (moisture cured), type I. Fill an epoxy lined pint container with the coating and determine the viscosity in accordance with ASTM D562. Tightly seal the container and place sample in a preheated oven for 168 hours at  $140 \pm 1.8$  °F ( $60 \pm 1$  °C). Allow to cool to room temperature and examine the contents. Check for compliance with 3.5.2.1.

#### 4.6.4.2 Full container storage stability, types I and II.

4.6.4.2.1 Component A type I, moisture cured polyurethane type I and single component type II. Allow a full quart can of product to stand undisturbed for one (1) year in accordance with ASTM D1849 and then examine the contents. Agitate the can for five (5) minutes on a paint shaker and evaluate the pigment settling as specified in 3.5.2.2. Determine viscosity and other applicable tests for compliance with 3.5.2.2.

4.6.4.2.2 Component B types I and II. Allow a full 8 ounce can of component B to stand for one (1) year under laboratory room conditions of  $73 \pm 4$  °F ( $23 \pm 2$  °C) and a 40 - 70 percent relative humidity. At the end of this period, examine the contents for compliance to 3.5.2.2.

4.6.4.3 Type III powder primer. The powder primer shall be stored under ambient conditions with a temperature not exceeding 80 °F (27 °C) and a relative humidity between 50 and 60 percent for one year. At the end of this period, examine the powder for compliance to 3.5.2.3.

4.6.5 Mixing properties for multi-component products. Thoroughly mix the components per the manufacturer's requirements and examine for compliance with 3.5.3. Place 5 ounces of the material in an eight ounce glass jar and do not agitate or disturb for 4 hours. At the end of this period, examine for compliance with 3.5.3.

4.6.6 Spraying properties. If reduction is necessary for spray application for types I and II primers, reduce as recommended by the manufacturer, not to exceed VOC limits where applicable. Spray primer on a steel panel to a dry film thickness as specified in 4.6.1. The coating properties of the dry sprayed surface shall be observed for compliance with 3.5.4. For type III powder primer, spray the powder coating on a solvent cleaned steel panel as per TT-C-490 method II to the dry film thickness specified in 4.6.1 and cure according to manufacturers' instructions. Observe the coating appearance for compliance with 3.5.4.

4.6.7 Flexibility. Determine flexibility in accordance with ASTM D522, method B using a one inch cylindrical mandrel. Spray the coating, according to manufacturers' recommendations, on a steel panel, 0.024-0.026 inches thick. Cure according to manufacturer's instructions. Bend the coated panels according to ASTM D522, method B. Examine the coating for cracks over the area of the bend for compliance with 3.5.5.

4.6.8 Adhesion.

4.6.8.1 Dry adhesion tape pull. Spray the primer as in 4.6.6 on three (3) steel panels, which have a minimum thickness of at least 0.125 inch (see 4.6.1.1). Air dry types I and II specimens for 168 hours. For type III specimens, cure the panel as recommended by manufacturer. On one of the panels, perform adhesion testing as specified in ASTM D3359, method B and examine for compliance with 3.5.6.1.

4.6.8.2 Pull off adhesion. Using the panels from 4.6.8.1, a minimum of ten (10) pull-off tests shall be completed on each panel (top and bottom). Testing according to ASTM D4541 shall be completed using a hydraulic pull-off adhesion tester with a minimum upper limit of 3,500 psi. Testing shall be done to failure or upper limit of device. Inspection shall note the final pressure and the failure mode. Examine for compliance to 3.5.6.2.

4.6.9 Embrittlement testing. Unless otherwise specified and approved, the test for the effectiveness of the procedures used to control hydrogen embrittlement shall be performed using procedures outlined in ASTM F519. Apply primer to three (3) type 1e coupons according to manufacturer's recommended cleaning and application procedures. The notch should be masked for any mechanical cleaning procedures. Coupons shall be tested according to A3 of ASTM F519. If product is found to contribute to hydrogen embrittlement, a statement to that effect will be required on packaging and relief procedures in accordance with MIL-STD-171 shall be provided with application procedure. Prior to submission and QPD testing, verification results in accordance with ASTM F519 using an ISO 9000/IEC 17025 or NADCAP certified laboratory shall be forwarded to ARL. The results will be checked for compliance to 3.5.7.

4.6.10 Compatibility. Prepare two (2) test panels as in 4.6.8.1. Apply epoxy primer (see 4.6.1.3) over the specimens. Let the panels dry for 2 hours and then apply polyurethane topcoat (see 4.6.1.4). Air dry both panels for 24 hours. Examine panels for lifting, softening, and any evidence of other irregularities and for compliance with 3.5.8. Allow the specimens to air dry for a total of 168 hours. Perform adhesion testing as specified in 4.6.8.1 and 4.6.8.2. Nonconformance to 3.5.6.1 and 3.5.6.2 constitutes failure of this test.

4.6.11 Water resistance. Prepare test panels as specified in 4.6.8.1 and 4.6.10. Coat all exposed, uncoated metal surfaces with wax or other suitable coating. Immerse the panels for 168 hours in distilled water at  $73 \pm 2$  °F ( $23 \pm 1$  °C) as specified in ASTM D1308. Upon removal, observe panels for compliance with 3.5.9. Nonconformance to 3.5.9 constitutes failure of this test.

4.6.12 Hydrocarbon fluid resistance. Prepare test panels as specified in 4.6.8.1 and 4.6.10. Do not wax or treat the exposed metal surfaces. Immerse the panels for 168 hours in a hydrocarbon fluid conforming to JP8 at  $70 \pm 5$  °F ( $21 \pm 3$  °C). Panels shall be immersed at a minimum depth of 50 percent. At the end of the test period, remove and examine for compliance with 3.5.10. Nonconformance to 3.5.10 shall constitute failure of this test.

4.6.13 Corrosion test samples. Prepare ten (10) steel 4 × 6 inch panels as specified in 4.6.10 and let air dry for 168 hours. Coat uncoated metal surfaces with the barrier primer (MIL-DTL-53022 or MIL-DTL-53030) being used to prevent edge corrosion effects. Tape, wax, and chromated coatings are unacceptable for edge and back coatings. After the 168 hour dry time and just prior to exposure to corrosion testing, an “X” scribe shall be made through the primer. The linear portion of each scribe will start in a corner 0.5 inch from the edges of the panel and end 0.5 inch from the edges on the opposite corner, with the two scribes intersecting in the middle of the panel to form an “X” (i.e., one scribe will start from the top left corner and end in the bottom right corner with the other starting in the top right corner and ending in the bottom left corner). The scribe shall penetrate through all coating layers exposing the underlying steel substrate.

4.6.13.1 Cyclic corrosion resistance. Take the five (5) steel panels from 4.6.13 and expose three (3) to accelerated cyclic corrosion for 80 cycles and two (2) for 100 cycles according to GMW 14872. Upon removal, wash the panels gently in warm running water or DI water until free from any visible salt deposits. For panels removed after 80 cycles, remove the primer in accordance with ASTM D1654 and inspect for rust, pitting or corrosion not evident with paint present. For panels removed after 100 cycles, inspect for blisters. Nonconformance to 3.5.11.1 shall constitute failure of this test.

4.6.13.2 Atmospheric corrosion resistance. Take five (5) specimens/coupons from 4.6.13 and make an “X” scribe through the coating system to the substrate. Expose these for two (2) years at a suitable test site in accordance with ASTM G50, with equivalent or greater mass loss than 1.5 mils per year (mpy), such as the ARL site at Cape Canaveral Air Force Station. Upon completion of the 2 year exposure, specimen/coupons shall be field evaluated, then returned to ARL for a final evaluation. Upon return, wash the specimens/coupons gently in warm running water or DI until free from any visible salt deposits and examine immediately for compliance with 3.5.11.2. When visual examination is indeterminate, the specimens/coupons shall undergo coating removal along the scribe as per ASTM D1654 and inspection for rust, pitting or corrosion not evident with paint present. Nonconformance to 3.5.11.2 shall constitute failure of this test.

4.6.14 Toxic ingredients. Other than PCBTF, the manufacturer shall certify that the primer contains no benzene (benzol), chlorinated solvents or ethylene based glycol ethers and their acetates. Nonconformance to 3.5.12 constitutes failure of this requirement.

## 5. PACKAGING

5.1 Packaging and markings. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point’s packaging activities within the Military Service or Defense Agency, or within the military service’s system command. Packaging data retrieval is available from the managing Military Department’s or Defense Agency’s automated packaging files, CD-ROM products, or by contacting the responsible packaging activity. For markings, containers or packaging of the coating shall be marked with a label that identifies the specification number, type, color, and material designation so that traceability to the QPD can be verified.

## 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 primers described in this specification, which are lead and hexavalent chromium free, are intended for use on clean, blasted ferrous substrates with the CARC coating system. These coatings use metal particles that make up a part of the pigment content to provide sacrificial cathodic protection to steel substrates. These primers are intended to be applied to blasted steel having a surface profile of 1-2 mils. As a stack up system, which contains a metal-rich primer, barrier primer and CARC topcoat will provide enhanced corrosion performance of 80+ cycles on the cyclic corrosion test.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Type, form, and class of coating (see 1.2, 1.2.1 and 1.2.2).
- c. Part or identifying number (PIN) (see 1.3).
- d. Color characteristics (see 3.3).
- e. Composition (see 3.4).
- f. Whether SDS is required with each shipment (see 3.7.1 and 6.4.3).
- g. If a toxicity clearance is required (see 3.8).
- h. If qualification samples are required and where to send them (see 4.2 and 6.4).
- i. If extension of qualification samples are required and where to send them (see 4.2 and 6.4).
- j. If conformance samples are required and where to send them (see 4.3).
- k. Packaging requirements (see 5.1).

6.3 Basis of purchase. Primers covered by this specification may be single component purchased in units of gallons or multi-component kits purchased as quart or gallon kits. The kit components need not be the same size, 1 quart of 57.75 cubic inches or 1 gallon of 231 cubic inches. The type III primer covered by this specification should be purchased by mass, the unit being one pound.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in the Qualified Products List QPL No. 32550, whether or not such products have actually been so listed by that date. The attention of contractors is called to these requirements and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from and samples for QPD testing (see 4.2) should be submitted to ARL, ATTN: RDRL-WMM-C, Organic Coatings Team, Building 4600, Deer Creek Loop, Aberdeen Proving Ground, MD 21005-5066. An online listing of products qualified may be found in the QPD at <https://assist.dla.mil>.

6.4.1 Retention of qualification. In order to retain qualification of a product approved for listing in the QPD, the manufacturer will verify by certification to the qualifying activity that the manufacturer's product complies with the requirements of this specification. Unless otherwise

specified, the time of periodic verification by certification will be in two year intervals from the date of the original qualification, and will be initiated by the qualifying activity. No change will be made in formulation, raw materials or supplier(s) of raw materials, methods of manufacture, equipment, or geographic location without prior written Government approval. The Government reserves the right to re-examine the qualified product whenever deemed necessary to determine that the product continues to meet any or all of the specification requirements.

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

6.4.3 SDS. Contracting officers will identify those activities requiring copies of a completed SDS prepared in accordance with 3.7.1. The pertinent Government mailing addresses for submission of data are listed in 3.7.1.

6.4.4 Sample identification for qualification inspection. Samples for QPD testing are to be identified in a cover letter with the following information:

- Manufacturer's name and product number.
- Submitted by (name and date).
- Specify the number of samples.
- Specify the reason for submitting the samples.
- Specification MIL-PRF-32550; Type \_\_\_\_\_, Form \_\_\_\_\_, Class \_\_\_\_\_, "Metal-rich Primer".
- Provide a copy of the SDS.
- Provide a copy of the notarized statement of composition.
- Provide a copy of the technical data sheet.
- Provide a copy of the test report.

6.5 Conformance rejection and retest. Failure in any conformance inspection will result in the rejection of the batch from which it was obtained and constitutes justification for removal from the qualified products list. Rejected material cannot be resubmitted for acceptance without written approval from the qualification activity (see 4.3). The application for resubmission will contain all details concerning previous rejections and measures taken to correct these deficiencies.

6.6 Cyclic corrosion testing. The requirement of 80 cycles, as specified in 4.6.13.1, has an equivalent severity (mass loss) as 105 cycles of the GM 9540P cyclic corrosion test.

6.7 Toxicity request. Department of the Army Regulation (AR) 40-5, Preventive Medicine, (AR) 70-1, Acquisition Policy, and Department of the Army Pamphlet 70-3, Acquisition Procedures, require a toxicity clearance. Army toxicity questions and/or a toxicity clearance request should be addressed to: US Army Public Health Command (USAPHC), ATTN: MCHB-IP-TTE, 5158 Blackhawk Road, APG-EA, MD 21010-5403 or emailed to [usaphctepinfo@amedd.army.mil](mailto:usaphctepinfo@amedd.army.mil).

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

6.9 New document. SAE-AMS-STD-595M (Colors Used in Government Procurement) will supersede FED-STD-595 when approved.

6.10 Subject term (key word) listing.

CARC  
Color  
Composition  
HAPs  
Metallic  
Pigment  
Substrates  
Topcoat  
VOCs  
VOHAPs

## CONCLUDING MATERIAL

Custodians:

Army – MR

Navy - SH

Air Force - 11

Preparing activity

Army – MR

Project 8010-2016-002)

Review activities:

Army - MD1, MI

Navy - AS, CG, MC

Air Force - 84, 99

Civil agency:

GSA/FAS

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