

INCH-POUND

MIL-PRF-32440A

20 March 2018

SUPERSEDING

MIL-PRF-32440

28 February 2013

PERFORMANCE SPECIFICATION

COATINGS, CHIP-, IMPACT-, WEAR-, AND ABRASION-RESISTANT

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

1. SCOPE

1.1 Scope. This specification covers chip-, impact-, wear-, and abrasion-resistant coatings for use on areas of military vehicles or ground support equipment that may encounter chip, impact, wear, or abrasion damage. Examples of subject areas are bed liners and cargo beds of trucks, undercarriages of ground support equipment, torsion bars, and other areas subject to chipping, impact, wear, or abrasion.

1.2 Classification. Chip-, impact-, wear-, and abrasion-resistant coatings are of the following types and classes as specified (see 6.2):

a. Type I. Type I coatings consist of 100 percent solids, two-component polyurethane, polyurea, or hybrid of polyurethane/polyurea.

(1) Class I. For application with heated, plural component spray equipment.

(2) Class II. For use with manually-powered, pneumatic application equipment, or with an applicable hand applicator in accordance with the manufacturer's technical data.

b. Type II. DELETED

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-C-490 - Chemical Conversion Coatings and Pretreatments for Metallic Substrates (Base for Organic Coatings)

Comments, suggestions, or questions on this document should be addressed to Marine Corps Systems Command, 2000 Lester Street, Quantico, VA 22134 ATTN: SEAL-SE-STDS or emailed to USMC_STDZ@usmc.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>.

MIL-PRF-32440A

DEPARTMENT OF DEFENSE SPECIFICATIONS

- MIL-DTL-53030 - Primer Coating, Epoxy, Water Based, Lead and Chromate Free
- MIL-DTL-53072 - Chemical Agent Resistant Coating (CARC) System Application Procedures and Quality Control Inspection
- 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.

CODE OF FEDERAL REGULATIONS (CFR)

- 49 CFR 571.302 - Flammability of Interior Materials

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

UNITED STATES MARINE CORPS TECHNICAL MANUALS

- TM 4750-OD/1 - Paint, Coating, Underbody and Registration Marking for Marine Corps Combat and Tactical Equipment

(Copies of this document are available by emailing USMC_STDZ@usmc.mil.)

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.

AEROSPACE INDUSTRIES ASSOCIATION (AIA)

- AIA NAS411-1 - Hazardous Materials Target List

(Copies of this document are available online at www.aia-aerospace.org/.)

ASTM INTERNATIONAL

- ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension
- ASTM D522/D522M - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
- ASTM D570 - Standard Test Method for Water Absorption of Plastics
- ASTM D714 - Standard Test Method for Evaluating Degree of Blistering of Paints
- ASTM D1141 - Standard Practice for the Preparation of Substitute Ocean Water
- ASTM D2240 - Standard Test Method for Rubber Property – Durometer Hardness
- ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
- ASTM D3170/D3170M - Standard Test Method for Chipping Resistance of Coatings
- ASTM D3359 - Standard Test Methods for Rating Adhesion by Tape Test

MIL-PRF-32440A

- ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
- ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
- ASTM D5402 - Standard Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs
- ASTM D6677 - Standard Test Method for Evaluating Adhesion by Knife
- ASTM E1347 - Standard Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry

(Copies of these documents are available online at www.astm.org.)

GENERAL MOTORS CORPORATION

- GMW14872 - Cyclic Corrosion Laboratory Test

(Copies of this document are available online at <https://global.ihs.com/>.)

SAE INTERNATIONAL

- SAE AMS-STD-595 - Colors Used in Government Procurement
- SAE AMS-STD-595/17038 - OSHA Black, ANA 515, 622
- SAE AMS-STD-595/27038 - ANA 514
- SAE AMS-STD-595/27041 - Black
- SAE AMS-STD-595/37030 - Black Camo
- SAE AMS-STD-595/37031 - Interior Aircraft Black
- SAE AMS-STD-595/37038 - Black Int'l, Navy #3 Black, ANA 604
- SAE AMS-STD-595/37056 - Miscellaneous, Flat
- SAE AMS-STD-595/37100 - Violet

(Copies of these documents are available online at www.sae.org.)

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

- SSPC-PA 2 - Procedure for Determining Conformance to Dry Coating Thickness Requirements
- SSPC-SP 1 - Solvent Cleaning
- SSPC-SP 3 - Power Tool Cleaning
- SSPC-SP 10/NACE NO. 2 - Near-White Metal Blast Cleaning
- SSPC-SP 16 - Brush-off Blast Cleaning of Non-Ferrous Metals

(Copies of these documents are available online at www.sspc.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.

MIL-PRF-32440A

3. REQUIREMENTS

3.1 Qualification. Coatings furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Materials. The resin and isocyanate components furnished under this specification, when mixed and applied in accordance with the manufacturer's instructions, shall produce a chip-, impact-, wear-, and abrasion-resistant coating that satisfies all of the requirements of this specification. The composition of the coating furnished under this specification shall be the responsibility of the manufacturer, except as limited by this specification.

3.2.1 Recycled, recovered, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.2.2 Materials dispensing. Class I materials shall be sprayable through a heated, plural component system (see 3.3.18 and 4.4.20). Class II materials shall be applied by manually-powered or pneumatic systems (see 3.3.16, 3.3.17, 4.4.18, and 4.4.19).

3.2.3 Chemical composition. 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 (see 4.4.1) and be compatible with the chemical agent resistant coating (CARC) primers and topcoats (see 3.3.4 and 4.4.6) in accordance with MIL-DTL-53072 and TM 4750-OD/1. Class I coatings shall be compatible with Class II coatings, and vice versa.

3.2.3.1 Base component. The base component shall contain a polyether-polyol based resin blend, polyamine or polyetheramine-based resin blend, or a combination of the two (for hybrid systems). The base resin may be aliphatic or aromatic in nature. The polymeric resin used in base components shall be 100 percent solids.

3.2.3.2 Isocyanate component. The isocyanate component shall be methylene di-isocyanate (MDI). Regardless of chemistry, the coating cannot contain any hazardous toluene di-isocyanate (TDI) or more than 0.5 percent free monomers of hexamethylene di-isocyanate (HDI) or MDI. The coating shall be aromatic or aliphatic in nature. The polymeric resin used in isocyanate components shall be 100 percent solids.

3.2.4. Storage stability.

3.2.4.1 Accelerated storage stability. When tested as specified in 4.4.2.1, the individual components of multi-component systems or the final product of single component systems shall show no visual signs of curdling or hardening, and any sedimentation or material separation shall be easily mixed back into a smooth homogeneous state. After the specified conditioning period, coatings shall meet the requirements for solvent resistance (see 3.3.12), hardness (see 3.3.13), gel time (see 3.3.16), tack-free time (see 3.3.17), and application properties (see 3.3.18).

3.2.4.2 Long-term storage stability. When tested as specified in 4.4.2.2, the individual components of multi-component systems or the final product of single component systems shall show no visual signs of curdling or hardening, and any sedimentation or material separation shall be easily mixed back into a smooth homogeneous state. After the specified conditioning period, coatings shall meet the requirements for solvent resistance (see 3.3.12), hardness (see 3.3.13), gel time (see 3.3.16), tack-free time (see 3.3.17), and application properties (see 3.3.18).

3.2.5 Toxicity and prohibited materials.

3.2.5.1 Toxicity. When evaluated in accordance with 4.4.14, the coating shall pose no serious or high risk to the health of personnel or the environment when used for its intended purpose (see 4.4.14 and 6.4).

3.2.5.2 Prohibited materials. The coating shall not contain any chemicals categorized as "prohibited" in accordance with AIA NAS411-1.

MIL-PRF-32440A

3.3 Performance. Performance of coatings shall be as follows:

3.3.1 Color. Unless otherwise indicated in the contract, purchase order, drawings, or by the procuring authority (see 6.2), coatings shall be black in color, corresponding to the tristimulus color values, but not the gloss values, unless contraindicated by contract or drawing, commercially available black. The color shall be tested in accordance with 4.4.3. Examples of acceptable colors can be found in [table I](#).

TABLE I. Examples of acceptable colors.

SAE AMS-STD-595 Color ID	Gloss Level	L*	a*	b*	Color Name
17038	Gloss	24.23	0.05	-0.14	OSHA Black, ANA 515, 622
27038	Semi-Gloss	25.84	-0.13	-0.67	ANA 514
27041	Semi-Gloss	28.41	-0.05	-1.42	Black
37030	Flat	24.16	-0.32	-0.37	Black Camo
37031	Flat	23.81	-0.25	-0.38	Interior Aircraft Black
37038	Flat	24.33	-0.2	-0.33	Black Int'l, Navy #3 Black, ANA 604
37056	Flat	30.23	2.31	2.83	Miscellaneous, Flat
37100	Flat	35.66	19.72	-18.36	Violet

3.3.2 Flame resistance. Coatings shall be flame resistant when evaluated in accordance with Standard No. 302, Flammability of Interior Materials of the Federal Motor Vehicle Safety Standards and Regulations (FMVSSR), 49 CFR 571.302 for the burn rate requirement, and tested in accordance with 4.4.4.

3.3.3 Adhesion to primed substrate. The average pull-off adhesion shall be a minimum of 1,000 pounds per square inch (psi) when tested in accordance with 4.4.5. Knife adhesion shall have a minimum rating of 8 with regard to the degree of removal difficulty when tested in accordance with 4.4.5.

3.3.4 CARC overcoat adhesion. CARC topcoat shall show good adhesion and compatibility when applied over cured coatings when prepared and tested as specified in 4.4.6. The applied CARC topcoat shall not show visual evidence of coating defects, including but not limited to delamination, wrinkling, fish eyes, pinholes, or porosity. The average pull-off adhesion shall be a minimum of 1,000 psi when tested in accordance with 4.4.6. Tape test adhesion shall have an average rating of 4 or higher when tested in accordance with 4.4.6.

3.3.5 Chip resistance. Coatings shall have a rating of 10 when tested in accordance with 4.4.7.

3.3.6 Impact resistance. Coatings shall exhibit no cracking to the primed substrate when tested using a 0.625-inch indenter at 50 inch-pounds direct and at 25 inch-pounds reverse impact in accordance with 4.4.8.

3.3.7 Mandrel flexibility. Coatings shall demonstrate no cracking or delamination when bent over a 0.25-inch mandrel when tested in accordance with 4.4.9.

3.3.8 Tensile and elongation properties.

3.3.8.1 Tensile strength. Tensile strength for coatings shall be 1,200 psi minimum when prepared in accordance with 4.3.6 and tested in accordance with 4.4.10.

3.3.8.2 Elongation. Coatings shall meet 140 to 400 percent elongation when prepared in accordance with 4.3.6 and tested in accordance with 4.4.10.

MIL-PRF-32440A

3.3.9 Accelerated corrosion. When tested in accordance with 4.4.11, and when applied to steel, coatings shall have:

- a. A blistering size rating of 10 (no blistering).
- b. No delamination of the coating from the underlying primer or topcoat.

3.3.10 Appearance. When evaluated in accordance with 4.4.20, cured coatings shall have a uniform surface texture, free of sags, pits, blisters, or visual defects. The cured coatings shall form a monolithic layer free of through-thickness porosity. Mild orange peel is acceptable with Class I coatings. A stipple or textured finish may be used in areas where a nonslip effect is preferred (for example, torsion bars). When specified (see 6.2), visual acceptance criteria of these areas will be determined by the drawing or procuring authority.

3.3.11 Chemical resistance. Coatings appearance shall be in accordance with 3.3.10 and shall exhibit no softening failure when tested in accordance with 4.4.12. Softening failure shall be defined as any hardness value varying more than 5 percent from the average hardness at laboratory conditions as defined in 4.3.5 and tested in accordance with 4.4.15.

3.3.12 Solvent resistance. When evaluated in accordance with 4.4.13, test panels with coating subjected to 25 methyl ethyl ketone (MEK) double rubs shall not be visually affected more than the same panel subjected to 25 water double rubs. Further, the average dry film thickness (DFT) measurement (in accordance with SSPC-PA 2) taken after the 25 MEK double rubs shall be within 5 percent of the average DFT measurement before the 25 MEK double rubs in the area where the double rubs were performed.

3.3.13 Hardness. When evaluated in accordance with 4.4.15, the average hardness of cured coatings shall be 35-65 Type D.

3.3.14 Abrasion resistance. When evaluated in accordance with 4.4.16, coatings shall not lose more than 30 milligrams of material.

3.3.15 Water absorption. When tested and evaluated in accordance with 4.4.17, coatings shall display less than 1.2 percent water absorption.

3.3.16 Gel time. When tested in accordance with 4.4.18, Class I coatings shall have a maximum gel time of 15 seconds, and Class II coatings shall have a maximum gel time of 5 minutes.

3.3.17 Tack-free time. When tested in accordance with 4.4.19, Class I coatings shall have a maximum tack-free time of 180 seconds. Class II compounds shall have a maximum tack-free time of 30 minutes.

3.3.18 Application properties. When tested in accordance with 4.4.20, coatings shall be able to be applied without any vertical sagging and shall conform to the requirements of 3.3.10.

3.3.19 Film build. When prepared in accordance with 4.4.21, the coated specimen prepared in the vertical orientation shall display no apparent sagging. In addition, coatings shall be capable of application of 0.125 inch minimum dry film thickness validated in accordance with 4.4.21. When tested in accordance with 4.4.21, knife adhesion on each coated specimen shall have an average rating of 8 or higher with regard to the degree of removal difficulty.

4. VERIFICATION

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

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

4.2 Qualification inspection. Qualification inspection shall include the examination and testing as specified in [table II](#). The products tested shall be materials drawn from regular production stocks and shall be a 5-gallon kit for Class I or 750-milliliter cartridge for Class II. Testing of products on government platforms shall be conducted at the convenience of the Government.

MIL-PRF-32440A

TABLE II. Requirements and verification.

Item	Ref	Class I (sprayed coating)			Class II (non-sprayed coating)		
		Qualification testing required	Conformance testing required	Verification paragraph	Qualification testing required	Conformance testing required	Verification paragraph
Materials dispensing	3.2.2	YES	YES	4.4.20	YES	YES	4.4.18 4.4.19
Chemical composition	3.2.3	YES	NO	4.4.1	YES	NO	4.4.1
Storage stability	3.2.4	YES	NO	4.4.2	YES	NO	4.4.2
Toxicity	3.2.5	YES	NO	4.4.14	YES	NO	4.4.14
Color	3.3.1	YES	YES	4.4.3	YES	YES	4.4.3
Flame resistance	3.3.2	YES	NO	4.4.4	YES	NO	4.4.4
Adhesion to primed substrate	3.3.3	YES	NO	4.4.5	YES	NO	4.4.5
CARC overcoat adhesion	3.3.4	YES	NO	4.4.6	YES	NO	4.4.6
Chip resistance	3.3.5	YES	NO	4.4.7	YES	NO	4.4.7
Impact resistance	3.3.6	YES	NO	4.4.8	YES	NO	4.4.8
Mandrel flexibility	3.3.7	YES	NO	4.4.9	YES	NO	4.4.9
Tensile strength	3.3.8.1	YES	NO	4.4.10	YES	NO	4.4.10
Elongation	3.3.8.2	YES	NO	4.4.10	YES	NO	4.4.10
Accelerated corrosion	3.3.9	YES	NO	4.4.11	YES	NO	4.4.11
Appearance	3.3.10	YES	YES	4.4.20	YES	YES	4.4.20
Chemical resistance	3.3.11	YES	NO	4.4.12	YES	NO	4.4.12
Solvent resistance	3.3.12	YES	YES	4.4.13	YES	YES	4.4.13
Hardness	3.3.13	YES	YES	4.4.15	YES	YES	4.4.15
Abrasion resistance	3.3.14	YES	NO	4.4.16	YES	NO	4.4.16
Water absorption	3.3.15	YES	NO	4.4.17	YES	NO	4.4.17
Gel time	3.3.16	YES	YES	4.4.18	YES	YES	4.4.18
Tack-free time	3.3.17	YES	YES	4.4.19	YES	YES	4.4.19
Application properties	3.3.18	YES	YES	4.4.20	YES	YES	4.4.20
Film build	3.3.19	YES	NO	4.4.21	YES	NO	4.4.21

MIL-PRF-32440A

4.2.1 Formulation changes. Any changes in formulation, ingredients, manufacturing processes, or manufacturing locations of the coating shall be approved by the Marine Corps Systems Command. Incorporation of any changes, which have not been so approved, shall require requalification of item in question.

4.3 Conformance inspection. The conformance inspection shall be performed on each production batch, and the results shall be provided when requested by the contracting officer or the qualifying activity (see 6.2). Conformance inspection shall consist of specific tests as specified in [table II](#). There shall be no failures (see 6.5).

4.3.1 Lot. For purposes of sampling and conformance inspection, a lot shall consist of all coating/compound of the same formula number from a single uniform batch or uniform blend of batches offered for delivery at one time. The addition of any substance to a batch shall constitute a new lot and full conformance testing is required.

4.3.2 Sampling for conformance testing. A production sample sufficiently large enough to permit the performance of all conformance tests shall be selected. Representative packaged samples sufficient to perform conformance testing shall be forwarded to a designated approved laboratory. If sample panels are to be coated at the vendor's facility and forwarded to an external laboratory for testing, preparation of the panels and application of the coating system shall be observed by a representative from the Defense Contract Management Agency.

4.3.3 Noncompliance. If a sample fails to pass its conformance inspection, the lot shall be rejected. Further guidance for noncompliant samples is described in 6.5.

4.3.4 Test panels and surface preparation. Unless otherwise specified herein, test panels shall be 6- by 12- by 0.125-inch SAE 1008 – 1010 carbon steel. Test panels shall be degreased in accordance with SSPC-SP 1 or TT-C-490, Methods II, III, IV, VI, or VII. The degreased test panels shall be abrasive blasted in accordance with TT-C-490, Method I with clean abrasive blast media to provide an average profile of 0.0010 ± 0.0005 inch on both sides.

4.3.5 Coated test panels. Panels shall be prepared according to 4.3.4. Panels shall be primed on both sides in accordance with MIL-DTL-53072 with a water-reducible epoxy in accordance with MIL-DTL-53030 to a dry film thickness of 0.0015 ± 0.0002 inch when measured in accordance with SSPC-PA 2. The coated panels shall be allowed to cure in controlled laboratory conditions (77 ± 10 °F and 40 to 60 percent relative humidity) for a minimum of 24 hours. Class I coatings shall be spray-applied with a monolithic layer to a thickness of 0.060 to 0.080 inch on one side. Coating surface shall be flat with no surface irregularities, other than mild orange peel. Class II coatings shall be applied per manufacturer's instructions to test panels at a thickness of 0.060 to 0.080 inch. The panels shall be cured according to manufacturer's instructions.

4.3.6 Free films. Free films of coatings shall be prepared at a cured film thickness of 0.060 to 0.080 inch. After manufacturer specified cure time, the coating shall be separated from the release material and allowed to cure for a minimum of 24 hours at laboratory conditions.

4.3.7 Sample conditioning procedures. Unless otherwise specified herein, all test samples shall be prepared and tested at controlled laboratory conditions (see 4.3.5). Tests used to verify operational temperature limits—chip resistance (see 3.3.5 and 4.4.7), impact resistance (see 3.3.6 and 4.4.8), and mandrel flexibility (see 3.3.7 and 4.4.9)—shall be conducted at three distinct temperatures: -40 ± 1.8 °F, controlled laboratory conditions, and 180 ± 1.8 °F, where sample set conditioning shall be for a period of 90 minutes. Following this conditioning, testing of each sample shall be initiated within 3 minutes.

4.4 Test methods. Tests shall be conducted as specified in [table II](#).

4.4.1 Chemical composition. The coating shall be verified to be VOC free. The isocyanate component, if applicable, shall be verified to be free of TDI and contain no more than 0.5 percent free monomers of HDI or MDI.

4.4.2 Storage stability.

4.4.2.1 Accelerated storage stability. A tightly sealed sample of the coating, as received from the manufacturer, shall be placed in a preheated oven for 7 days at 120 ± 1.8 °F. The sample shall be allowed to cool to room temperature and then examined for compliance with 3.2.4.1. After this conditioning period, the final product shall be prepared in accordance with manufacturer's instructions and tested for conformance with 3.2.4.1. The sample size shall be a 5-gallon kit for Class I and 750-milliliter kit for Class II.

MIL-PRF-32440A

4.4.2.2 Long-term storage stability. A tightly sealed sample of the coating, as received from the manufacturer, shall be conditioned at the controlled laboratory temperature in accordance with 4.3.5 for 12 months. The sample size shall be a 5-gallon kit for Class I and 750-milliliter kit for Class II.

4.4.3 Color. Color shall be determined by use of a colorimeter (see 3.3.1 and 6.2) in accordance with ASTM E1347.

4.4.4 Flame resistance. The samples shall be prepared in accordance with 4.3.6. The coatings shall be tested in accordance with Standard No. 302, Flammability of Interior Materials of the FMVSSR, 49 CFR 571.302, and meet the requirements of 3.3.2.

4.4.5 Adhesion to primed substrate. Three steel test panels shall be prepared in accordance with 4.3.4 and coated in accordance with 4.3.5. An adhesion test shall be performed in accordance with ASTM D4541 on each of the three panels, using a minimum of five adhesion dollies per panel. Mechanical scoring around the dollies to the substrate, not greater than 2 millimeters (0.079 inch) of the radius of the dolly, is required. In the remaining area on each panel, an adhesion test shall be performed in accordance with ASTM D6677 with the cut made through to the substrate surface.

4.4.6 CARC overcoat adhesion. Three steel test panels shall be prepared in accordance with 4.3.4 and coated in accordance with 4.3.5. After the coating cures for 24 hours, a minimum 0.0018-inch coating in conformance with MIL-DTL-64159 Tan 686A shall be spray-applied in accordance with MIL-DTL-53072, and shall cure according to the manufacturer's recommended instructions under controlled laboratory conditions (see 4.3.5), observing a minimum cure time of 7 days. An adhesion test shall be performed in accordance with ASTM D4541 on each of the three panels, using a minimum of five adhesion dollies per panel. In addition, the coating shall be evaluated in accordance with ASTM D3359, Method A (X-cut), with the cut made through the topcoat and into the candidate coating.

4.4.7 Chip resistance. Three 4- by 6- by 0.125-inch steel test panels for each of the three test temperatures specified in 4.3.7 shall be prepared and conditioned in accordance with 4.3.4, 4.3.5, and 4.3.7. Chip resistance shall be tested in accordance with ASTM D3170/D3170M, with the test panel positioned at a 90-degree angle to the gravelometer nozzle, and evaluated for penetration of coating damage to the substrate. Note that if panel dimensions specified in this section are not compatible with the gravelometer apparatus, then alternate panel sizes appropriate for the apparatus may be used.

4.4.8 Impact resistance. A total of eighteen (18) 4- by 6- by 0.025-inch steel test panels shall be prepared in accordance with SSPC-SP 3 and 4.3.5, and conditioned in accordance with 4.3.7. For each of the three specified operational temperatures, three test panels shall be subjected to direct impact at 50 inch-pounds and three additional test panels shall be subjected to reverse impact at 25 inch-pounds. The test apparatus shall be in accordance with ASTM D2794. Five impact measurements shall be taken for each tested panel. Examination for coating failure shall be in accordance with ASTM D2794.

4.4.9 Mandrel flexibility. A total of nine (9) 4- by 6- by 0.030-inch steel test panels, in accordance with ASTM D522/D522M, shall be prepared in accordance with SSPC-SP 3 and 4.3.5, and conditioned in accordance with 4.3.7. Three mandrel tests shall be performed at each of the three specified operational temperatures. The conditioned test panels shall be bent over a 0.25-inch mandrel in accordance with ASTM D522/D552M, Method B, and examined immediately for defects.

4.4.10 Tensile and elongation properties. Three samples of coatings shall be prepared in accordance with 4.3.6. Specimens shall be cut in accordance with ASTM D412, Method A, using any of the standard dies for cutting dumbbell specimens. Samples shall be run in accordance with ASTM D412, Method A, and analyzed for tensile strength and elongation at rupture.

4.4.11 Accelerated corrosion. Three test panels shall be prepared in accordance with 4.3.4 and 4.3.5. The samples shall be subjected to cyclic accelerated corrosion cabinet testing in accordance with GMW14872, exterior vehicle area test mass loss values, for a duration of 40 cycles. Each panel shall be evaluated and rated for any visible coating defect in accordance with ASTM D714.

MIL-PRF-32440A

4.4.12 Chemical resistance. Prepare two test panels in accordance with 4.3.4 and 4.3.5. Three- to five-milliliter spots of each chemical listed below shall be placed on the surface of the coating. The spots shall be covered with an appropriately sized watch glass and allowed to stand for 4 hours at controlled laboratory conditions (see 4.3.5). The watch glass shall then be removed and the spots rinsed thoroughly with deionized water, allowed to dry, and examined for blistering, wrinkling, and softening. Evaluation of blistering and wrinkling shall be a visual determination via the unaided eye. The following fluid chemicals shall be used:

- a. Mild acid (10 percent by volume sulfuric acid).
- b. Mild caustics (1 percent by volume sodium hydroxide).
- c. Synthetic seawater (in accordance with ASTM D1141).
- d. Oils (motor oil SAE 5W-30).
- e. Oxidizers (3 percent by volume hydrogen peroxide).

4.4.13 Solvent resistance. One steel test panel shall be prepared in accordance with 4.3.4 and 4.3.5. MEK solvent resistance shall be evaluated in accordance with ASTM D5402, Method A.

4.4.14 Toxicity and prohibited materials. A Health Hazard Assessment (HHA) will be conducted to ensure conformance to 3.2.5.1 and 3.2.5.2, as required by the qualifying activity. The Navy and Marine Corps Public Health Center (NMCPHC) will evaluate the coating using data provided by the manufacturer/distributor to the NMCPHC (see 3.2.5.1 and 6.4).

4.4.15 Hardness. One steel test panel shall be prepared in accordance with 4.3.4 and 4.3.5. The test panel shall be measured for hardness on a flat surface in accordance with ASTM D2240 using a Shore D Durometer. Five random site readings shall be made. Each reading shall be taken in accordance with the durometer manufacturer's recommendations.

4.4.16 Abrasion resistance. Two 4- by 4- by 0.025-inch test panels prepared in accordance with 4.3.4 and 4.3.5 and tested in accordance with ASTM D4060 using a CS-10 wheel set and 1,000 grams of weight. The test shall be run for 1,000 cycles, and the wheels shall be resurfaced every 500 cycles. Results shall be quantified as milligram weight loss per 1,000 cycles. Samples may be pre-conditioned by smoothing until one uniform ring is visually evident on the coating surface to eliminate any roughness, if needed.

4.4.17 Water absorption. Two samples shall be prepared in accordance with ASTM D570 for sheet material. The samples shall be cut from a free film sample prepared in accordance with 4.3.6. The samples shall be pre-conditioned in accordance with ASTM D570, for specimens of materials whose water-absorption value would be appreciably affected by temperatures of 110 °C (230 °F), and then submerged in distilled water at 75±1.8 °F for 24 hours. After 24 hours, the specimens shall be patted dry and evaluated for increase in percent by weight in accordance with ASTM D570.

4.4.18 Gel time. Class I coating shall be applied to one steel test panel prepared in accordance 4.3.4 and continually probed with a toothpick at 5 second intervals at different locations along the panel. The time required for the coating material to no longer stick to the toothpick shall be the gel time.

4.4.19 Tack-free time. One steel test panel shall be prepared in accordance with 4.3.4. Class I coating shall be applied to the test panel and allowed to set to gel condition. Mild thumb pressure on a thin polyethylene sheet, placed between the thumb and coating surface, shall be applied at different locations across the panel. The time required for the coating material to no longer stick to the polyethylene sheet shall determine the tack-free time.

4.4.20 Application properties. One steel test panel shall be prepared in accordance with 4.3.4 and primed on both sides with water-reducible epoxy in accordance MIL-DTL-53030 to a dry film thickness of 0.0015±0.0002 inch in accordance with SSPC-PA 2. Class I coating shall be applied, as specified by the manufacturer's recommended parameters and equipment, to the test panel held vertically and applied at a thickness of 0.060 to 0.080 inch. Maximum application time shall be 3 minutes. After tack-free conditions have been met (see 4.4.19), a visual inspection shall be performed.

MIL-PRF-32440A

4.4.21 Film build. Two steel test panels shall be prepared in accordance with 4.3.4 and primed on both sides with water-reducible epoxy in accordance MIL-DTL-53030 to a dry film thickness of 0.0015 ± 0.0002 inch in accordance with SSPC-PA 2. These two panels shall be sprayed with the coating, such that one test specimen is held vertically, and the other test specimen held horizontally. Multiple passes shall be applied in order to achieve a final minimum uniform DFT of 0.125 inch. In accordance with SSPC-PA 2, the DFT of each panel shall be measured using an appropriate DFT gauge, ensuring that the minimum DFT was achieved on the entirety of the panel. Each panel shall be subjected to an adhesion test in accordance with ASTM D6677, with a cut made through the coating system and down to the substrate, and rated in accordance with the test method's rating standard.

5. PACKAGING

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

6. NOTES

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

6.1 Intended use. The chip-, impact-, wear-, and abrasion-resistant coating covered by this specification is intended for use on areas of military vehicles or ground support equipment that may encounter chipping, impact, wear, and abrasion. The coating is a 100 percent solids, chemical cure lining used in protecting profiled, cleaned, and primed (when required) wood, concrete, rigid plastic, fiberglass, elastomeric plastic, and metal substrates. The coating and lining system is intended for protection against abrasion, stone and gravel impact, mild chemicals, corrosion, vibration, and sound emission over a wide temperature range. This material is designed for use as a durable protective layer for abrasion resistance on vehicle interior surfaces such as doors and floors, and abrasion-prone vehicle exterior surfaces such as wheel wells, undercarriages, footsteps, equipment storage areas and beds for tactical, combat, and construction equipment. The material can be applied with a variety of application equipment ranging from high volume production heated plural component equipment to moderate volume static mix cartridge guns and small volume kits. The approximate film thickness is dependent on the particular application needs.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Type and class (see 1.2).
- c. SAE AMS-STD-595 color required (see 3.3.1).
- d. Non-slip texture or finish, if required (see 3.3.10).
- e. When results of conformance inspection for each production batch are to be provided (see 4.3).
- f. Instructions for noncompliant samples (see 4.3.3 and 6.5).
- g. Packaging requirements (see 5.1 and 6.6).
- h. Requirement for a Product Data Sheet in accordance with ASTM F718.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. 32440 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Marine Corps Systems Command, 2000 Lester Street, Quantico, VA 22134 ATTN: SEAL-SE-STDS or emailed to USMC_STDZ@usmc.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.dla.mil>.

MIL-PRF-32440A

6.4 Toxicity evaluation. The NMCPHC requires sufficient information to permit an HHA of the product. Upon completion of the HHA, a copy will be provided by the NMCPHC to the Government for evaluation. The HHA process is described on the NMCPHC's website, <http://www.med.navy.mil/sites/nmcphc/industrial-hygiene/Pages/health-hazard-assessment.aspx>.

6.5 Noncompliance. If a sample fails to pass its conformance inspections, the manufacturer should notify the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted. Acceptance and shipment of the product should be discontinued until corrective action, agreed upon by the inspection activity, has been taken. After the corrective action has been taken, conformance inspections should be repeated on the new lot. In the event of failure after re-inspection, information concerning the failure should be furnished to the cognizant inspection activity.

6.6 Typical container sizes. Chip-, impact-, wear-, and abrasion-resistant coatings are typically available in the following container sizes:

a. Class I heated sprayable coatings:

5-gallon (20-liter)

55-gallon (208-liter)

275-gallon (1041-liter)

b. Class II coatings:

250-milliliter cartridge

300-milliliter cartridge

600-milliliter cartridge

750-milliliter cartridge

6.7 Shelf-life. This specification covers items where the assignment of a Federal shelf-life code is a consideration. Specific shelf-life requirements should be specified in the contract or purchase order, and should include, as a minimum, shelf-life code, shelf-life package markings in accordance with MIL-STD-129 or FED-STD-123, preparation of a materiel quality storage standard for type II (extendible) shelf-life items, and a minimum of 85 percent shelf-life remaining at time of receipt by the Government. These and other requirements, if necessary, are in DoDM 4140.27, DoD Shelf-Life Management Program. The shelf-life codes are in the Federal Logistics Information System Total Item Record. Additive information for shelf-life management may be obtained from DoDM 4140.27, or the designated shelf-life Points of Contact (POC). The POC should be contacted in the following order: (1) the Inventory Control Points that manage the item and (2) the DoD Service and Agency administrators for the DoD Shelf-Life Program. Appropriate POCs for the DoD Shelf-Life Program can be contacted through the DoD Shelf-Life Management website: <https://www.shelflife.dla.mil/>.

6.8 Subject term (key word) listing.

Abrasion protection

Corrosion protection

Durable

Impact protection

Isocyanate

Polyurea

Polyurethane

6.9 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.

MIL-PRF-32440A

CONCLUDING MATERIAL

Custodians:

Army – MR
Navy – MC
Air Force – 99

Preparing Activity:

Navy – MC
(Project 8010-2017-002)

Review Activities:

Army – AT, AV, MI, TE
Navy – AS, CG, SH
Air Force – 11, 84
GSA – FAS

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