

INCH-POUND

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6 December 2018
SUPERSEDING
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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 which may encounter diminished service life through 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, which may compromise the established quality and function of the original equipment manufacturers (OEM) part along with traditional coatings, promoting corrosion and other detrimental effects.

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

1.2.1 Class I. For application with heated, plural component spray equipment.

1.2.2 Class II. For use with pneumatic application equipment, or with a suitable hand applicator in accordance with the manufacturer's technical data.

Comments, suggestions, or questions on this document should be addressed to Director, U.S. Army Research Laboratory, Weapons and Materials Research Directorate, Specifications & Standards Office, Attn: RDRL-WMM-C, Aberdeen Proving Ground, MD 21005-5069. Since contact information may 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

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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)

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-53022 - Primer, Epoxy Coating, Corrosion Inhibiting Lead and Chromate Free
 MIL-DTL-53030 - Detail Specification: Primer Coating, Epoxy, Water Based, Lead and Chromate Free
 MIL-DTL-53039 - Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant
 MIL-DTL-53072 - Chemical Agent Resistant Coating (CARC) System Application Procedures and Quality Control Inspection
 MIL-DTL-64159 - Detail Specification Coating, Water Dispersible Aliphatic Polyurethane, Chemical Agent Resistant

(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.

CODE OF FEDERAL REGULATIONS (CFR)

49 CFR 571, Standard No. 302 - Flammability of Interior Materials – Passenger Cars, Multipurpose Passenger Vehicles, Trucks, and Buses

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

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

AEROSPACE INDUSTRIES ASSOCIATION

AIA NAS411-1 - Hazardous Materials Target List

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

ASTM INTERNATIONAL

ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension cc
ASTM D570 - Standard Test Method for Water Absorption of Plastics
ASTM D1141 - Standard Practice for the Preparation of Substitute Ocean Water
ASTM D1654 - Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
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 - Standard Test Method for Chipping Resistance of Coatings
ASTM D3359 - Standard Test Methods for Measuring Adhesion by Tape Test
ASTM D4060 - Standard Test Method for the 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 F718 - Standard Specification for Shipbuilders and Marine Paints and Coatings Product/Procedure Data Sheet

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

GENERAL MOTORS CORPORATION

GMW14872 - Cyclic Corrosion Laboratory Test

(Copies of this document are available online at http://www.globalspec.com/industrial-directory/general_motors_engineering_standard.)

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SAE INTERNATIONAL

SAE-AMS-STD-595 - Colors Used in Government Procurement

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

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC-SP 1 - Solvent Cleaning
SSPC-SP 10 - Near-White Metal Blast Cleaning
SSPC-SP 16 - Brush-Off Blast Cleaning of Coated and Uncoated
Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
SSPC-PA 2 - Measurement of Dry Coating Thickness with Magnetic
Gages

(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.

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. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this specification.

3.2.1 Materials application. Class I materials shall be sprayable through a heated, plural component system. Class II materials shall be applied by manually-powered or pneumatic systems (see 3.2.4, 3.2.5, 4.4.3, and 4.4.4).

3.2.2 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)

3.2.2.1 Base component. The resin component shall contain a polyether-polyol based resin blend, polyamine or polyetheramine-based resin blend, or a combination of the two (for hybrid systems).

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The base resin shall be aliphatic or aromatic in nature. The polymeric resin used in resin components shall be 100 percent solids.

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

3.2.3 Storage stability.

3.2.3.1 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 3.3.11), hardness (see 3.3.12), gel time (see 3.2.4), tack-free time (see 3.2.5), and application properties (see 3.3.15).

3.2.3.2 Long term storage stability. When tested as specified in 4.4.2.2, the individual components of multi-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 3.3.11), hardness (see 3.3.12), gel time (see 3.2.4), tack-free time (see 3.2.5).

3.2.4 Gel time. When tested in accordance with 4.4.3, 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.

3.2.5 Tack-free time. When tested in accordance with 4.4.4, 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.

3.2.6 Toxicity. When evaluated in accordance with 4.4.5, the coating shall have no adverse effect on the health of personnel when used for its intended purpose (see 6.4).

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), the color of the coating shall be characteristic of black pigments or a charcoal color not lighter than color chip number 36099 of SAE-AMS-STD-595 (see 6.3.2 for extension colors).

3.3.2 Flame resistance. Coatings shall be flame resistant when evaluated in accordance with Federal Motor Vehicle Safety Standards and Regulations (FMVSSR), 49 CFR 571, Standard Number 302 for the burn rate requirement, and tested in accordance with 4.5.2.

3.3.3 Adhesion to primed substrate. The average pull-off adhesion shall be a minimum of 1200 pounds per square inch (psi) when tested in accordance with 4.5.3. Knife adhesion shall have a minimum rating of 8 with regard to the degree of removal difficulty, when tested in accordance with 4.5.3.

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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 4.5.4. 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 1200 psi when tested in accordance with 4.5.4. Tape test adhesion shall have an average rating of 4 or higher when tested in accordance with 4.5.4.

3.3.5 Chip resistance. Coatings shall have a rating of 10 when tested in accordance with 4.5.5.

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 4.5.6.

3.3.7 Tensile and Elongation properties.

3.3.7.1 Tensile strength. Tensile strength for coatings shall be 1200 psi minimum when prepared in accordance with 4.3.6 and tested in accordance with 4.5.7.

3.3.7.2 Elongation. Coatings shall meet 140 to 400 percent elongation when prepared in accordance with 4.3.6 and tested in accordance with 4.5.7.

3.3.8 Accelerated corrosion. When tested in accordance with 4.5.8, and when applied to steel, coatings shall have:

- a. A blistering size rating of 10 (no blistering) in accordance with ASTM D1654 and TT-C-490.
- b. No delamination of the coating from the underlying primer or topcoat.

3.3.9 Atmospheric corrosion resistance. When tested in accordance with 4.5.9, and when applied to steel, Class I shall have:

- a. A blistering size rating of 10 (no blistering) in accordance with ASTM D1654 and TT-C-490.
- b. No delamination of the coating from the underlying primer or topcoat.

3.3.10 Chemical resistance. Coatings appearance shall be in accordance with 3.3.16 and shall exhibit no softening failure when tested in accordance with 4.5.10. Softening failure shall be defined as any hardness value varying more than 5% from the average hardness at ambient conditions as defined in 3.3.12, and tested in accordance with 4.5.12.

3.3.11 Solvent resistance. When evaluated in accordance with 4.5.11, test panels 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 DFT measurement (per SSPC-PA 2) taken after the 25 MEK double rubs shall be within 5% of the average DFT measurement before the 25 MEK double rubs, in the area where the double rubs were performed.

3.3.12 Hardness. When evaluated in accordance with 4.5.12, the average hardness cured coatings shall be 35-65 Type D.

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3.3.13 Abrasion resistance. When evaluated in accordance with 4.5.13, coatings shall not lose more than 30 milligrams of material.

3.3.14 Water absorption. When tested and evaluated in accordance with 4.5.14, coatings shall display less than 1.2 percent water absorption.

3.3.15 Application properties. When tested in accordance with 4.5.15, coatings shall be able to be applied without any vertical sagging and shall conform to the requirements of 3.3.16.

3.3.16 Appearance. When prepared in accordance with 4.3.4 and 4.3.5, cured coatings shall have a uniform surface texture, free of sags, pits, blisters, or visual defects. The cured coating shall form a monolithic layer free of through-thickness porosity. Mild orange peel is acceptable with the Class I coatings. A stipple or textured finish may be used when required by contract or drawing. Visual acceptance criteria of these areas shall be determined by the drawing or procuring authority.

3.4 User instruction markings. All primary containers shall be legibly marked or labeled "Component A (resin component)" or "Component B (catalyst component)" as applicable, with the manufacturer's mixing instructions, the VOC content (in lbs/gal or g/l), HAP content and the following:

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

3.4.2 Instructions for use label. INSTRUCTIONS FOR USE: For MIL-DTL-53022 primers, mix component A well; then add 1 part by volume of component B to 4 parts by volume of component A and mix well. If thinning is required for spray application, for MIL-DTL-53022 type II primer, consult with the manufacturer of the primer for the appropriate thinner to stay within the regulatory limits. For thinning the type MIL-DTL-53022 III or IV primers, follow the manufacturer's instructions. The solvents used shall be HAP-free material and stay within the regulatory VOC limits. The admixed coating may require a 30 minute induction time before use. Follow the manufacturer's recommendations. During spray application, avoid inhalation and eye or skin contact.

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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 3.1 and 6.3). The qualification test sample shall consist of five (5) gallon kits of material for Class I, or 750 milliliter for Class II. The samples shall be legibly identified (see 6.3.1). 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 3.4). 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 coating represented by the sample test shall not be approved for inclusion in the QPD under this specification. Conditional approval shall be given until completion of the atmospheric corrosion resistance test (see 4.5.9). Upon completion of this test, then final approval shall be given. When specified in the contract or purchase order (see 6.2), a test report will be provided.

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). The contractor shall be responsible for compliance with all the provisions of the contract and for furnishing specific supplies and services which meet all the requirements of the contract. Conformance inspection shall consist of specific tests as specified in Table I. There shall be no failures (see 6.5).

4.3.1 Lot. The addition of any substance that was not present in the qualification sample requires requalification. 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 verification testing shall be forwarded to ARL if required.

4.3.3 Noncompliance. If a sample fails to pass its conformance inspection, the lot shall be rejected. Further guidance for noncompliant samples shall be specified in the contract or purchase order (see 6.2) and is described in 6.5.

4.3.4 Test panels and surface preparation. Unless otherwise specified herein, test panels shall be SAE 1008 – 1010 carbon steel. Test panels shall be degreased in accordance with SSPC-SP 1 or Methods II, III, IV, VI, or VII in TT-C-490. 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 1.0 to 1.5 mils (25.4 to 38.1 microns) on both sides per SSPC-SP 10 for steel, as appropriate unless otherwise specified.

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4.3.5 Coated test panels. Panels shall be primed on both sides with MIL DTL 53022 or MIL-DTL-53030 in accordance with MIL-DTL-53072 to a dry film thickness of 1.5 ± 0.2 mils (37.5 ± 5 microns) per when measured in accordance with SSPC-PA 2. Allow to cure in controlled laboratory conditions (77 ± 10 °F and 40-60 percent relative humidity) for a minimum of 24 hours or as specified by the manufacturer. Class I coatings shall be spray-applied with a monolithic layer to a thickness as specified by manufacturer. 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 as specified by manufacturer. The panels shall be cured according to manufacturer's instructions.

4.3.6 Free films. Free films shall be prepared at a cured film thickness as specified by manufacturer. 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 stated in this specification, 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 4.5.5), and impact resistance (see 3.3.6 and 4.5.6) shall be conducted at controlled laboratory conditions where sample set conditioning shall be for a period of 90 minutes, or as specified by manufacturer. 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 I.

4.4.1 Chemical composition. The coating shall be verified and documented 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 3.2.3.1. After this conditioning period, the final product shall be prepared in accordance with manufacturer's instructions and tested for conformance with 3.2.3.1. The sample size shall be a 5-gallon kit for Class I and 750-milliliter kit for Class II.

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 standard 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. See 3.2.3.

4.4.3 Gel time. A 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.

4.4.4 Tack-free time. One steel test panel shall be prepared in accordance with 4.3.4. A Class I coating shall be applied to the test panel and allowed to set to gel condition (4.4.3). Mild thumb

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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 be defined as the tack-free time.

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

4.5 Performance tests on applied coatings.

4.5.1 Color. Color shall be tested visually and shown to be characteristic of black pigments and not lighter than color chip number 36099 of SAE-AMS-STD-595 (see 3.3.1).

4.5.2 Flame resistance. Sample shall be prepared in accordance with 4.3.6. The coatings shall be tested in accordance with Federal Motor Vehicle Safety Standards and Regulations (FMVSSR), 49 CFR 571, Standard No. 302, and meet the requirements of 3.3.2.

4.5.3 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 mm (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. See 3.3.3.

4.5.4 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 24 hours cure for the coating, a minimum 1.8 mils coating of MIL-DTL-53039 or MIL-DTL-64159 shall be spray-applied in Tan 686A in accordance with MIL-DTL-53072, and shall cure under standard laboratory conditions (see 4.3.5), observing a minimum cure time of 168 hours. 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 (see 3.3.4). 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.

4.5.5 Chip resistance. Three (3) steel test panels of appropriate dimensions, 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, with the test panel positioned at a 90° angle to the gravelometer nozzle, and evaluated for penetration of coating damage to the substrate (see 3.3.5).

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TABLE I. Requirements and testing.

Item	Ref	Class I			Class II		
		Qualification testing required	Conformance testing required	Test reference paragraph	Qualification testing required	Conformance testing required	Test reference paragraph
Accelerated storage stability	3.2.3.1	YES	NO	4.4.2.1	YES	NO	4.4.2.1
Long term storage stability	3.2.3.2	YES	NO	4.4.2.2	YES	NO	4.4.2.2
Gel time	3.2.4	YES	YES	4.4.3	YES	YES	4.4.3
Tack-free time	3.2.5	YES	YES	4.4.4	YES	YES	4.4.4
Toxicity	3.2.6	YES	NO	4.4.5	YES	NO	4.4.5
Color	3.3.1	YES	YES	4.5.1	YES	YES	4.5.1
Flame resistance	3.3.2	YES	NO	4.5.2	YES	NO	4.5.2
Adhesion to primed substrate	3.3.3	YES	YES	4.5.3	YES	NO	4.5.3
CARC overcoat adhesion	3.3.4	YES	YES	4.5.4	YES	YES	4.5.4
Chip resistance	3.3.5	YES	NO	4.5.5	YES	NO	4.5.5
Impact resistance	3.3.6	YES	NO	4.5.6	YES	NO	4.5.6
Tensile strength	3.3.7.1	YES	NO	4.5.7	YES	NO	4.5.7
Elongation	3.3.7.2	YES	NO	4.5.7	YES	NO	4.5.7
Accelerated corrosion	3.3.8	YES	NO	4.5.8	YES	NO	4.5.8
Atmospheric corrosion	3.3.9	YES	NO	4.5.9	YES	NO	4.5.9
Chemical resistance	3.3.10	YES	NO	4.5.10 4.5.12 4.5.16	YES	NO	4.5.10
Solvent resistance	3.3.11	YES	YES	4.5.11	YES	YES	4.5.11
Hardness	3.3.12	YES	YES	4.5.12	YES	YES	4.5.12
Abrasion resistance	3.3.13	YES	NO	4.5.13	YES	NO	4.5.13
Water absorption	3.3.14	YES	NO	4.5.14	YES	NO	4.5.14
Application properties	3.3.15	YES	YES	4.5.15	YES	YES	4.5.15
Appearance	3.3.16	YES	YES	4.5.16	YES	YES	4.5.16

4.5.6 Impact resistance. A total of six (6) steel test panels of appropriate dimensions and minimum thickness of 24-gage (0.025 in. or 0.63 mm) shall be prepared in accordance with SSPC-SP 10 and 4.3.5, and conditioned in accordance with 4.3.7. 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 the requirements of ASTM D2794. Five impact measurements shall be taken for each tested panel. Examination for coating failure shall be in accordance with ASTM D2794 (see 3.3.6).

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4.5.7 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 die listed in Figure 2. Samples shall be tested in accordance with ASTM D412, Method A, and analyzed for tensile strength and elongation at rupture (see 3.3.7).

4.5.8 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 as specified in GMW14872 for a duration of 30 cycles. Each panel shall be evaluated and rated for any visible corrosion in accordance with 3.3.8.

4.5.9 Atmospheric corrosion resistance. Five test panels shall be prepared in accordance with 4.3.4 and 4.3.5. The samples shall be subjected to 2 years of outdoor exposure on the ARL test site at Cape Canaveral Air Force Station, or equivalent beach site with mass loss greater than or equal to 1.5MPY. Upon completion of the 2 year exposure, specimen/coupons shall be field evaluated, then returned to ARL for a final evaluation. Each panel shall be evaluated and rated for any visible corrosion in accordance with 3.3.9. Nonconformance shall constitute failure of this test.

4.5.10 Chemical resistance. Prepare two test panels in accordance with 4.3.4 and 4.3.5. Three- to five-milliliter (ml) 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 room temperature. The watch glass shall then be removed and the spots rinsed thoroughly with deionized water, allowed to dry, and examined for changes in appearance to include blistering, wrinkling and softening. The evaluation of blistering and wrinkling and any other resulting defects shall be a visual determination via the unaided eye (see 3.3.10 and 3.3.16). 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 (conforming to ASTM D1141)
- d. Oils (motor oil SAE 5W-30)
- e. Oxidizers (3 percent by volume hydrogen peroxide)

4.5.11 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 (see 3.3.11).

4.5.12 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 (See 3.3.12).

4.5.13 Abrasion resistance. Two (2) steel test panels prepared in accordance with 4.3.4 and 4.3.5 and tested in accordance with ASTM D4060 using a CS17 wheel set and 1000 grams of weight. The test shall be run for 1000 cycles and wheels shall be resurfaced every 500 cycles. Results shall be quantified as milligram weight loss per 1000 cycles (See 3.3.13). Samples may be pre-conditioned by smoothing until one uniform ring is visually evident on the coating surface, to eliminate any roughness, if needed.

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4.5.14 Water absorption. Two samples shall be prepared in accordance with ASTM D570, section 5.3. 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, section 6.1.1, 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 (See 3.3.14).

4.5.15 Application properties. One steel test panel shall be prepared in accordance with 4.3.4 and primed on both sides with MIL-DTL-53022 or MIL-DTL-53030 to a dry film thickness of 1.5 ± 0.2 mils (37.5 ± 5 microns) per SSPC-PA 2. A 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 as specified by manufacturer. Regardless of any manufacturer's recommendation to the contrary, maximum application time shall be 3 minutes. After tack-free conditions have been met (see 4.4.4), a visual inspection shall be performed.

4.5.16 Appearance. After preparation in accordance with 4.3.4 and 4.3.5, test specimen panels shall be visually inspected to verify a uniform surface texture, free of sags, pits, blisters, or other objectionable defects (3.3.16). The cured coating shall form an adherent monolithic layer free of through-thickness porosity with mild orange peel acceptable on Class I coatings. Stippled or textured finishes when required by contract or drawing shall be visually examined to verify specific visual acceptance criteria determined by the drawing or procuring authority.

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

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floors, and abrasion-prone vehicle exterior surfaces such as wheel wells, undercarriages, footsteps, equipment storage areas and beds for tactical, combat, and construction equipment.

6.1.1 Compositions. This coating may be formulated from chemicals such as polyurethane, polyurea, and a combination of polyurea and polyurethane (hybrid coating). Regardless of chemistry, the coating should not contain any hazardous TDI or any free monomers of MDI or its most common isomers 2,2', 2,4', and 4,4' MDI or HDI. The coating should be aromatic or aliphatic in nature.

6.1.2 Equipment. The material may 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. Class (see 1.2).
- c. The color if not commercially available black. (see 3.3.1, 4.5.1, and 6.3.2).
- d. When a test report is to be provided (see 4.2).
- 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), if different.
- g. Packaging requirements (see 5.1 and 6.6).

6.3 Qualification. With respect to products requiring qualification, awards should be made only for products that 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. The activity responsible for the qualified products list is Director, U.S. Army Research Laboratory, Weapons and Materials Research Directorate, Specifications & Standards Office, Attn: RDRL-WMM-C, Aberdeen Proving Ground, MD 21005-5069. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.dla.mil>.

6.3.1 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-32440; Class _____, Color _____,
- “COATINGS, CHIP-, IMPACT-, WEAR-, AND ABRASION-RESISTANT”.
- Provide a copy of the MSDS.
- Provide a copy of the notarized statement of composition.

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Provide a copy of the technical data sheet.
Provide a copy of the test report.

6.3.2 Extension of Qualification for Color. Qualification of the black sample as referenced in 3.3.1 should extend to all other colors that may be required under this specification. The Qualified Products Database (QPD) for this specification should only list the black sample.

6.4 Toxicity evaluation. 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, APGEA, MD 21010-5403 or emailed to usaphctepinfo@amedd.army.mil.

6.5 Noncompliance. If a sample fails to pass its conformance inspections, the lot should be rejected and 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, suitable to 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
- b. Class II coatings:
 - 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 I, Class 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 DoD 4140.27-M, *Shelf-life Management Manual*. The shelf-life codes are in the Federal Logistics Information System Total Item Record. Additive information for shelf-life management may be obtained from DoD 4140.27-M, or the designated shelf-life Point 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 should be contacted through the DoD Shelf-Life Management website: <https://www.shelflife.hq.dla.mil/>.

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6.8 Accelerated corrosion. The target mass loss range for a properly calibrated cyclic chamber performing GMW14872, Exterior, 4 sprays/cycle, Exposure C is 3660 - 4220 mg at 26 ± 3 cycles on a standardized 3.18mm steel mass loss coupon (see 4.5.8).

6.9 Subject term (key word) listing.

- Abrasion protection
- Corrosion protection
- Durable
- Impact protection
- Isocyanate
- Polyurea
- Polyurethane
- Quality program

6.10 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.

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CONCLUDING MATERIAL

Custodians:

Army - MR
Navy - MC
Air Force - 20

Preparing Activity:

Army - MR
(Project 8010-2019-001)

Review Activities:

Army - AV, MI, TE
Navy - AS, CG, SH
Air Force - 02
GSA - FAS
DLA - CQ

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