

INCH-POUND

MIL-PRF-32440

28 February 2013

PERFORMANCE SPECIFICATION

COATINGS, CHIP-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-resistant coatings for use on areas of military vehicles or ground support equipment which may encounter wear and abrasion. Examples of subject areas are bed liners and cargo beds of trucks, undercarriages of ground support equipment, and other areas subject to abrasion and wear, which may abrade original equipment manufacturer (OEM) and traditional coatings.

1.2 Classification. Chip-resistant coatings are of the following types as specified (see 6.2).

a. Type I. 100 percent solids, two-component lining (polyurethane, polyurea, hybrid polyurethane/polyurea) for primary use in plural component spray equipment for a rapid return-to-service.

b. Type II. 100 percent solids, two-component lining (polyurethane, polyurea, hybrid polyurethane/polyurea) for primary use in touch-up or seam sealing applications for shop and field use.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

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 STANDARDS

FED-STD-595	-	Colors Used in Government Procurement
FED-STD-595/27038	-	Miscellaneous Flat or Lusterless (Black)

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-53030	-	Primer Coating, Epoxy, Water Based, Lead and Chromate Free
MIL-DTL-64159	-	Camouflage Coating, Water Dispersible Aliphatic Polyurethane, Chemical Agent Resistant

(Copies of these documents are available online at <http://quicksearch.dla.mil/> or <https://assist.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.

Comments, suggestions, or questions on this document should be addressed to the Marine Corps Systems Command, ATTN: SIAT - PM-CPAC, 2200 Lester Street, Quantico, VA 22134 or emailed to commandstandards@navy.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>.

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CODE OF FEDERAL REGULATIONS (CFR)

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

(Copies of this document are available from the Superintendent of Documents, U.S. Government Printing Office, Washington DC 20401 or 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 online at the Marine Corps Publications website at <https://pubs.ala.usmc.mil/front.htm> or by emailing commandstandards@navy.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.

ASTM INTERNATIONAL

ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic
Elastomers – Tension

ASTM D522 - Standard Test Methods for Mandrel Bend Test of Attached Organic
Coatings

ASTM D570 - Standard Test Method for Water Absorption of Plastics

ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel
Surfaces

ASTM D714 - Standard Test Method for Evaluating Degree of Blistering of Paints

ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheet

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 D1729 - Standard Practice for Visual Appraisal of Colors and Color Differences
of Diffusely-Illuminated Opaque Materials

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

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(Copies of these documents are available from ASTM International, 100 Barr Harbor Dr., P.O. Box C700, West Conshohocken, PA 19428-2959 or online at www.astm.org.)

GENERAL MOTORS CORPORATION

GMW14872 - Cyclic Corrosion Laboratory Test

(Copies of this document are available from General Motors Corporation c/o Global Engineering Documents, 15 Inverness Way East, Inglewood, CO 80112.)

SAE INTERNATIONAL

SAE J400 - Test for Chip Resistance of Surface Coatings

(Copies of this document are available from SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or online at www.sae.org.)

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP-1 - Solvent Cleaning

SSPC PA-2 - Measurement of Dry Coating Thickness with Magnetic Gages

(Copies of these documents are available from SSPC Publication Sales, 40 24th Street, 6th Floor, Pittsburgh, PA 15222-4656 or online at www.sspc.org.)

UNDERWRITERS LABORATORIES, INC. (UL)

UL 94 - Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

(Copies of this document are available from COMM 2000, 151 Eastern Avenue, Bensenville, IL 60106 or online at www.comm-2000.com.)

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-resistant coating that satisfies all of the requirements of this specification. The composition of the coatings/compounds furnished under this specification shall be the responsibility of the manufacturer, except as limited by this specification.

3.2.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable 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. Type I materials shall be sprayable using standard plural component equipment equipped with in-line heaters (see 3.3.19 and 4.4.20). Type II materials shall be applied by cartridge or trowel for repair and touch-up applications (see 3.3.17, 3.3.18, 4.4.18, and 4.4.19).

3.2.3 Chemical composition. The chip-resistant coating 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 the USMC Painting Technical Manual 4750-OD/1.

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3.2.3.1 Base component. Types I and II coatings 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 can be aliphatic or aromatic in nature. The polymeric resin used in Type I and II base components shall be 100 percent solids.

3.2.3.2 Isocyanate component. Types I and II material shall be methylene di-isocyanate (MDI) or its most common isomers 2,2', 2,4', and 4,4' MDI or hexa-methylene di-isocyanate (HDI). Regardless of chemistry, the coating cannot contain any hazardous toluene di-isocyanate (TDI) or more than 0.5 percent free monomers of MDI or its most common isomers 2,2', 2,4', and 4,4' MDI or free monomers of HDI. The coating shall be aromatic or aliphatic in nature. The polymeric resin used in Type I and II isocyanate components shall be 100 percent solids.

3.2.3.3 Characteristics of the mixed components. The characteristics of the mixed components (base and isocyanate) shall meet the requirements of 3.3.

3.2.4. Storage stability.

3.2.4.1 Accelerated storage stability. When tested as specified in 4.4.2.1, the two individual components of the final product shall show no curdling or hardening, and any sedimentation or material separation shall be easily mixed back into a smooth homogeneous state. After the specified conditioning period, the admixed coating shall meet the requirements for solvent resistance (see 3.3.13), hardness (see 3.3.14), gel time (see 3.3.17), tack-free time (see 3.3.18), and application properties (see 3.3.19).

3.2.4.2 Long term storage stability. When tested as specified in 4.4.2.2, the two individual components of the final product shall show no curdling or hardening, and any sedimentation or material separation shall be easily mixed back into a smooth homogeneous state. After the specified conditioning period, the admixed coating shall meet all the requirements of this specification.

3.2.5 Toxicity. When evaluated in accordance with 4.4.14 [the Health Hazard Assessment (HHA)], the coating shall have no adverse effect on the health of personnel when used for its intended purpose (see 4.4.14 and 6.4).

3.3 Performance. The performance of the sprayed coating (Type I) and repair compound (Type II) shall be as follows.

3.3.1 Color. The sprayed-on coating (Type I) and repair compound (Type II) shall be in accordance with FED-STD-595, as specified (see 6.2). Property values listed in this specification are tested to black color 27038.

3.3.2 Flame resistance. The coating shall be flame resistant when evaluated in accordance with 4.4.4.

3.3.3 Adhesion to steel and aluminum.

3.3.3.1 Type I. The pull-off adhesion after 24 hours cure shall be minimum 2000 pounds per square inch (psi) when tested in accordance with 4.4.5. X-cut tape adhesion shall have a rating of 5A over steel and aluminum as measured in accordance with 4.4.5.

3.3.3.2 Type II. The pull-off adhesion after 24 hours cure shall be minimum 2000 psi, in accordance with 4.4.5, depending on substrate. X-cut tape adhesion shall have a rating of 5A over steel and other suitable substrates as measured in accordance with 4.4.5.

3.3.4 CARC overcoat adhesion. CARC topcoat shall show good adhesion and compatibility when applied over cured Type I sprayed chip-resistant coating and Type II repair chip-resistant compound, when prepared and tested as specified in 4.4.6. The appearance of the CARC shall not delaminate, wrinkle, or show evidence of holidays after being applied to the Type I and Type II compounds. Adhesion shall be 4A or better when tested in accordance with 4.4.6.

3.3.5 Operational temperature range. The operational temperature range required shall be -40 to +180 °F for both Type I coatings and Type II repair compounds for continual exposure (see 4.3.7, 4.4.7, 4.4.8, and 4.4.10).

3.3.6 Chip resistance. The coating shall not display evidence of any penetration to aluminum or steel substrates when tested as specified in 4.4.7 and prepared in accordance with 4.3.5. This is equivalent to a Rating 10 in accordance with visual standards of ASTM D3170, section 8.

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3.3.7 Impact resistance. The coating shall exhibit no cracking when tested using the 0.625-inch hemispherical head steel punch at 50 inch-pounds direct and at 25 inch-pounds reverse impact in accordance with 4.4.8.

3.3.8 Mandrel flexibility. A 0.050-inch free-film of both Type I and Type II material shall demonstrate no cracking, crazing, or deformation when bent over a 0.25-inch mandrel when prepared in accordance with 4.3.6 and tested in accordance with 4.4.9.

3.3.9 Tensile and flexural properties.

3.3.9.1 Flexural modulus. The flexural modulus for both Types I and II shall be a minimum of 900 psi when prepared as in 4.3.6 and tested in accordance with 4.4.10.

3.3.9.2 Elongation. The elongation shall meet 180 to 400 percent when prepared in accordance with 4.3.6 and tested in accordance with 4.4.10.

3.3.9.3 Tensile strength. The tensile strength for Type I and II coatings shall be 1200 psi minimum when prepared in accordance with 4.3.6 and tested in accordance with 4.4.10.

3.3.10 Accelerated corrosion. When tested in accordance with 4.4.11, and when applied to both steel and aluminum, both Types I and II shall have:

- a. A scribe creep rating of 9 in accordance with ASTM D1654, Procedure A,
- b. A rust grade rating of 10 in accordance with ASTM D610, and
- c. A blistering size rating of 10 in accordance with ASTM D714.

Both Types I and II shall exhibit no scribe creep, no corrosion and no undercutting away from the scribe, and no blistering.

3.3.11 Appearance. When evaluated in accordance with 4.4.20, the cured coating shall have a uniform surface texture, free of sags, pits, blisters, or visual defects. The cured coating shall form a monolithic layer free of porosity. Mild orange peel is acceptable with the Type I sprayed-on coating.

3.3.12 Chemical resistance. The Type I coating and Type II repair compound shall show no blistering, wrinkling, or softening when tested in accordance with 4.4.12.

After 24 hours of air drying, the portion of the panel that was exposed shall be indistinguishable with regard to adhesion and general appearance from a panel prepared at the same time but not immersed.

3.3.13 Solvent resistance. When evaluated in accordance with 4.4.13, the coating shall have no evidence of breakdown after exposure to 25 methyl ethyl ketone (MEK) double rubs. Breakdown is defined as a dramatic lifting of pigments.

3.3.14 Hardness. When evaluated in accordance with 4.4.15, the average hardness of Type I and II materials shall be 55-65 Type D.

3.3.15 Abrasion resistance. When evaluated in accordance with 4.4.16, the coating shall not lose more than 30 milligrams of material.

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

3.3.17 Gel time. When tested in accordance with 4.4.18, the Type I coatings shall have a maximum gel time of 15 seconds, and Type II repair compounds shall have a maximum gel time of 5 minutes.

3.3.18 Tack-free time. When tested in accordance with 4.4.19, the Type I coatings shall have a maximum tack-free time of 180 seconds. The Type II repair compounds shall have a maximum tack-free time of 30 minutes.

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3.3.19 Application properties. When tested in accordance with 4.4.20, Type I and II coatings shall be able to be applied up to 0.050-inch thickness without any vertical sagging. Surfaces shall be glossy and smooth. Mild orange peel is acceptable for Type I. No wrinkling, voids, through-thickness porosity, blisters, cracks, or other defects shall be observed.

3.3.20 Minimum dry film thickness. The Type I coating shall be able to be built up to a minimum of 0.125 inch in consecutive multiple passes when tested in accordance with 4.4.21. Type II coatings can be trowel applied in lieu of spraying.

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 tests as specified in [table I](#). The products tested shall be materials drawn from regular production stocks and shall consist of enough component materials (i.e., resin and isocyanate component) to create 1 gallon of the final mixed coating. When specified (see 6.2), a test report will be provided. Testing of products on government platforms shall be conducted at the convenience of the government.

4.2.1 Formulation changes. Any changes in formulation, ingredients, manufacturing processes, or manufacturing locations shall be approved by the Marine Corps.

4.3 Conformance inspection. The conformance inspection shall be performed on each production batch and the results will 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 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. If it is required, two representative packaged samples (four samples for plural component systems) shall be forwarded to a designated laboratory for verification tests. 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 Contracts Management Agency (DCMA).

4.3.3 Noncompliance. If a sample fails to pass its conformance inspections, 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 inches plate aluminum or cold rolled steel. Test panels shall be degreased in accordance with SSPC SP-1. The degreased test panels shall be abrasive blasted with new, clean aluminum oxide to provide an average profile of 0.0015 to 0.0020 inch on both sides. Both sides of the panels shall be primed with MIL-DTL-53030 water-reducible epoxy to a dry film thickness of 0.0025 to 0.0030 inches and allowed to cure in laboratory conditions (approximately 77 °F and 50 percent relative humidity) for a minimum of 24 hours.

4.3.5 Coated test panels. Panels shall be prepared in accordance with 4.3.4 and spray-applied with a monolithic layer of Type I coating to a nominal thickness of 0.050 inch. Coating surface shall be flat with no surface irregularities such as orange peel. A single pass or multiple passes is acceptable. The panels shall be cured according to manufacturer's instructions.

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4.3.6 Free films. Free films of coatings shall be prepared by spray applying a nominal thickness of coating (0.020 to 0.050 inch) to a release paper. After proper cure time, the coating shall be separated from the release paper and allowed to cure for a minimum of 24 hours at laboratory conditions. For Type II repair compounds, a draw down or trowel application approximating 0.050 inch shall be performed. For flexibility and elongation test specimen preparation, see 4.4.10.

4.3.7 Sample conditioning procedures. Unless otherwise stated in this specification, all test samples shall be prepared and tested at laboratory conditions (see 4.3.4). In addition, tests used to verify operational temperature range—chip resistance (see 3.3.6 and 4.4.7), impact resistance (see 3.3.7 and 4.4.8), and mandrel flexibility (see 3.3.8 and 4.4.9)—shall also be conditioned between 90 and 120 minutes at temperatures of both -40 °F and 180 °F. Following this conditioning, samples shall be removed to laboratory conditions and testing shall be initiated within 60 seconds.

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

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TABLE I. Requirements and testing.

Item	Ref	Type I (sprayed coating)			Type II (repair compound)		
		Qualification testing required	Conformance testing required	Test reference paragraph	Qualification testing required	Conformance testing required	Test reference paragraph
Materials dispensing	3.2.2	YES	YES	4.4.20	YES	YES	4.4.18 4.4.19
Storage stability	3.2.4	YES	NO	4.4.2	YES	NO	4.4.2
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 steel and aluminum	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	3.3.6	YES	NO	4.4.7	YES	NO	4.4.7
Impact resistance	3.3.7	YES	NO	4.4.8	YES	NO	4.4.8
Mandrel flexibility	3.3.8	YES	NO	4.4.9	YES	NO	4.4.9
Flexural modulus	3.3.9.1	YES	NO	4.4.10	YES	NO	4.4.10
Elongation	3.3.9.2	YES	NO	4.4.10	YES	NO	4.4.10
Tensile strength	3.3.9.3	YES	NO	4.4.10	YES	NO	4.4.10
Accelerated corrosion	3.3.10	YES	NO	4.4.11	YES	NO	4.4.11
Chemical resistance	3.3.12	YES	NO	4.4.12	YES	NO	4.4.12
Solvent resistance	3.3.13	YES	YES	4.4.13	YES	YES	4.4.13
Toxicity	3.2.5	YES	NO	4.4.14	YES	NO	4.4.14
Hardness	3.3.14	YES	YES	4.4.15	YES	YES	4.4.15
Abrasion resistance	3.3.15	YES	NO	4.4.16	NO	NO	---
Water absorption	3.3.16	YES	NO	4.4.17	NO	NO	---
Gel time	3.3.17	YES	YES	4.4.18	YES	YES	4.4.18
Tack-free time	3.3.18	YES	YES	4.4.19	YES	YES	4.4.19
Application properties	3.3.19	YES	YES	4.4.20	N/A	N/A	---
Minimum dry film thickness	3.3.20	YES	NO	4.4.21	YES	NO	4.4.21

4.4.1 Chemical composition. The coating shall be verified and documented to be VOC free. The isocyanate component 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 49 ± 1 °C (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 the conditioning period, the two components shall be mixed together 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 Type I and 750 milliliter kit for Type II.

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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 4.3.4 for 12 months. The sample size shall be a 5-gallon kit for Type I and 750 milliliter kit for Type II.

4.4.3 Color. Color shall be determined by visual color match (see 3.3.1 and 6.2) in accordance with ASTM D1729.

4.4.4 Flame resistance. The candidate coatings and repair compounds shall be tested in accordance with the Federal Motor Vehicle Safety Standards and Regulations (FMVSSR), 49 CFR 571, Standard No. 302 and meet the requirements of 3.3.2 for a self-extinguishing (SE) rating. Alternatively, both Type I and Type II coatings can be tested in accordance with UL 94 Vertical Burn Test, and pass with a 94V-0 rating, vertical burn test requirements (self-extinguishing in less than 10 seconds with no flaming drips).

4.4.5 Adhesion to steel and aluminum. One steel and one aluminum test panel shall be prepared in accordance with 4.3.4. Approximately 0.050 inch of Type I coating shall be spray-applied in a single or multiple passes and allowed to cure in accordance with manufacturer's instructions, observing a minimum cure time of 24 hours. An adhesion test shall be performed in accordance with ASTM D4541, using a minimum of three adhesion dollies per panel. (Mechanical scoring around the dollies to the substrate is required.) In the remaining area on the panel, an adhesion test shall be performed in accordance with ASTM D3359, Method A (X-cut).

4.4.6 CARC overcoat adhesion. Two steel and two aluminum test panels shall be prepared in accordance with 4.3.4. Approximately 0.050 inch of Type I coating shall be spray-applied in a single or multiple passes to one aluminum and one steel panel, and allowed to cure in accordance with manufacturer's instructions, observing a minimum cure time of 24 hours. Approximately 100 grams of the Type II compound shall be mixed and trowel-applied to the primed panels to a thickness of approximately 0.125 inch and allowed to cure for 24 hours minimum. After 24 hours cure for both the Type I and Type II compounds, a 2 to 3 mil coating of MIL-DTL-64159 shall be spray-applied in a contrasting color to the coating specified herein and shall cure according to the manufacturer's recommended instructions under standard laboratory conditions (see 4.3.4). The coating shall be evaluated in accordance with ASTM D3359, Method A (X-cut), with the cut made through the topcoat only.

4.4.7 Chip resistance. Test panels 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 or SAE J400 and evaluated for penetration of coating damage to the substrate. Note that if panel dimensions specified in 4.3.4 are not compatible with the gravelometer apparatus, then alternate panel sizes appropriate for the apparatus may be used.

4.4.8 Impact resistance. Test panels shall be prepared and conditioned in accordance with 4.3.4, 4.3.5, and 4.3.7. For each condition of 4.3.7, triplicate coating samples shall be prepared and tested and in accordance with ASTM D2794. The value at which no cracking in the impact zone occurs for both direct impact and reverse impact shall be recorded as the accepted data point.

4.4.9 Mandrel flexibility. Free film samples shall be prepared, cured, and conditioned in accordance with 4.3.6 and 4.3.7. The conditioned free films shall be bent over a 0.25 inch mandrel as specified in ASTM D522, Method B, and examined immediately for defects. Both Type I and Type II materials shall conform to the requirements of 3.3.8.

4.4.10 Tensile and flexural properties. Triplicate samples of candidate coatings shall be prepared as 0.050 inch free films in accordance with 4.3.6. Die cut specimens, nominally 1 inch by 6 inches, shall be prepared and measured for uniformity. Samples shall be run using a Universal Testing Machine type tensionometer in accordance with ASTM D412 (tensile properties) or ASTM D882 (flexural properties), and analyzed for tensile strength and elongation at rupture. Results shall be in accordance with 3.3.9.

4.4.11 Accelerated corrosion. Ten replicate coating samples per coating shall be prepared in accordance with 4.3.4. A single 6-inch line, exposing the metallic substrate, shall be scribed diagonally across the coated surface of each panel. The samples shall be subjected to cyclic accelerated corrosion cabinet testing as specified in GMW14872 for a duration of 40 cycles. Each panel shall be evaluated and rated for any visible corrosion in accordance with GMW14872 and ASTM D1654.

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4.4.12 Chemical resistance. Using a test panel prepared in accordance with 4.3.4, a 20 mil sample of chip-resistant coating shall be spray-applied and cured for at least 24 hours. A 3- to 5-milliliter (ml) spot of a 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 water, allowed to properly dry, and examined for blistering and softening. The candidate coating shall meet the following conditions:

- a. Mild acid (10 percent sulfuric acid)
- b. Mild caustics (1 percent sodium hydroxide)
- c. Seawater (natural or synthetic conforming to ASTM D1141)
- d. Oils (motor oil)
- e. Oxidizers (3 percent hydrogen peroxide)

4.4.13 Solvent resistance. Two steel and two aluminum test panels shall be prepared in accordance with 4.3.4. Approximately 0.050 inch of Type I coating shall be spray-applied in a single or multiple passes to one aluminum and one steel panel and allowed to cure in accordance with manufacturer's instructions, observing a minimum cure time of 24 hours. On separate panels, approximately 100 grams of the Type II compound shall be mixed and trowel-applied to the primed panels to a thickness of approximately 0.125 inch and allowed to cure for 24 hours. MEK solvent resistance shall be evaluated in accordance with ASTM D5402, Method A.

4.4.14 Toxicity. A Health Hazard Assessment shall be conducted to ensure conformance to 3.2.5, as required by the qualifying activity. The Navy and Marine Corps Public Health Center (NMCPHC) will evaluate the coating using the administrative Health Hazard Assessment (HHA) data provided by the manufacturer/distributor to the NMCPHC.

4.4.15 Hardness. Approximately 0.050 inch of Type I coating shall be spray-applied in a single or multiple passes to one steel panel and allowed to cure in accordance with manufacturer's instructions, observing a minimum cure time of 24 hours. After 24 hours minimum cure, the specimen shall be measured for Shore D hardness on a flat surface in accordance with ASTM D2240. Five random readings shall be made. Each reading shall be recorded one second after the pressure foot of the Durometer is in firm contact with the surface of the compound. For Type II repair compounds, freshly prepared compound, mixed in accordance with manufacturer's instructions, shall be placed into small (1.5 to 2.5 inches) diameter flat-bottom disposable aluminum foil cups. After 24 hours minimum cure, the Shore D hardness shall be measured by peeling away the aluminum foil on the flat bottom surface in accordance with ASTM D2240. Five random readings shall be made. Each reading shall be recorded one second after the pressure foot of the Durometer is in firm contact with the surface of the compound.

4.4.16 Abrasion resistance. Abrasion resistance shall be measured in accordance with ASTM D4060 using a CS17 Wheel and 1000 grams of weight. The test shall be run for 1000 cycles. Results shall be quantified as milligram weight loss per 1000 cycles. Samples may be pre-conditioned by smoothing to eliminate any roughness, if needed.

4.4.17 Water absorption. Two 2.0-inch diameter discs (at 0.250-inch thickness) shall be prepared as a free film or in a mold and allowed to cure for 24 hours. Samples shall be immersed in distilled water at 75 °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. The candidate coatings shall meet the requirements as specified in 3.3.16.

4.4.18 Gel time. Type I coatings shall be freshly spray-applied to any substrate panel and continually probed with a toothpick at 1 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 (see 3.3.17). Similarly, Type II repair compounds shall be troweled onto any substrate and tested as described above.

4.4.19 Tack-free time. Type I coatings shall be freshly spray-applied to any substrate panel and allowed to set. After a reasonable cure, mild thumb pressure on a thin polyethylene sheet, placed between the thumb and coating, shall be applied. The time required for the coating material to no longer stick to the polyethylene sheet shall be defined as the tack-free time. Coatings shall meet the requirements of 3.3.18. Similarly, Type II repair compounds shall be troweled onto any substrate and tested as described above.

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4.4.20 Application properties. Type I and II coatings shall be applied as specified by the manufacturer's recommended parameters and equipment to any substrate held vertically and sprayed to a nominal built-up thickness of 0.050 inch. After tack-free conditions have been met (see 4.4.19), a visual inspection shall be performed to verify that the appearance of the coating conforms to the requirements as specified in 3.3.11 and 3.3.19.

4.4.21 Minimum dry film thickness (DFT). Type I coatings shall be sprayed in accordance with the manufacturer's recommended parameters to primed steel and aluminum substrates as specified in 4.3.4. Three panels shall be sprayed with the candidate coating. Multiple passes shall be applied in order to achieve a final uniform dry film thickness of 0.125 inches minimum. Following the guidelines of SSPC PA-2, each panel shall be measured in six different locations using a DFT gage outfitted with a probe capable of measuring such a thickness, and ensuring the proper gage is used depending on whether the substrate is steel or aluminum. An alternate method is to spray a free film and measure final thickness with calipers. Final measurements shall conform to 3.3.20. Type II repair compounds must meet the same criteria; however, they can be trowel applied.

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-resistant coating covered by this specification is intended for use on areas of military vehicles or ground support equipment which may encounter wear and abrasion. The coating is a 100 percent solids, two-component 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 spray-on protective layer for thermal insulation and 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. A durable trowel-on repair compound is also covered in this specification.

This coating can be made from a wide variety of chemistries, such as polyurethane, polyurea, and a combination of polyurea and polyurethane (hybrid coating). Regardless of chemistry, the coating cannot 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 can be aromatic or aliphatic in nature.

The material can be applied with a variety of application equipment ranging from high volume production plural component equipment to moderate volume static mix cartridge guns and small volume spot repair kits. The approximate film thickness is dependent on the particular application needs. A general guideline is to use approximately 50 mils (0.050 inch) of coating thickness in high use or chip prone areas like wheel wells, undercarriages, and other similar areas and lower film thicknesses (approximately 20 mils) in less demanding application areas like vehicle interiors. The material can easily be repaired with small volume repair kits and readily bonds with itself.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Type (see 1.2).
- c. FED-STD-595 color required (see 3.3.1).
- d. When a test report is to be provided (see 4.2).

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- 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).

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, ATTN: SIAT – PM-CPAC, 2200 Lester Street, Quantico, VA 22134, commandstandards@navy.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.dla.mil>.

6.4 Toxicity evaluation. The Navy and Marine Corps Public Health Center (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.

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 resistant coatings are typically available in the following container sizes:

- a. Type I sprayable coatings:
 - 5-gallon (20-liter)
 - 55-gallon (208-liter)
 - 275-gallon
 - 300-milliliter cartridge
 - 600-milliliter cartridge
 - 750-milliliter cartridge
- b. Type II repair compounds:
 - 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 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 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.hq.dla.mil/>.

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6.8 Subject term (key word) listing.

Abrasion protection
Corrosion protection
Corrosion resistance
Durable
Impact protection
Isocyanate
Polyurea
Polyurethane
Stone pecking
Tough

Custodians:

Army – MR
Navy – MC
Air Force – 99

Preparing Activity:

Navy – MC
(Project 8010-2011-001)

Review Activities:

Army – 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>.