

INCH-POUND

MIL-PRF-14105E  
w/AMENDMENT 1  
14 August 2013  
SUPERSEDING  
MIL-PRF-14105E  
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## PERFORMANCE SPECIFICATION

## PAINT, HEAT-RESISTING (FOR STEEL SURFACES)

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

## 1. SCOPE

1.1 Scope. This specification covers a heat-resisting, ambient dry/heat cure paint that will withstand temperatures to a maximum of 1,400 °F (760 °C). The paint is intended for use on steel surfaces exposed to high temperatures and exterior weathering. The coating is free of volatile organic hazardous air pollutants (VOHAP-free). The coating is lead and hexavalent chromium free.

1.2 Types. The coating will be furnished in the following types as specified (see 6.2).

Type I - Lead and chromate free, volatile hazardous air pollutants-free (VOHAPS-free) formulation to meet a maximum volatile organic compound (VOC) content of 3.5 pounds/gallon (lbs/gal) (420 grams/liter (g/l)) as applied.

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

AMSC N/A

FSC 8010

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Type II - Lead and chromate free, VOHAPS-free formulation to meet a maximum (VOC) content of 2.8 lbs/gal (340 g/l) as applied.

1.2.1 Part or identifying number (PIN). Use the following example to create the PINs to be used for coatings acquired to this specification.

<u>M14105</u>	-	<u>X</u>	-	<u>XXXX</u>	-	<u>XXXXX</u>
Specification Identifier		Coating type designator		Container size designator		Color designator
		Type I = 1 Type II = 2		1 quart = 001Q 1 gallon = 001G		FED-STD-595 color chip number

## 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-313	-	Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities.
FED-STD-595 Color Chips	-	Colors Used in Government Procurement. 36099, 37038. These colors are flat or lusterless.

(Copies of these documents are available online at <http://quicksearch.dla.mil> or <https://assist.dla.mil> from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

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.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (EPA)

The Clean Air Act Amendments of 1990 List of Hazardous Air Pollutants.  
EPA Method 311 - HAPS in Paints & Coatings.

(Copies of these documents are available online at <http://www.epa.gov/ttn/atw/orig189.html> and <http://www.epa.gov/ttn/emc> respectively or from the Environmental Protection Agency, Ariel Rios Building, 1200 Pennsylvania Avenue, N.W., Washington, DC 20460.)

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 A1008/<br>A1008M | - Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High Strength Low Alloy, High Strength Low Alloy with Improved Formability, Solution Hardened, and Bake Hardenable. |
| ASTM B117             | - Standard Practice for Operating Salt Spray (Fog) Apparatus.   |
| ASTM B499             | - Standard Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals.  |
| ASTM D523             | - Standard Test Method for Specular Gloss.  |
| ASTM D562             | - Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer Type Viscometer.   |
| ASTM D609             | - Standard Practice for Preparation of Cold Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products.  |
| ASTM D610             | - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces.   |
| ASTM D710             | - Standard Specification for Vulcanized Fibre Sheets, Rods, and Tubes Used for Electrical Insulation.   |
| ASTM D870             | - Standard Practice for Testing Water Resistance of Coatings Using Water Immersion.   |
| ASTM D1210            | - Standard Test Method for Fineness of Dispersion of Pigment Vehicle Systems by Hegman Type Gage.   |
| ASTM D1475            | - Standard Test Method for Density of Liquid Coatings, Inks, and Related Products.  |
| 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.   |

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|------------|---|
| ASTM D1849 | - Standard Test Method for Package Stability of Paint.  |
| ASTM D2369 | - Standard Test Method for Volatile Content of Coatings.  |
| ASTM D2371 | - Standard Test Method for Pigment Content of Solvent Reducible Paints.   |
| ASTM D2805 | - Standard Test Method for Hiding Power of Paints by Reflectometry.   |
| ASTM D3271 | - Standard Practice for Direct Injection of Solvent Reducible Paints Into a Gas Chromatograph for Solvent Analysis.           |
| ASTM D3335 | - Standard Test Method for Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy.        |
| ASTM D3359 | - Standard Test Methods for Measuring Adhesion by Tape Test.  |
| ASTM D3924 | - Standard Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer and Related Materials. |
| ASTM D3960 | - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.                   |
| ASTM D5895 | - Standard Test Methods for Evaluating Drying or Curing During Film Formation of Organic Coatings Using Mechanical Recorders. |
| ASTM D7232 | - Standard Test Method for Rapid Determination of the Nonvolatile Content of Coatings by Loss in Weight.                      |
| ASTM G155  | - Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non Metallic Materials.                           |

(Copies of these documents are available from [www.astm.org](http://www.astm.org) or ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959.)

SSPC: THE SOCIETY FOR PROTECTIVE COATINGS

- SSPC-SP 1 - Solvent Cleaning. (DoD adopted)

(Copies of these documents are available from [www.sspc.org](http://www.sspc.org) or SSPC: The Society for Protective Coatings, 40 24<sup>th</sup> Street, 6<sup>th</sup> Floor, Pittsburgh, PA 15222-4656.)

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

### 3. REQUIREMENTS

3.1 Qualification. The coating furnished under this specification shall be a product authorized by the qualifying activity for listing in the Qualified Products Database (QPD) before contract award (see 4.2 and 6.4). Any change in the formulation of a qualified

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product shall necessitate its requalification. The material supplied under contract shall be identical, within manufacturing tolerances, to the product receiving qualification.

3.2 Color. The color of the paint shall be characteristic of inorganic black spinel pigments or a dark gray or charcoal not lighter than color chip number 36099 of FED-STD-595. For color 37038 the paint shall match the actual standard color chip of FED-STD-595. Additional colors of the paint shall match the appropriate FED-STD-595 color chip.

3.3 Formulation. Paints which meet the requirements of this specification contain a blend of ceramic frits, refractories, and pigments in a vehicle of pure or modified silicone resins; a mixture thereof; or a blend of the aforementioned with other compatible resins. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this specification.

3.4 Composition. The paint shall be furnished as a single component in 1 quart, 1 gallon, 4 gallon or 5 gallon primary containers (see 6.2). A product in meeting the applicable requirements of this specification shall result.

3.4.1 Pigment. Hexavalent chromium shall not be present. Pigments contained in these coatings shall be HAPS-free. Compounds of lead and chromium shall be absent. Small amounts of tinting pigments are permissible to achieve the color as in 3.2. Compounds of antimony, arsenic, beryllium, cadmium, cyanide, manganese, mercury, nickel and selenium shall be absent.

3.4.2 Lead content. The lead content shall not exceed 0.05 percent by weight of total nonvolatile content upon analysis as specified in 4.11.

3.4.3 VOC content. The VOC content for the types of coatings shall be as specified in 1.2 and tested in accordance with 4.12.1.

3.4.4 VOHAP content. All types of coatings shall be VOHAP-free when tested in accordance with 4.12.2.

3.5 Quantitative requirements. The paint shall conform to the quantitative requirements specified in table I.

3.6 Qualitative requirements.

3.6.1 Condition in container. The paint in a freshly opened full container shall show no curdling, livering, caking, lumps, or skins and shall show no more settling than may be redispersed with a paddle to a homogeneous state when tested as specified in 4.13.

3.6.2 Storage stability.

3.6.2.1 Accelerated storage stability. After testing as in 4.14.1, the coating shall meet all the requirements of the specification and have a maximum viscosity of 95 KU. There

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shall be no curdling or hard dry caking and any sedimentation shall easily mix back into a smooth homogeneous state.

3.6.2.2 Full container storage stability. The liquid coating, stored in the full quart can shall show no skinning, livering, curdling, hard dry caking nor tough gummy sediment when tested as specified in 4.14.2. It shall remix readily to a smooth homogeneous state, shall have a maximum viscosity of 95 KU, and shall meet all other requirements of this specification.

3.6.3 Brushing and spraying properties. When tested as specified in 4.15, the paint shall be satisfactory for brushing, as received, and shall be satisfactory for spraying when reduced in accordance with the supplier's recommendations, but not to exceed VOC limits where applicable. The paint when applied by brush or spray shall not run, sag, or have other defects.

TABLE I. Quantitative requirements.

Characteristics	Requirements	
	Minimum	Maximum
Nonvolatile vehicle, percent by weight of vehicle	45.0	-
Viscosity, Krebs-Stormer Shearing rate 200 rpm: Grams	125.0	225.0
Equivalent Krebs units	65.0	85.0
Specular gloss (60 degree)	-	18.0
Fineness of grind	4.0	-
Hiding power (contrast ratio)	0.95	-
VOC content, lbs/gal (g/l): Type I	-	3.5 (420)
Type II	-	2.8 (340)
VOHAP content	Absent	
Inorganic HAP compounds, other than cobalt and non-hexavalent chromium	Absent	
Pigment, hexavalent chromium, cadmium, cadmium compounds	Absent	
Lead content, percent	-	0.05

3.6.4 Suspension properties. When tested as specified in 4.18, the paint shall show no more than slight settling, no caking, and shall redisperse to a homogeneous state.

3.6.5 Drying properties.

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3.6.5.1 Air drying. The paint, when applied to steel panels as specified in 4.20.1, shall dry tack-free within 1 hour to a smooth film free from sags, runs, creep, orange peel, pits, and streaks.

3.6.5.2 Baking. The paint, when applied to steel panels as specified in 4.20.2, shall form an adherent, hard, tough film free from blisters, sags, runs, creep, orange peel, pits, and streaks.

3.6.6 Water resistance. A film of the paint applied and tested as specified in 4.21 shall show no wrinkling, blistering, softening, or loss of adhesion. Disregard any change in color.

3.6.7 Hydrocarbon fluid resistance. A film of the paint tested as specified in 4.22 shall show no wrinkling or blistering immediately after removal of the panel from JP8. The paint film shall show no defect other than some color and gloss change after testing.

3.6.8 Salt spray resistance. A film of the paint prepared and tested as specified in 4.23 shall show no corrosion, creepage, or undercutting beyond 1/8 inch (3.175 mm) from the scratch mark. The scribe line areas shall have ratings as specified in ASTM D1654 method A of not less than six (6) for steel. At all other points of the panel, there shall be no more than a trace of rusting (ASTM D610, table I, rust grade no. 9) and no more than five (5) scattered blisters no larger than 0.03937 inches (1 mm) in diameter.

3.6.9 Accelerated weathering. When subjected to the accelerated weathering test specified in 4.24, the paint film shall show only slight color change or chalking.

3.6.10 Recoating properties. Recoating the test surface as specified in 4.25 shall produce no lifting, blistering, pinholing, or other film irregularity.

3.6.11 Adhesion. The assessment of the adhesion of the coating film shall be determined by its ability to not peel from the substrate as specified in 4.26 when tested in accordance with ASTM D3359. After bake cured, the resultant test rating shall be classified as scale 4B or better, when tested as specified in 4.26.

3.6.12 High temperature resistance.

3.6.12.1 Heat exposure cycle. When tested as specified in 4.27.1, the paint film shall show no cracking, flaking, or chipping after being exposed to one heat exposure cycle.

3.6.12.2 Salt spray. When tested as specified in 4.27.2 and examined immediately after removal from the salt spray test, the scribed areas on the paint film shall have ratings as specified in ASTM D1654 method A of not less than six (6) for steel. The paint film shall show not more than a trace of rusting (ASTM D610, table I, rust grade no. 9) or corrosion for unscribed regions.

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3.6.12.3 Quenching cycle. When tested as specified in 4.27.3, the paint film shall show no cracking, flaking, or chipping.

3.6.12.4 Accelerated weathering (high temperature). When tested as specified in 4.27.4, the paint film shall show no marked checking, color change, or chalking.

3.6.13 Toxic ingredients. Other than parachlorobenzotrifluoride (PCBTF) and ethylene glycol n-butyl ether (butyl cellosolve), the paint shall contain no benzene, chlorinated solvents or ethylene based glycol ethers and their acetates (see 4.28). The paint shall have no adverse effects on the health of personnel when used for its intended purpose.

3.6.14 User instruction marking. In addition to the markings specified herein, all containers shall include the VOC content and VOHAP content in lbs/gal or g/l of coating. All containers shall be legibly marked or labeled with precautionary information as follows:

CAUTION: 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.

3.6.15 MSDS. A MSDS shall be prepared for the paint in accordance with FED-STD-313 and forwarded to the qualifying activity (see 6.4.2). The MSDS shall be included with each shipment of the material covered by this specification and submitted to pertinent Government agencies as stated in FED-STD-313.

3.6.16 Toxicity clearance. All new chemicals and materials being added to the Army supply system shall have a toxicity clearance. A toxicity clearance involves a toxicological evaluation of materials prior to introduction into the Army supply system. The Army program manager shall be responsible for identifying technically feasible materials and requesting a toxicity clearance for use of that material within their program (see 6.5).

3.6.17 HAP ingredients. The paint shall be formulated free of HAPs (see 4.29). The current list of HAPs can be found on The Clean Air Act Amendments of 1990 List of Hazardous Air Pollutants (see 2.2.2).

#### 4. VERIFICATION

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

- a. Qualification inspection (see 4.2).
- b. Extension of qualification inspection (see 4.2.1).
- c. Conformance inspection (see 4.3).



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4.2 Qualification inspection. Qualification shall be conducted by the qualifying activity (see 6.4). The qualification test sample shall consist of three quarts (or kits as the case may be) of each material. The samples shall be legibly identified (see 6.4.3). Qualification inspection shall consist of tests for all requirements specified in section 3 and table II. Qualification inspection shall examine for user instruction marking (see 3.6.14). The results of each test shall be compared with the applicable requirement in section 3. Failure to conform to any requirement shall be counted as a defect, and paint represented by the sample test shall not be approved for inclusion in the QPD under this specification.

4.3 Conformance inspection. The manufacturer shall forward from each production lot (see 4.3.1) a batch validation letter detailing the batch number, manufacturer's code, specification and type number, QPL number and batch volume to U.S Army Research Laboratory, Attn: RDRL-WMM-C, Organic Coatings Team, Building 4600, Deer Creek Loop, Aberdeen Proving Ground, MD 21005-5066. The manufacturer shall perform conformance inspection testing on each production lot and have these test results on file when requested by the contracting officer. Conformance inspection for individual lots shall consist of VOC, condition in container, total solids, viscosity, fineness of grind, mixing properties, spraying properties, drying time and 60 degree specular gloss. There shall be no failures (see 6.4.5).

4.3.1 Lot and batch formation. For purposes of conformance inspection, a lot shall consist of all coatings of the same type, composition and color, from a single uniform batch, produced and offered for delivery at one time (see 6.4.1). A batch shall consist of all coating material (in U.S. gallons) manufactured during one continuous operation and forming part of one contract or order for delivery (see 6.4.1). When required, the manufacturer shall furnish with each lot and/or batch a certified test report showing that the material has passed the conformance inspection, and that there has been no formulation or process change from that which resulted in the production of the qualification inspection sample. The addition of any substance to a batch shall constitute a new lot.

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

4.5 MSDS. A MSDS not prepared in accordance with FED-STD-313 shall be cause for rejection.

4.6 Tests.

4.6.1 Test conditions. Except as otherwise specified herein, the routine and referee testing conditions shall be in accordance with ASTM D3924. Failure of any test result to fall within the ranges specified in section 3 shall constitute failure of the applicable test.

4.6.2 Test paint films. Dry film thickness of the coating films shall be 2 to 2.5 mils (50 to 62.5 microns) or as specified by the technical data sheet from the manufacturer. The

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dry film thickness shall be measured after the coated panel has been baked at  $400 \pm 4$  °F ( $204 \pm 2$  °C) for one (1) hour. If the test method specifies that the film is not to be heated, the dry film thickness shall then be measured after the twenty four (24) hour ambient temperature dry.

4.6.3 Test procedures. The following tests shall be conducted in accordance with table II. The right is reserved to make any additional tests deemed necessary to determine that the coating meets the requirements of this specification.

TABLE II. Index.

Item	ASTM Method	Test Paragraph	Requirement Paragraph or Table
Color	-	4.8	3.2
Pigment analysis	D2371	4.9	3.4.1 and Table I
Hexavalent chromium	-	4.10	Table I
Cadmium content	D3335	-	Table I
Lead content	D3335	4.11	3.4.2 and Table I
VOC content	D3960	4.12.1	3.4.3 and Table I
VOHAP content	D3271	4.12.2	3.4.4 and Table I
Condition in container	-	4.13	3.6.1
Accelerated storage stability	-	4.14.1	3.6.2.1
Full container storage stability	D1849	4.14.2	3.6.2.2
Brushing properties	-	4.15	3.6.3
Spraying properties	-	4.15	3.6.3
Hiding power (contrast ratio)	D2805	4.16	Table I
Viscosity, Krebs-Stormer	D562	4.17	Table I
Fineness of grind	D1210	-	Table I
Suspension properties	-	4.18	3.6.4
Specular gloss (60 degree)	D523	4.19	Table I

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TABLE II. Index - Continued.

Item	ASTM Method	Test Paragraph	Requirement Paragraph or Table
Drying properties:			
Air drying	D5895	4.20.1	3.6.5.1
Baking	D5895	4.20.2	3.6.5.2
Water resistance	D870	4.21	3.6.6
Hydrocarbon fluid resistance	-	4.22	3.6.7
Salt spray resistance	B117	4.23	3.6.8
Accelerated weathering	G155	4.24	3.6.9
Recoating	-	4.25	3.6.10
Adhesion by tape test	D3359	4.26	3.6.11
High temperature resistance:			
Heat exposure cycle	-	4.27.1	3.6.12.1
Salt spray	B117	4.27.2	3.6.12.2
Quenching cycle	-	4.27.3	3.6.12.3
Accelerated weather	G155	4.27.4	3.6.12.4
Toxic ingredients	-	4.28	3.6.13
HAP ingredients	-	4.29	3.6.17

#### 4.7 Surface preparation of test panels.

4.7.1 Test panels. Unless otherwise specified herein, test panels shall be rust free cold rolled steel panels 0.1875 inches (4.7625 mm) gauge by 3 inches (76.2 mm) width by 6 inches (152.4 mm) length. The panels shall be solvent cleaned in accordance with SSPC-SP 1 solvent cleaning, after which the panels shall be blast cleaned with a low profile depth of 1.0 - 1.5 mils (25.4 - 38.1 microns) maximum or mechanically wire brushed according to manufacturers' instructions.

4.7.2 Coating and conditioning of test panels. Spray coat the panels to produce a dry film thickness of 2.0-2.5 mils (50-62.5 microns). Then air dry or bake and condition as specified herein. Air drying shall be accomplished at  $77 \pm 4$  °F ( $25 \pm 2$  °C) in an atmosphere of 50 percent  $\pm$  4 percent relative humidity. Baking shall be accomplished in a well-ventilated laboratory oven at  $400 \pm 4$  °F ( $204 \pm 2$  °C). Conditioning of the coated panels for the tests specified herein shall be at atmospheric conditions for air drying.

4.8 Color. Determine color on coated test panels prepared as specified in 4.7.1 and 4.7.2. Compare the color as specified in 3.2. Nonconformance to 3.2 shall constitute failure of this test.

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4.9 Pigment analysis. Extract the pigment as in ASTM D2371, except use ethanol for the extraction. Make appropriate qualitative and quantitative tests on the extracted pigment to determine if only permissible pigments were used. Nonconformance to table I shall constitute failure of this test.

4.10 Hexavalent chromium. Determine the presence or absence of hexavalent chromium by either of the following chemical reagent screening techniques:

(a) Weigh approximately 250 mg of pigment into a small glass test tube. Add 5 ml of 25 percent aqueous KOH and shake vigorously for 1 - 2 minutes. Decant a 1 ml aliquot into a plastic micro-centrifuge tube and centrifuge for five (5) minutes at 17,000 rpm, balancing the centrifuge with a tube containing 1 ml of the KOH solution. The resulting supernatant liquid shall be nearly colorless. Use the tube containing the KOH solution as a reference. A distinct yellow color indicates the presence of hexavalent chromium, and, therefore, shall constitute failure of the test requirement.

(b) Weigh approximately 50 mg of pigment into a small glass test tube. Add 5ml of 10 percent aqueous H<sub>2</sub>SO<sub>4</sub> and shake vigorously for 1 - 2 minutes. Decant a 1 ml aliquot into a plastic micro-centrifuge tube and centrifuge for five (5) minutes at 17,000 rpm, balancing the centrifuge with a second tube containing one ml of the H<sub>2</sub>SO<sub>4</sub> solution. The solution in the second tube shall act as the test "blank". Immerse a chromate ion (CrO<sub>4</sub><sup>2-</sup>) test strip into the supernatant from each tube. Shake off the excess liquid, and, after approximately one minute, compare the color change in the reaction zone of the strips to the color scale (concentration levels) provided by the manufacturer. The appearance of a purple/violet color from the "sample" strip is indicative of hexavalent chromium, and, therefore, shall constitute failure of the test requirement. If a color change is apparent from the "blank" strip, rerun the test using fresh, chromium-free reagents. The appearance of a pronounced color change is indicative of hexavalent chromium, and, therefore, shall constitute failure of the test requirement.

4.11 Lead content. Determine the presence or absence of lead by weighing 50 mg of pigment into a small glass test tube. Add 5 ml of dilute HNO<sub>3</sub> and shake vigorously for 1-2 minutes. Decant a one ml aliquot into a plastic micro centrifuge tube and centrifuge for five (5) minutes at 17,000 rpm, balancing the centrifuge with a second tube containing 1 ml of the dilute HNO<sub>3</sub> solution. The solution in the second tube shall act as the test "blank". Immerse a lead ion test strip into the supernatant from each tube. Shake off the excess liquid, and, after approximately one minute, compare the color change in the reaction zone of the strips to the color scale (concentration levels) provided by the manufacturer. If a color change is apparent from the "blank" strip rerun the test using fresh, lead-free reagents. Confirmation of the exact lead concentration in the coating's solids shall be quantified using ASTM D3335. Nonconformance to the table II requirements shall constitute failure of this test.

4.12 Solvent analysis.

4.12.1 Volatile content. The volatile content of the coating (see 1.2) determined by EPA Method 311 and the VOC analysis (see 3.4.3) determined in accordance with ASTM

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D3960 shall comply with table I. Nonconformance to the VOC limit shall constitute failure of this test.

4.12.2 VOHAP content. Hazardous solvent content (see 3.4.4) of each individual coating shall be determined in accordance with ASTM D3271 or EPA Method 311, as applicable. Check for compliance with table I. Nonconformance shall constitute failure of this test.

4.13 Condition in container. Upon opening a full previously unopened container the condition of the contents shall be examined for compliance with 3.6.1. Reseal, then agitate the container for three (3) minutes on a paint shaker and reexamine for compliance with 3.6.1. On reexamination of the contents, the disclosure of any gel bodies or undispersed pigment indicates unsatisfactory settling properties.

4.14 Storage stability.

4.14.1 Accelerated storage stability. Fill an epoxy lined pint container with the coating and determine the viscosity in accordance with ASTM D562. Tightly seal the container and place sample in a preheated oven for 7 days at  $140 \pm 1.8$  °F ( $60 \pm 1$  °C). Allow to cool to room temperature and examine the contents. Check for compliance with 3.6.2.1.

4.14.2 Full container storage stability. Allow two (2) quarts of liquid coating to stand undisturbed for six (6) and twelve (12) months respectively in accordance with ASTM D1849. Examine the contents for skinning. Reseal and agitate the can for five (5) minutes on a paint shaker. Reexamine and evaluate for pigment settling. Determine viscosity and other applicable tests for compliance with 3.6.2.2.

4.15 Brushing and spraying properties. The paint shall be satisfactory for brushing, as received, and shall be satisfactory for spraying when reduced in accordance with the supplier's recommendations, but not to exceed the 3.5 lbs/gal (420 g/l) VOC limitation. The paint when applied by brush or spray shall not run, sag, or have other defects.

4.16 Hiding power (contrast ratio). Using a sprayed sample from the color determination after air dry for twenty four (24) hours (see 3.2), determine the reflectance using the daylight reflectance factor of ASTM D2805 over the black and white portion of the card. Record the values as  $R_B/R_W$  and check for compliance with table I.

4.17 Viscosity, Krebs-Stormer. Determine viscosity in accordance with ASTM D562. Check for compliance with table I.

4.18 Suspension properties. Reduce the paint to spraying consistency according to the supplier's instructions. Place six (6) ounces of the reduced paint in an eight (8) ounce glass jar and do not agitate or disturb for twenty four (24) hours. At the end of this period, examine the paint for hard or excessive settlings by means of a spatula. Restopper the jar and shake vigorously for twenty (20) seconds. Reexamine the paint for any evidence of nonhomogeneity or undispersed pigment. Nonconformance to 3.6.4 shall constitute failure of this test.

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4.19 Specular gloss (60 degree). Prepare a film of the paint on steel as specified in 4.7 and allow to dry twenty four (24) hours. Determine the 60 degree specular gloss in accordance with ASTM D523. Nonconformance to table I shall constitute failure of this test.

4.20 Drying properties.

4.20.1 Air drying. Determine the air drying properties of the paint in accordance with ASTM D5895 by spraying or brushing a coat of the paint to a dry film thickness of 2.0-2.5 mils (50-62.5 microns) on test panels prepared as specified in 4.7. Air dry the panels in a vertical position for one (1) hour. Nonconformance to 3.6.5.1 shall constitute failure of this test.

4.20.2 Baking. Bake a coated test panel prepared as specified in 4.7 in a well-ventilated laboratory oven at 400 °F (204 °C) for one (1) hour. Allow to cool to room temperature, and examine in accordance with ASTM D5895. Nonconformance to 3.6.5.2 shall constitute failure of this test.

4.21 Water resistance. Prepare a coated test panel, 3 inches (76.2 mm) x 6 inches (152.4 mm) in accordance with 4.7 and air dry for one hundred sixty eight (168) hours. Coat all exposed uncoated metal surfaces with wax or other suitable protective coating and immerse the test panel to a depth of 3 inches (76.2 mm) for eighteen (18) hours in distilled water at  $77 \pm 9$  °F ( $25 \pm 5$  °C). At the end of the immersion time, remove the panel from the distilled water and examine the paint film. Nonconformance to 3.6.6 shall constitute failure of this test.

4.22 Hydrocarbon fluid resistance. Prepare a coated test panel in accordance with 4.7. Air dry for one (1) hour, then bake in a well-ventilated laboratory oven at 400 °F (204 °C) for one (1) hour. Allow to cool to room temperature. Unpainted surfaces shall not be coated with wax or other material. Immerse the coated test panel to a depth of 3 inches (76.2 mm) for eighteen (18) hours in JP8. Remove the test panel and immediately examine the paint film for wrinkles or blisters. Air dry the test panel for two (2) hours and reexamine the film for defects. Nonconformance to 3.6.7 shall constitute failure of this test.

4.23 Salt spray resistance. Prepare three (3) coated steel test panels in accordance with 4.7 and air dry for one hundred sixty eight (168) hours. Coat the exposed unpainted areas of the panels with a protective material. Make an "X" scribe to the base metal. Expose to salt spray for one hundred (100) hours in accordance with ASTM B117, using five (5) percent salt solution and examine. Nonconformance to 3.6.8 shall constitute failure of this test.

4.24 Accelerated weathering. Prepare a coated steel test panel in accordance with 4.7 and air dry for one hundred sixty eight (168) hours. Expose the panel for three hundred (300)

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hours to accelerated weathering in accordance with ASTM G155 method A, type BH, and examine the paint film. Nonconformance to 3.6.9 shall constitute failure of this test.

4.25 Recoating. Prepare two coated steel test panels in accordance with 4.7. Air dry one test panel for eighteen (18) hours, and bake the other test panel in a well-ventilated laboratory oven at 400 °F (204 °C) for one (1) hour. Allow the baked panel to cool to room temperature. Recoat each panel as above, redry each panel as specified for the initial coat, and examine the paint film. Nonconformance to 3.6.10 shall constitute failure of this test.

4.26 Adhesion. Spray the paint as in 4.7.2 on a steel panel prepared as in 4.7.1. After bake cured, perform adhesion testing as specified in ASTM D3359, method B and examine for compliance with 3.6.11.

4.27 High temperature resistance.

4.27.1 Heat exposure cycle. Six (6) coated steel test panels shall be used in this test. Use five (5) panels for further testing (see 4.27.2, 4.27.3, and 4.27.4) and one (1) for use as a comparative standard. Prepare six (6) coated steel test panels (see 4.6.2) and bake for one (1) hour in accordance with 4.7.2 except the panel thickness shall be 0.1875 inches (4.7625 mm) gauge minimum. The blasting shall be in a 1.0 to 1.5 mil (25.4 to 38.1 microns) profile range. Subject the panels to one heat exposure cycle consisting of heating for eight (8) hours at 400 °F (204 °C), cooling for sixteen (16) hours at room temperature; then heat for eight (8) hours at 650 °F (343 °C), cooling for sixteen (16) hours at room temperature; heat again for eight (8) hours at 800 °F (427 °C), and cooling for sixteen (16) hours at room temperature; finish by heating for eight (8) hours at 1,400 °F (760 °C). Remove two (2) panels at the end of the 800 °F (427 °C) heating period for use in the salt spray test (see 4.27.2). Examine all panels at the end of each temperature variation. Nonconformance to 3.6.12.1 shall constitute failure of this test.

4.27.2 Salt spray resistance. Panels from the 800 °F (427 °C) heating period of 4.27.1 shall be tested for salt spray resistance. Protect the exposed unpainted areas of panels with separate applications of paint or wax. Make an "X" scribe to the base metal. Subject two test panels to 100 hours of salt spray in accordance with ASTM B117 using 5 percent salt solution, and examine. Nonconformance to 3.6.12.2 shall constitute failure of this test.

4.27.3 Quenching cycle. Subject one heat exposed test panel from the 1,400 °F (760 °C) heating period to five quenching cycles consisting of heating the panel to 650 °F (343 °C) and plunging it immediately into fresh tap water at a temperature of  $70 \pm 10$  °F ( $21 \pm 5$  °C). Examine the paint film after each quenching cycle. Nonconformance to 3.6.12.3 shall constitute failure of this test.

4.27.4 Accelerated weathering (high temperature). Expose two test panels that have been subjected to the heat exposure cycle 1,400 °F (760 °C) heating period to 300 hours of accelerated weathering in accordance with ASTM G155, cycle 1, and examine the paint film. Nonconformance to 3.6.12.4 shall constitute failure of this test.



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4.28 Toxic ingredients. Other than PCBTF and ethylene glycol n-butyl ether (butyl cellosolve), the manufacturer shall certify that the paint contains no benzene, chlorinated solvents or ethylene based glycol ethers and their acetates. Check for compliance with 3.6.13. Nonconformance to 3.6.13 shall constitute failure of this test.

4.29 HAP ingredients. The manufacturer shall certify that the paint contains no HAPs. Check for compliance with 3.6.17. Nonconformance to 3.6.17 shall constitute failure of this test.

## 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 command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

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

6.1 Intended use. This paint is intended for use on solvent degreased and blasted steel surfaces of components which are subject to temperatures as high as 1,400 °F (760 °C) and exterior weathering. Components such as mufflers, exhaust manifolds, and exhaust pipes may be protected by the use of this paint. The paint provides excellent protection against corrosion and chemical attack.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of the specification.
- b. Type of coating (see 1.2).
- c. Part or identifying number (PIN) (see 1.2.1).
- d. Color of coating required (see 3.2).
- e. Composition of paint (see 3.4).
- f. Whether a MSDS is required with each shipment (see 3.6.15 and 4.5).
- g. If a toxicity clearance is required (see 3.6.16).
- h. If qualification samples are required and where to send them (see 4.2 and 6.4).
- i. If extension of qualification samples are required and where to send them (see 4.2.1 and 6.4).
- j. If conformance samples are required and where to send them (see 4.3).



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- k. Lot and batch formation (see 4.3.1).
- l. Packaging requirements (see 5.1).

6.3 Basis of purchase. The paint covered by this specification should be purchased by volume, the unit being one U.S. liquid gallon of 231 cubic inches at 68 °F (20 °C).

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in the QPD. The attention of contractors is called to this requirement and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Samples for QPD testing (see 4.2) should be submitted to ARL, ATTN: RDRL-WMM-C, Organic Coatings Team, Building 4600, Deer Creek Loop, APG, MD 21005-5066. For a list of those companies qualified to this specification, please refer to <http://quicksearch.dla.mil/> for the ASSIST Overview – Qualification page.

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

6.4.2 MSDS. Contracting officers will identify those activities requiring copies of a completed MSDS prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313.

6.4.3 Sample identification for qualification inspection. Samples for QPD testing and for the extension testing program 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-14105E; Type \_\_\_\_\_, Color \_\_\_\_\_, "Paint, Heat-Resisting (For Steel Surfaces)".
- Provide a copy of the MSDS.
- Provide a copy of the notarized statement of composition.
- Provide a copy of the technical data sheet.
- Provide a copy of the test report.

6.4.4 Retention of qualification. To retain qualification of products approved for listing in the QPD, the manufacturer will be requested to verify by certification to the qualifying activity that its product(s) comply with the requirements of this specification. Unless otherwise specified by the qualifying activity, the time of periodic verification by

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certification will be in two-year intervals from the date of original qualification and will be initiated by the qualifying activity.

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

6.5 Toxicity clearance request. Department of the Army Regulation (AR) 40-5, Preventive Medicine, (AR) 70-1, Acquisition Policy, and Department of the Army Pamphlet 70-3, Acquisition Procedures, require a toxicity clearance. Army toxicity questions and/or a toxicity clearance request should be addressed to: Commander, Public Health Command (Provisional) (MCHB-TS-T), 5158 Blackhawk Road, APG, MD 21010-5403.

6.6 Painting other than blasted surfaces. These coatings have been found to perform satisfactorily when applied to parts that do not lend themselves to blast cleaning in a touch-up application. In application to such parts, however, it is absolutely necessary that all loose rust and tight and loose mill scale must be removed by wire brushing and chipping. Coatings should then be applied by brushing, taking care to work the paint well into the roughened surfaces.

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

6.8 Subject term (key word) listing.

Mufflers  
Pigments  
Temperature

6.9 Amendment notations. The margins of this specification are marked with vertical lines to indicate modifications generated by this amendment. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations.

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CONCLUDING MATERIAL

Custodians:

Army - MR

Navy - SH

Preparing activity:

Army - MR

Project 8010-2013-016

Review activities:

Army - MD1, MI

Navy - AS, CG, MC

Civil agency:

GSA/FAS

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