

INCH - POUND

MIL-C-29475 (MC)

7 July 1994

## MILITARY SPECIFICATION

## COATING, WATER BORNE POLYURETHANE CAMOUFLAGE

This specification is approved for use by the Marine Corps Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

## 1. SCOPE

1.1 Scope. This specification covers the requirements of a camouflage, chemical agent resistant, reduced volatile organic compound (VOC) water reducible polyurethane coating, for use as a finished coat on military equipment.

1.2 Classification.

1.2.1 Colors. The coating shall be one of the following Federal Standard 595B colors as specified (see 6.2)

Brown 383	30051
Green 383	34094
Black 383	37030
Tan 686A	33446

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Marine Corps Systems Command, Program Support Directorate (PSE-P), 2033 Barnett Ave., Room 315, Quantico, VA, 22134-5010 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 8010

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distribution is unlimited.

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## 2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and handbooks, form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

## SPECIFICATIONS

## FEDERAL

- |            |   |   |
|------------|---|---|
| TT-C-490   | - | Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings.     |
| TT-S-735   | - | Standard Test Fluids, Hydrocarbon.  |
| PPP-B-601  | - | Boxes, Wood, Cleated Plywood.   |
| PPP-B-621  | - | Box, Wood, Nailed and Corner Locked.  |
| PPP-B-636  | - | Box, Shipping, Fiberboard.  |
| PPP-C-96   | - | Can, Metal, 28 Gage and Lighter.  |
| PPP-D-729  | - | Drums, Shipping and Storage, Steel, 55 Gallon (208 Liters).                     |
| PPP-D-732  | - | Drum, Metal, 55 Gallon Reconditioned (for Shipment of Noncorrosive Material.    |
| PPP-F-320  | - | Fiberboard, Corrugated and Solid, Stock (Container Grade), and Cut Sheets.      |
| PPP-P-704  | - | Pail, Metal (Shipping, Steel, 1 through 12 Gallons).                            |
| PPP-P-1892 | - | Paint, Varnish, Lacquer and Related Materials; Packaging, Packing & Marking of. |

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- |             |   |  |
|-------------|---|--|
| MIL-L-2104  | - | Lubricating Oil, Internal Combustion Engine, Heavy-Duty.             |
| MIL-P-53022 | - | Primer, Epoxy Coating, Corrosion Inhibiting, Lead and Chromate Free. |
| MIL-P-53030 | - | Primer Coating, Epoxy, Water Reducible, Lead and Chromate Free.      |

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## STANDARDS

## FEDERAL

- FED-STD-141 - Paint, Varnish, Lacquer and Related Materials: Methods of Inspections, Sampling and Testing.
- FED-STD-313 - Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities.
- FED-STD-595 - Colors Used in Government Procurement.

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- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-129 - Marking for Shipment and Storage
- MIL-STD-147 - Palletized Unit Loads.
- MIL-STD-45662 - Calibration Systems Requirements.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, BLDG. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 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 are those cited in the solicitation.

## ENVIRONMENTAL PROTECTION AGENCY (EPA)

Code of Federal Regulations (CFR) 40 CFR CH. 1, Part 60, Appendix A, Method 24 - Determination of Volatile Matter Content, Water Content, Density, Volume Solids and Weight Solids of Surface Coatings.

40 CFR, Part 261, Appendix II

DEPARTMENT OF LABOR, OCCUPATIONAL HEALTH AND SAFETY  
ADMINISTRATION (OSHA)

29 CFR 1910, 1915, 1917, 1918, 1926 and 1928 -  
Hazardous Communication Standard.

(The Code of Federal Regulations (CFR) and the Federal Register (FR) are for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402. When indicated, reprints of certain

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regulations may be obtained from the Federal agency for issuance thereof.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS  
(ACGIH)

Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents in the Work Environment and Biological Indices.

(Application for copies should be sent to the American Conference of Governmental Hygienists, 6500 Glenway Avenue, BLDG. D7, Cincinnati, Ohio 45211.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- D 476 - Titanium Dioxide Pigments, Specification for.
- D 523 - Standard Test Method for Specular Gloss.
- D 562 - Consistency of Paints Using the Stormer Viscosimeter.
- D 659 - Evaluating Degree of Resistance to Chalking of Exterior Paints.
- D 714 - Standard Test Method for Evaluating Degree of Blistering of Paints.
- D 768 - Specification for Yellow Iron Oxide, Hydrated.
- D 1014 - Standard Test Method for Conducting Exterior Exposure Tests of Paints on Steel.
- D 1210 - Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems.
- D 1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
- D 1364 - Standard Test Method for Water in Volatile Solvents (Fischer Reagent Titration Method).
- D 1475 - Standard Test Method For Density of Paint, Varnish, Lacquer, and Related Products.
- D 1654 - Standard Test Method for Evaluation of Painted or Coated Specimens Subject to Corrosive Environments.
- D 1849 - Standard Test Method for Package Stability of Paint.

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- D 2243 - Standard Test Method for Freeze-Thaw Resistance of Water Borne Coatings.
- D 2244 - Standard Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- D 2369 - Standard Test Method for Volatile Content of Paints.
- D 2805 - Standard Test Method for Hiding Power of Paints by Reflectometry.
- D 3168 - Standard Practice for Qualitative Identification of Polymers in Emulsion Paints.
- D 3278 - Standard Practice for Determination of Flash Points by Setaflash Closed Cup Apparatus.
- D 3335 - Test for Low Concentrations of Lead, Cadmium and Cobalt in Paint by Atomic Absorption Spectroscopy.
- E 97 - Direction Reflectance Factor, 45-degree, 0-deg, of Opaque Specimens by Broad-Band Filter Reflectometry.
- E 167 - Goniophotometry of Reflecting Objects and Materials.
- E 308 - Standard Recommended Practices for Spectrophotometry and Description of Color in CIE 1931 System.
- F 718 - Standard for Shipbuilders and Marine Paints and Coatings Product/Procedure Data Sheet.
- G 53 - Standard Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the reference 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.

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## 3. REQUIREMENTS

3.1 Qualification. Coating systems furnished under this specification shall be those systems which are approved by the qualifying activity for listing on the applicable qualified products list (QPL) at the time of award of the contract (see 4.4 and 6.4). Any change in the formulation of a qualified product will necessitate its requalification. The material supplied under contract shall be identical, within manufacturing tolerances, to the product receiving qualification.

3.1.1 Materials. The materials used in the coating shall be as specified herein. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this specification. (see 3.5)

3.2 Material safety data sheets (MSDS). The contracting activity shall be provided a material safety data sheet at the time of the contract award. The MSDS shall be provided in accordance with the requirements of FED-STD-313. The MSDS shall be included with each shipment of the material covered by this specification (see 6.5).

3.3 Directions for use. The contractor shall provide written directions on each container for the mixing and applying of the material supplied and this direction shall include all information necessary to comply with OSHA Hazard Communication Standard and FED-STD-313. In addition, the contractor shall provide an ASTM F 718 data sheet which shall separately detail requirements for small unit (metric and English equivalents of pint, quart, gallon) and large unit (5-gallon, 55-gallon) containers.

3.4 Hazardous material. Manufacturers shall prepare container label instructions for paint in accordance with the requirements of 29 CFR Parts 1910, 1915, 1917, 1918 1926 and 1928 Hazard Communication Act, Final Rule (see 5.1). In choosing the specific ingredients to manufacture the paint, the manufacturer shall insure that the paint offered for delivery does not contain the following materials in excess of 0.05% by weight of either the total formulated paint or in the dry film formed by the paint: Benzene, Toluene, chlorinated solvents, esters or ethers derived from ethylene glycol, hydrolyzable chlorine derivatives, coal tar and coal tar derivatives, lead or lead derivatives, any ACGIH carcinogenic or ACGIH suspected carcinogenic compounds.

3.4.1 Toxic product and formulation. The material shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the contracting activity to the appropriate

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departmental medical service who will act as advisor to the contracting activity.

3.5 Composition. The contractor is given his choice in the formulation of the paints provided the end product conforms to all requirements of this document (see 4.1.1). However, contractor shall assure composition conforms to the requirements of 3.4 and that soluble metal content and total metal content of the paints shall not exceed the values listed in Tables I and II.

3.5.1 Volatile organic compound content. The volatile organic compound content shall not exceed 216 gm/liter (1.8 lbs/gal) as applied when tested as specified in 4.17 as defined in 40 CFR CH. 1, Part 60, Appendix A, Method 24 - Determination of Volatile Matter Content, Water Content, Density, Volume Solids and Weight Solids of Surface Coatings.

3.5.2 Pigment. The pigments listed in Table VI, or any combination thereof, shall make up the primary hiding pigmentation for the colors specified. Iron oxides used as hiding pigments shall be of synthetic origin and not naturally occurring. The titanium dioxide shall be rutile chalk resistant type conforming to ASTM D 476, Type III. If other tinting pigments are used to match the spectral characteristics, these additional pigments must have good color stability. No lead or chromate (hexavalent) pigments shall be used and antimony sulfide shall not be present. The extender pigments may be siliceous matter but if used shall not exceed the amount specified in Table VIII.

3.5.3 Lead Content. The lead content shall not exceed 0.06 percent by weight of the total nonvolatile content upon analysis.

3.6 Color and spectral reflectance. As tested in 4.9, all camouflage colors listed in Table III shall impart to the substrate the required spectral reflectance properties in the visible (380 - 700 nanometers) and near infrared (700 - 900 nanometers) spectrums. Camouflage colors are those for which there are numerical requirements for chromaticity as listed in Tables III and IV. The colors of the camouflage system shall fall within 2.0 National Institute of Standards and Technology (NIST) units under Standard Illuminant C of the values listed when observed at 10°. Figures 1 through 4 may be used as approximate guidelines for the appropriate color. The color Green 383, 34094 shall meet the spectral reflectance limits specified in Table IV, Table V and in Figure 1. The color Black 383, 37030 shall meet the spectral reflectance limits specified in Table IV and in Figure 2. The color Brown 383, 30051 shall meet the spectral reflectance specified in Table IV and in Figure



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3. The color Tan 686A, 33446 shall meet the spectral reflectance specified in Table IV and in Figure 4.

3.7 Quantitative Requirements. The paint shall conform to the quantitative requirements specified in Table VIII and as follows when tested as specified in section 4.

3.8 Material requirements. The coating supplied shall consist of pigments, additives, and assorted resins, so combined as to produce a ready-for use material meeting all the requirements of this document. (See 3.5)

3.9 Condition in container.

3.9.1 Ready mixed materials. When tested in accordance with method 3011.2 of FED-STD-141, the paint shall be ready mixed and shall show no hard pigment settling, phase separation, evidence of biological growth, livering, skinning, putrification, corrosion of the container, grit or seeding particles, or persistent foam. Any settled pigment shall be easily and completely reincorporated with a paddle or mechanical mixer within 5 minutes to a smooth and uniform condition, free from persistent foam.

3.9.2 Multiple component supplied materials. When tested in accordance with method 3011.2 of FED-STD-141, each component shall show no hard pigment settling, phase separation, evidence of biological growth, livering, skinning, putrification, corrosion of the container, grit or seeding particles, or persistent foam. After mixing in accordance to the manufacturer's instructions the material shall be mixed to a uniform, smooth homogeneous state. After ageing as specified in 4.10.1, the coating shall show no signs of gelation and any settled pigment shall be easily and completely reincorporated with a paddle or mechanical mixer within 5 minutes to a smooth and uniform condition, free from persistent foam.

3.10 Spraying properties. When tested as in 4.11, the coating shall spray satisfactorily in all respects and shall show no running, sagging, or streaking. The dried film shall show no dusting, mottling or color separation and shall present a smooth lusterless finish free from seediness.

3.11 Brushing properties. The coating shall brush satisfactorily and shall dry to a smooth, uniform film, free from seeds, runs, sags, or streaks when tested as specified in 4.12. The dried film shall show no discernible brush marks.

3.12 Flexibility. A film of the coating tested as specified in 4.14, shall withstand bending without cracking or lifting.



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3.13 Recoatability. When tested as specified in 4.27 recoating of the dried film shall produce no lifting, softening or other film irregularities.

3.14 Water resistance. A film of the coating tested as specified in 4.15, shall show no blistering or wrinkling and no more than a slight whitening or softening immediately upon removal from the water. After 2 hours air drying the portions of the panel that were immersed shall be indistinguishable with regard to adhesion, hardness, color and gloss from the portion that was not immersed.

3.15 Hydrocarbon resistance. A film of the coating when tested as specified in 4.16, shall show no blistering or wrinkling when examined immediately after removal from the hydrocarbon test fluid. When examined 2 hours after removal, there shall be no excessive softening, whitening or dulling. After 24 hours drying, the portion of the panel that was immersed shall be indistinguishable with regard to hardness, adhesion and general appearance from a panel prepared at the same time but not immersed and shall have no more than a 0.5 gloss unit increase over the original 60 and 85 degree specular gloss.

3.16 Acid resistance. A film of the coating when tested as specified in 4.26 shall have no blistering and show no change from the original color.

3.17 Polish resistance. A film of the coating when tested as specified in 4.21, shall have a maximum 60 and 85 degree specular gloss of 8 for all colors.

3.18 Accelerated weathering. A film of the coating when tested as specified in 4.22, for 300 hours shall show no cracking, chalking, loss of adhesion or increase in the 60 and 85 degree specular gloss. The color change shall be less than 2.5 N.B.S. units in Table IV. The infrared reflectance and allowable ratio shall remain within those limits originally specified.

3.19 DS2 resistance. A film of the coating when tested as specified in 4.23, shall show no blistering, wrinkling or film softening when examined immediately after washing with water. After drying, there shall be a maximum color change of 2.5 N.B.S. units when comparing a portion of the untested panel to that of the tested area.

3.20 Chemical agent resistance. A film of the coating when tested as specified in 4.24, shall desorb a maximum of 40 micrograms of agent GD and 180 micrograms of agent HD (see Appendix A, 10.1)

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3.21 Weather resistance. Films of the coating tested as specified in 4.28 shall not show a rating less than 9 (ASTM D 660) for checking, not be rated lower than a 9 (ASTM D 661) for cracking, not be rated less than an 8 (ASTM D 659) for chalking and not rated less than 10 (ASTM D 714) for blistering. No other film defects shall be allowed. The color shall not change more than 2.5 N.B.S. units and the infrared and allowable ratio shall remain within those limits originally specified.

3.22 Primer compatibility.

3.22.1 Dry adhesion. Films of the coating when tested as specified in 4.29.1 shall show no blistering (ASTM D 714, rating 10), wrinkling or any other evidence of separation from the primer. The adhesion of the tape test shall not be rated lower than 4A (ASTM D 3359, Method A).

3.22.2 Wet adhesion. Films of the coating when tested as specified in 4.29.2 shall show no blistering (ASTM D 714, rating 10), wrinkling or any other evidence of separation from the primer. The adhesion of the tape test shall not be rated lower than 4A (ASTM D 3359, Method A).

3.23 Knife test. When tested as specified in 4.30 a film of the coating shall adhere tightly to the panel. It shall be difficult to furrow off with the knife and shall not flake, chip or powder. The material shall not show brittle or rubbery characteristics. The knife cut shall have beveled edges when view under a 10X magnification.

3.24 Storage stability.

3.24.1 Shelf life. When tested as specified in 4.10.1, one year after date of manufacture, an original, unopened container of the material shall meet the requirements of paragraphs 3.6 through 3.23 inclusive.

3.24.2 Partially full container. After exposure as specified in 4.10.2, the material shall show no skinning, livering, curdling, hard dry caking or tough gummy sediment. The material shall readily mix with a paddle or mechanical mixer within 5 minutes to a smooth, uniform state, free from seeds, grit, lumps and skins. No color change shall be noted and the consistency of the material shall not change more than +/- 10 % of the stated manufacturer's original requirements.

3.25 Freeze-thaw stability. When tested as specified in 4.31, the material shall be free of livering, curdling, hard caking, seeds, grit or tough gummy sediments. The material shall readily mix with a paddle or mechanical mixer within 5 minutes to

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a smooth, uniform state, free from seeds, grit, lumps and skins or persistent foam. No color change shall be noted and the consistency of the material shall not change more than +/- 10 % of the stated manufacturer's original requirements.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or other facilities as approved by the Department of Defense for the performance of the inspection requirements specified herein. A list of approved facilities may be obtained from; Defense Technical Information Center, Defense Logistics Agency, Cameron Station, Alexandria, VA 22304-6145. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3, 4 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirement in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements; however, this does not authorize submission of known defective materials, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Sampling, inspection and testing. Unless otherwise specified, sampling, inspection and testing shall be in accordance with section 1000 of FED-STD-141.

4.2 Material safety data sheet. Material safety data sheets must address all components supplied and be in compliance with FED-STD-313 (see 3.2)

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

- (a) Qualification inspection (see 4.4)
- (b) Quality conformance inspection (see 4.5)

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4.4 Qualification inspection. Qualification inspection (see 3.1 and 6.4) shall be conducted at an approved Department of Defense laboratory or manufacturer's laboratory approved by the Marine Corps Systems Command (MARCORSYSCOM). Tests shall be monitored by the Defense Contract Administration Service Management Area (DCASMA). Qualification tests shall consist of all tests specified in Section 3 and Table IX. If no test paragraph is listed in Table IX, the test shall be conducted in accordance with the method listed and results shall comply with the requirement paragraph listed. A test report detailing the results of any required testing performed by the manufacturer, his representatives or at his behest by employed agents shall be provided by the manufacturer to the contracting officer, his agent or the qualifying activity, as appropriate.

4.5 Quality conformance inspection. Quality conformance testing of individual lots shall consists of the tests listed in Table IX marked with a 1/ (see Table IX footnote). Tests shall be performed and documented on a certified test report with each lot offered for delivery.

4.5.1 Lot. A lot shall consist of a single uniform batch or a uniform blend of batches offered for delivery at one time.

4.5.1.1 Batch. A batch shall consist of a quantity of an individual finished paint manufactured at the same time from the same units (sacks, cans, barrels, etc.) of ingredients.

4.6 Test conditions. Unless otherwise specified, the routine and referee testing conditions shall be in accordance with FED-STD-141. The term referee condition shall mean a temperature of  $23 \pm 1^{\circ}\text{C}$  ( $73 \pm 2^{\circ}\text{F}$ ) and a relative humidity of  $50 \pm 10$  percent. A dry film thickness of 3.8 to 5.1 mm (0.0015 to 0.002 inches (1.5 - 2.0 mils)) shall be used whenever film thickness is required in any test unless otherwise specified by the test.

4.7 Test procedures. Tests shall be conducted in accordance with FED-STD-141 or ASTM as specified herein unless other specified (see Table IX). The Government reserves the right to make any additional tests deemed necessary to determine that the coating meets the requirements of this specification.

4.8 Test panels. Unless otherwise specified test panels shall be pretreated with a zinc phosphate coating conforming to TT-C-490, Type I.

4.9 Color and spectral reflectance. Prepare four drawdowns of the coating on black and white Morset cards to a dry film

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thickness of 0.002 (+/- 0.0002) inches. Dry for 48 hours. Determine the color from the spectral reflectance curves using a recording spectrophotometer method in accordance with ASTM-E-308. Determine the infrared reflectance in accordance with method 6241 of FED-STD-141. Measurements shall be made over the black portion of the Morset card. Non-compliance to 3.6 shall constitute failure of this test.

#### 4.10 Storage stability.

4.10.1 Shelf life. When allowed to remain undisturbed for one year under ambient conditions, the coating shall conform to the requirements in 3.24.1.

4.10.2 Partially full container. A 3/4 full container of each component of the material shall be resealed and allowed to age at 60°C (140°F) for 30 days and then examined for compliance to 3.24.2.

4.11 Spraying properties. The coating shall be sprayed in an "as-received" condition, following manufacturer's recommended mixing requirements, on a test panel prepared in 4.8 to a dry film thickness of 0.002 inches. Spraying properties shall conform to 3.10 when tested in accordance to method 4331 of FED-STD-141. For referee tests use automatic application per method 2131 of FED-STD-141.

4.12 Brushing properties. Apply the coating in an "as-received" condition, following manufacturer's recommended mixing requirements, on a test panel prepared in 4.8 using a 2 inch brush in accordance with method 4321 of FED-STD-141. Compliance shall be in accordance with 3.11.

4.13 Mixing properties. If material is supplied in more than one component, then mixing shall conform to the manufacturer's recommendations. The mixed material shall be allowed to stand for 4 hours in a closed container. After 4 hours the material shall be examined for compliance to 3.9.

4.14 Flexibility. The flexibility of the coating shall be determined in accordance with method 6221 of FED-STD-141. A 2 inch wide film of the mixed coating shall be applied using a film applicator that will give a dry film thickness (DFT) of  $0.001 \pm 0.0001$  inch on a No. 31 gage (0.0107 inch) cold rolled, tin-plated steel panel prepared in accordance with procedure B, phosphoric acid etched, method 2012.1 of FED-STD-141. Age the film in an horizontal position for 72 hours and then bake the film at  $105^{\circ}\text{C} \pm 4^{\circ}\text{C}$  ( $221 \pm 4^{\circ}\text{F}$ ) for 96 hours. Condition the panel



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for 1/2 hour under referee conditions . Bend the panel over a 1/8 inch mandrel. Examine for compliance with 3.12.

4.15 Water resistance. Apply the mixed coating by spraying the material to a dry film thickness of 0.0009 to 0.0011 inches on a test panel prepared in 4.8 and air drying for 168 hours. Coat all exposed unpainted steel surfaces with wax or other suitable protective materials and immerse in distilled water at  $23 \pm 1$  °C ( $77 \pm 1$  °F) for 168 hours as in ASTM-D-1308, section 6.4. At the end of the test period remove and examine for compliance with 3.14.

4.16 Hydrocarbon resistance. Apply the mixed coating by spraying the material to a dry film thickness of 0.0009 to 0.0011 inches on a test panel prepared in 4.8 and air drying for 168 hours. Coat all exposed unpainted steel surfaces with wax or other suitable protective materials and immerse in a hydrocarbon fluid conforming to TT-S-735, Type III at  $23 \pm 1$  °C ( $77 \pm 1$  °F) for 168 hours as in ASTM-D-1308, section 6.4. At the end of the test period remove and examine for compliance with 3.15.

4.17 Volatile organic content. The VOC in the coating shall conform to the requirements of Table VIII, when tested in accordance with EPA 40 CFR CH. 1, part 60, Appendix A, Method 24.

4.18 Hiding power (Contrast ratio). Prepare one draw down as in 4.9 except that the final dry film thickness (DFT) should be  $0.001 \pm 0.0001$  inch. Verify the DFT in the area which the reflectance is to be measured. Determine the hiding power in accordance with ASTM D 2805. Record the values of  $R_b$  and  $R_w$  respectively. Calculate the hiding power and determine compliance with Table VIII.

4.19 Drying time. Draw down the mixed coating to a DFT of  $0.001 \pm 0.0001$  inch on a panel as prepared in 4.8 and determine the drying time under conditions described in 4.6 and ASTM-D-1640. Check for compliance with Table VIII.

4.20 Specular gloss. On an opaque white glass panel, draw down the mixed coating to a DFT of  $0.0020 \pm 0.0002$  inch. Test for 60 degree and 85 degree gloss and check for compliance with Table VIII.

4.21 Polish resistance.

4.21.1 Test apparatus. The apparatus shall consist of an electrically operated, straight line, reciprocating washability and abrasion machine with an abrasion boat attachment as described in ASTM D 3450 note 5. The abrasion boat shall be



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approximately 3.5 by 2.125 inches at the base and weigh 4.5 pounds including added weights. The abrasion boat shall have a spindle located at each end to retain the roll of polishing cloth and vertical pin by which it is attached to the driving cord. A cotton canton flannel cloth, 1.75 inches wide, shall be attached to the spindles for this test. The length of the stroke shall be approximately 13 inches. The speed shall be approximately 37 cycles per minute.

4.21.2 Polishing medium. The polishing medium shall consist of the following weight:

50 parts synthetic yellow iron oxide

100 parts SAE-10 engine oil conforming to MIL-L-2104.

4.21.3 Test procedure.

4.21.3.1 Test procedure (a). Draw down a 4 inch wide film of the coating with a 0.004 inch gap clearance doctor blade on a 6 by 17 inch glass panel prepared and cleaned as in method 2021 of FED-STD-141. Air dry the specimen for 168 hours and then apply a 0.002 inch film of the polishing medium over the coating areas of the test specimen.

4.21.3.2 Test procedure (b). Condition the flannel cloth by drawing down a 2 inch wide film of the polishing medium with a 0.004 inch gap clearance doctor blade on a 6 by 17 inch glass panel. Clamp the glass panel on the abrasion apparatus so the film is centered with the polishing stroke and run the apparatus for 10 cycles. Use a new flannel cloth for each test.

4.21.3.3 Test procedure (c). Remove the glass panel used to condition the flannel cloth and replace with the specimen test panel from 4.21.3.1. Run the apparatus for 500 cycles. Remove the panel, rinse with thinner conforming to TT-T-291, grade 1 and wash with a soft sponge or cloth using yellow laundry soap and water. Dry thoroughly, determine gloss and sheen at 60 and 85 degree of the area in the center of the panel as in 4.20, and check for compliance with Table VIII.

4.22 Accelerated weathering. Prepare four flat tin panels with a  $0.002 \pm 0.0002$  inches DFT of the coating to be tested. Air dry the panels for 72 hours under ambient conditions. Three panels are to be tested and one panel is to be used as a control. Determine and record the color and infrared reflectance as in 4.9. Determine and record the 60 and 85 degree glosses as in 4.20. Expose three of the panels for 300 hours to accelerated weathering in accordance with ASTM G 53 using 4 hours UV radiation at 60 °C and 4 hours condensation at 50 °C and QUV-313

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light source. Examine the panel for chalking by rubbing with a piece of velvet or cheese cloth. Check for compliance with 3.18.

4.23 DS2 resistance. Prepare one 4 by 12 inch steel panel as in 4.8, except spray the coating to a DFT of 0.002 inch minimum. Air dry the panel for 24 hours then bake for 24 hours at 105 °C  $\pm$  2 °C. Allow the panel to return to ambient temperature and place 2 spots approximately 1/2 ml each of DS2 reagent on the panel surface. Do not cover. Allow to stand 30 minutes then thoroughly wash with water. Examine for compliance with 3.19.

4.24 Chemical agent resistance.

4.24.1 Panel preparation. Spray eight 3 by 3 inch zinc phosphate pretreated according to TT-C-490, type I, steel panels with epoxy primer conforming to MIL-P-53022 or MIL-P-53030 and eight panels with MIL-P-24441, type III, formula 150 epoxy primer to a DFT between 0.0009 and 0.0011 inches. Air dry for 2 hours and spray the coating to be tested to a DFT between 0.0018 and 0.0022 inches. Air dry the panels for 96 hours and then bake for 72 hours at 105  $\pm$  2 °C.

4.24.2 Test conditions. Because the desorption rate of agents from paint is temperature dependant, all agent tests will be conducted at 25 °C. WARNING - EXTREMELY TOXIC MATERIALS ARE USED IN THIS TESTING. AGENT HD IS A KNOWN CARCINOGEN. ALL WORK WILL BE PERFORMED IN AN APPROVED DEPARTMENT OF THE MARINE CORPS LABORATORY. APPROPRIATE MEASURES SHALL BE TAKEN TO PROTECT INDIVIDUALS AT RISK FROM EXPOSURE AT ALL TIMES.

4.24.3 Test apparatus. In an approved fume hood, use a short length of tubing to attach an apparatus to a sampling bubbler, filled with 5 milliliters of diethyl phthalate. Connect the outlet of the bubbler to the vacuum line in the hood with a one liter per minute critical orifice inserted between the bubbler and the vacuum line. A charcoal trap or canister will be inserted directly before the vacuum line.

4.24.4 Test procedure. Mark a 5 square centimeter area in the center of the test panel and place the panel in the fume hood. Completely contaminate the area drop wise from a micro syringe, spreading the agent with the flat portion of the needle and being careful not to damage the paint. Keep the area wet for 30 minutes by adding more agent as required. After 30 minutes, pick up the panel with tongs, hold it over a toxic waste container and direct a stream of isopropyl alcohol (reagent grade) onto the surface of the panel to remove any liquid agent remaining. Using a wash bottle repeat the wash procedure an

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additional 5 times. Continuously monitor the panel until all the alcohol has evaporated. Place a stainless steel permeation cell over the contaminated area, seal with duct seal and begin sampling. Draw air into the end of the test apparatus, over the contaminated film and through the bubbler and critical orifice. Any agent vapors emitted will be picked up by the air stream and absorbed in the diethyl phthalate in the bubbler. After sampling continuously for 24 hours, analyze the diethyl phthalate for the presence of the agent using the methods described in Appendix A, or by an appropriate gas chromatographic method. Determine the agent recovered in micrograms for compliance with 3.20.

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4.25 Inspection of package.

	Defect	A	B	Comm.
101	Primary containers not of the types specified.	5.1.1.3		5.1.1.4
102	Primary containers not coated as specified	5.1.1.3		
103	Closure of primary containers not as specified	5.1.1.3		5.1.1.4
104	Primary containers not placed in unit containers as specified	5.1.2		5.1.2.2
105	Unit containers not as specified	5.1.2.1		5.1.2.2
106	Unit containers not placed in intermediate containers as specified	5.1.3		5.1.3.2
107	Intermediated containers not as specified	5.1.3.1		5.1.3.2
108	Unlike kits packed in same shipping container	5.2.1	5.2.2	5.2.3
109	Shipping containers not as specified	5.2.1	5.2.2	5.2.3
110	Palletization not as specified when required	5.2.4	5.2.4	5.2.4
111	Standard markings not as specified	5.3.1	5.3.1	5.3.2
112	Additional markings not as specified.1.1.3	5.3.3	5.3.3	5.3.3

4.25.1 Quality conformance inspection of pack.

4.25.1.1 Unit of product. For the purpose of inspection and testing, a complete pack prepared for shipment shall be considered a unit of product.

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4.25.1.2 Sampling. Sampling for examination and testing shall be in accordance with MIL-STD-105.

4.25.1.3 Examination. Samples selected in accordance with 4.25.1.2 shall be examined for the following defects to the container, package or unit of product. The acceptable quality level shall be 0.0 percent defective.

4.26 Acid Resistance. Using the film prepared in 4.20, place a 3 to 5 ml spot of a 10 percent by volume acetic acid solution on the surface of the coating. Cover with an appropriate size watch glass and allow to stand for 1 hour. Rinse with water thoroughly, allow to dry and examine for blistering and color change and compliance with 3.16.

4.27 Recoatability. On a panel as prepared in 4.8, spray the coating to a dry film thickness of 0.0008 to 0.0011 inch. Apply a second coat of paint to one panel after 2 hours air drying and a second coat to the other panel after 24 hours air drying. Air dry both panels for an additional 24 hours. Examine for compliance with 3.13.

4.28 Weather Resistance. Spray two 4 by 12 inch steel panels as in 4.24.1 and air dry for 7 days. Place the panels on an outdoor exposure apparatus for 1 year at an angle of 45 degrees south in the vicinity of Albany, GA. At the end of this exposure period examine the panels for compliance with 3.21. Determine chalking according to ASTM D 659. Wash the panels with warm soap solution using a soft sponge or cloth, rinse, dry and examine for color change.

4.29 Primer Compatibility.

4.29.1 Dry Adhesion. Prepare 18, 6 by 12 inch test panels by abrasive blasting with glass beads or garnet, conforming to MIL-A-22262, to a SSPC-SP-5 condition. Six panels shall be primed with MIL-P-24441 type III, F-150 epoxy polyamide to a dry film thickness of 2 +/- 0.5 mils, four panel with a NAVSEA 5141 approved inorganic zinc-zinc rich primer to a dry film thickness of 1 +/- 0.5 mils, four panels with MIL-P-53022 and four panels with MIL-P-53030 each to a dry film thickness of 3 +/- 0.2 mils. Two panels each prepared with MIL-P-24441 type III shall dry for 6, 24 and 168 hours respectively at standard test conditions, before the application of a spray coat of CARC paint applied at the manufacturer's recommended dry film thickness. Panels of the NAVSEA approved inorganic zinc-zinc rich primer shall be overcoated in the same manner as the MIL-P-24441 panels. Two panels each of the 53022 and 53030 shall be air dried for 24 and 168 hours respectively and overcoated with CARC material in the

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same manner as the MIL-P-24441 type IV panels. All overcoated panels shall be allowed to stand for 168 hours in a horizontal position at standard test conditions. At the conclusion of the drying cycle, a tape test shall be performed in accordance with ASTM D 3359, method A, except that the tape shall be a commercially available masking tape. Following the tape test, lifting characteristics shall be determined between the enamel and the primer at the scribe and at a distance up to 1 inch perpendicular to the scribe using the aid of a microscope. All test panels shall conform to 3.22.1.

4.29.2 Wet Adhesion. Application of the primers and CARC materials shall be made as specified in 4.29.1 and the systems shall be dried as previously indicated. At the conclusion of the drying cycle, the panels shall be scribed using a tool in accordance with ASTM D 1654 and immersed in distilled water at standard test conditions for 24 hours. While immersed, the panels shall be examined for evidence of blistering, wrinkling or other evidence of adhesion failure of the test enamel to the primers. Test for wet adhesion shall be accordance with method 6301.2 of FED-STD-141, except that the tape used shall be commercially available masking tape. Following the tape test, lifting characteristics shall be determined between the CARC and primer at the scribe and at a distance up to 1 inch perpendicular to the scribe using the aid of a microscope. The test results shall be as specified as in 3.22.2.

4.30 Knife Test. The knife test shall be conducted in accordance with method 6304.1 of FED-STD 141, using the flat portion of the panel from the flexibility test (see 4.14). The test results shall conform to 3.23.

4.31 Freeze Thaw resistance. For each component of the paint as received, fill a one pint lined friction top can two third full and close tightly. Expose the can and its contents three times to the following temperature cycle:

1. Low temperature of  $-9 \pm 2^{\circ}\text{C}$  ( $+15 \pm 3^{\circ}\text{F}$ ) for 16 hours
2. High temperature of  $49 \pm 3^{\circ}\text{C}$  ( $120 \pm 5^{\circ}\text{F}$ ) for 8 hours

At the completion of the exposure test measure the consistency of the CARC component using ASTM D 562 and compare with the original consistency to determine compliance with the requirements of 3.25.

## 5. PACKAGING



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5.1 Preservation. Preservation shall be level A or commercial as specified (see 6.2).

5.1.1 Primary containers.

5.1.1.1 Component A or Single Component Materials. The Primary containers for component A shall be 1 quart or 1 gallon multiple friction plug containers, each filled to its rated capacity with component A, 5 gallon lug cover steel pails filled with but 5 gallons of component A, 55 gallon steel drums filled with but 55 gallons of component A, or 55 gallon steel drums filled to their rated capacity with component A.

5.1.1.2 Component B (catalyst). The primary containers for component B shall be 1/2 pint, 1 quart or 1 gallon multiple friction plug containers, 10-gallon lug cover steel pails or 55 gallon steel drums. All primary containers for component B shall be filled to their rated capacities. If container sizes other than the ones listed above are used then these containers shall be filled to their rated capacity.

5.1.1.3 Level A. Primary containers, of the types and sizes specified in 5.1.1 shall comply with the following requirements:

a. Multiple friction plug containers shall be in accordance with PPP-C-96, type V, class 2. Interior coatings, as applicable, shall be as specified therein. Exterior coatings, including side seam stripping, shall be as specified therein for plan B. Wire handles as specified therein shall be provided for the 1 gallon container. Closure of the filled and properly sealed cans shall be as specified in appendix thereto.

b. Lug cover steel pails shall be in accordance with PPP-P-704, type II or III, class as applicable. Interior coatings and exterior coatings shall be as specified therein. Closure of filled and properly sealed pails shall be as specified in appendix thereto.

c. Steel drums shall conform to PPP-D-729. Alternatively, when specified, the 55 gallon drums shall conform to PPP-D-732. Drum types shall be as applicable and classes shall be optional.

d. The containers shall comply with the requirements of the Uniform Freight Classification (UFC) or the National Motor Freight Classification (NMFC) and the applicable requirements of the Code of Federal Regulations 49 CFR, Department of Transportation (DOT).

5.1.1.4 Commercial. Primary containers of the types and sizes specified in 5.1.1 shall be those containers normally used for

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products of this nature providing there will be no interaction chemically or physically with the contents so as to damage the container or alter the strength, quality or purity of the contents. The containers shall comply with the requirements of the UFC or the NMFC and the requirements of 49 CFR.

5.1.2 Unit (kit) containers. Components A and B, in the primary containers specified in 5.1.1, shall, as applicable, be placed in unit (kit) containers in the ratio as specified by the manufacturer. The following are examples of this unit container in a 4 to 1 ratio: 4 parts by volume of component A to one part by volume of component B (see 3.4), in the following manner:

- a. One, 1 quart primary container of component A shall be placed in a unit container with one, 1/2 pint primary container of component B.
- b. One, 1 gallon primary container of component A shall be placed in a unit container with one, 1 quart primary container of component B.
- c. One, 5 gallon primary container with but 4 gallons of component A shall be placed in a unit container with one, 1 gallon primary container of component B. this combination shall be described as a "5 gallon kit".
- d. Unit (kits) containers shall not be required for the 10 gallon primary containers or the 55 gallon primary containers, but the combination of one, 55 gallon primary container with but 40 gallons of component A and one, 10 gallon primary container of component B shall be described as a "50-gallon kit".

5.1.2.1 Level A. Unit containers, required of the component combinations in 5.1.2, shall be in accordance with PPP-B-636, type GF, grade V3c, W5c or W6c, as applicable, style optional. The primary containers shall be arranged within the unit container to provide the smallest practical cubage yet permit the application of cushioning and functional filler devices. Such cushioning and fillers shall completely fill the container. Container closure shall be in accordance with method IV of the appendix to PPP-B-636. Container shall comply to UFC or NMFC, and 49 CFR requirements.

5.1.2.2 Commercial. Unit containers, required of the component combinations in 5.1.2, shall be close-fitting corrugated fiberboard boxes in accordance with UFC or NMFC, and 49 CFR requirements. Cushioning and filler devices shall be utilized to prevent damage to the contents during shipment, handling and storage.

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5.1.3 Intermediate. The coating, in the unit containers specified in 5.1.2, shall be placed in intermediate containers in the following manner:

a. Eight unit containers, each with one, 1 quart primary container of component A and one, 1/2 pint primary container of component B shall be placed in an intermediate container.

b. Four unit containers, each with one, 1 gallon primary container of component A and 1 quart primary container of component B shall be placed in an intermediate container.

c. Intermediate containers shall not be required for the 4 gallon to 1 gallon combination, the 40 gallon to 10 gallon combination or the completely filled 55 gallon drums.

5.1.3.1 Level A. Intermediate containers, for the coating quantities specified in 5.1.3, shall comply with the requirements of PPP-B-636, type CF, grade V3c or W5c, as applicable, style optional. The containers shall be close-fitting and closure shall be in accordance with method IV of the appendix thereto. Containers shall comply with UFC or NMFC, and 49 CFR requirements.

5.1.3.2 Commercial. Intermediate containers, for the coating quantities specified in 5.1.3, shall be close-fitting corrugated fiberboard boxes in accordance with UFC or NMFC, and 49 CFR requirements.

5.2 Packing. Packing shall be level A, level B or commercial as specified.

5.2.1 Level A. Intermediate containers of like kits shall be packed in closefitting wood boxes conforming to PPP-B-601, overseas type, or PPP-B-621, class 2. Box closure shall be as specified in the applicable box specification or the appendix thereto except that strapping shall be flat steel and finish shall be "B". Unit containers of the 4 gallon to 1 gallon ratio of components A to B shall be packed for level A in the same manner. The primary container for the 40 gallon/10 gallon combination and the completely filled 55 gallon drums shall not require additional protection.

5.2.2 Level B. Level B packing shall be as specified in 5.2.1, for level A packing except that boxes shall be domestic type or class and the strapping shall be finish A.

5.2.3 Commercial. The coating, in intermediate containers and unit containers as specified in 5.1.3, shall be packed in

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multiples of like kits in accordance with UFC or NMFC, and 49 CFR requirements.

5.1.4 Palletization. When specified, the primary containers for the 40 gallon/10 gallon combination and the completely filled 55 gallon drums shall be palletized in accordance with the requirements of MIL-STD-147. Only one size primary container for a single component shall be placed on a pallet.

### 5.3 Marking.

5.3.1 Levels A and B. Each primary container, unit container, intermediate container and shipping container shall, as applicable, be marked in accordance with PPP-P-1892.

5.3.2 Commercial. Commercial marking shall be in accordance with ASTM D 3951 and 49 CFR. Additionally, the gross weight and cube shall be marked on each shipping container.

5.3.3 Additional Marking. In addition to any special or identification marking which may be required by the contract or purchase order, 5.3.1, and 5.3.2, each primary container shall be marked "Component A (resin)", or "Component B (catalyst)" as applicable.

5.4 Precedence. If there is any conflict between the requirements of this specification and the Department of Transportation Regulation 49 CFR for the types of containers specified, the contractor or manufacturer shall give the purchasing officer a statement in writing about the conflict and obtain instructions before proceeding with the packaging of the coating.

## 6. NOTES

6.1 Intended Use. This coating is intended for use to provide surfaces which are easily and effectively decontaminated after exposure to liquid chemical agents such as Marine Corps troop carriers and other combat vehicles. It may be used in areas where air Pollution Regulations are in force. This material shall not be thinned prior to its intended use. It is applied over epoxy primers, NAVSEA approved inorganic zinc-zinc rich primers, system primers, MIL-P-24441/1 (type 1 and 4), MIL-P-23377, MIL-P-53022 or MIL-P-53030 depending on the substrate or regulatory requirements. For adequate camouflage properties, it is necessary to apply the coatings to a minimum dry film thickness of 0.0018 inches.

6.2 Ordering Date. Procurement documents should specify the following:

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- a. Title, number, and date of this specification.
- b. Color and type of coating (see 1.2).
- c. Degree of preservation and degree of packing required (see 5.1 and 5.2).
- d. Size of primary containers required (see 5.1.1).
- e. When alternate PPP-D-732 reconditioned 55-gallon drums are acceptable (see 5.1.1.3c).
- f. When palletization is required (see 5.2.4).
- g. Any special marking requirement (see 5.3).

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

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable qualified products list whether or not such products have actually been so listed by that date. 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 orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Marine Corps Systems Command, Code PSE-P 2033 Barnett Ave Suite 315, Quantico, VA 22134-5010, and information pertaining to qualification of products may be obtained from the activity (see section 4).

6.4.1 Qualification Extension. Qualification testing shall be performed on the colors listed in Table III. Colors approved for qualification will not extend to other colors listed in the column.

6.4.2 Limitation of Olefinic Test. The test for olefinic and cyclo-olefinic compounds will not be positive for solvents containing less than 1 percent of these compounds.

6.5 Material Safety Data Sheet. Contracting officers will identify those actives requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313. The pertinent government mailing addresses for submission of data are listed in appendix B of FED-STD-313.

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6.6 Subject Term (key word) Listing.

Agent resistant  
Coating  
Camouflage  
CARC  
Chemical Agent Resistant Coating  
Top Coat

Preparing Activity:

NAVY - MC

Custodians:

NAVY - MC

Users:

NAVY - MC



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TABLE I. Total Metals Content

Requirements	Maximum
Metals content, mg/L	15
Antimony and/or its compounds	5
Arsenic and/or its compounds	100
Barium and/or its compounds excluding barite	0.75
Beryllium and/or its compounds	1
Cadmium and/or its compounds	5
Chromium (VI) compounds	560
Chromium and/or chromium (III) compounds	80
Cobalt and/or its compounds	25
Copper and/or its compounds	180
Fluoride salts	5
Lead and/or its compounds	0.2
Mercury and/or its compounds	350
Molybdenum and/or its compounds	20
Nickel and/or its compounds	1
Selenium and/or its compounds	5
Silver and/or its compounds	7
Thallium and/or its compounds	24
Vanadium and/or its compounds	250
Zinc and/or its compounds	

Table II Soluble Metals Content

Requirement	Maximum
Metals content, mg/L	0.05
Antimony and/or its compounds	0.05
Arsenic and/or its compounds	1.00
Barium and/or its compounds excluding barite	.0075
Beryllium and/or its compounds	0.01
Cadmium and/or its compounds	0.05
Chromium (VI) compounds	0.25
Chromium and/or chromium (III) compounds	0.80
Cobalt and/or its compounds	0.25
Copper and/or its compounds	1.80
Fluoride salts	0.10
Lead and/or its compounds	0.002
Mercury and/or its compounds	0.35
Molybdenum and/or its compounds	0.20
Nickel and/or its compounds	0.01
Selenium and/or its compounds	0.05
Silver and/or its compounds	0.07
Thallium and/or its compounds	0.24
Vanadium and/or its compounds	0.50
Zinc and/or its compounds	

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Table III Camouflage Colors

Color	Fed. Std. 595B
Green 383	34094
Brown 383	30051
Tan 686 A	33446
Black 383	37030

Table IV Color Reflectance and Requirements

Color	Visual (Y)	Chromaticity		Infrared <sup>1/</sup>		Allowable <sup>2/</sup>
		x	y	min	max	Ratio Min.
Green 383						
34094	0.063 - 0.383	0.328	0.365	-	60.0	5.2
Brown 383						
30051	0.060 - 0.080	0.357	0.342	8.0	20.0	-
Tan 686A						
33446	0.360 - 0.400	0.368	0.364	62.0	72.0	-
Black 383						
37030	0.030 - 0.041	0.310	0.315	0.0	15.0	-

<sup>1/</sup> For wavelength definition, see Table VII.

<sup>2/</sup> The ratio is calculated by dividing the value of the infrared by the value of the red spectral range.

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Table V Spectral Reflectance Limits for Green 383, 34094

Wavelength Nanometers	% Reflectance	
	Max.	Min.
600	10.2	-
610	9.8	-
620	9.8	-
630	9.8	-
640	9.5	-
650	9.5	-
660	10.0	-
670	10.5	4.0
680	13.0	5.8
690	21.5	8.5
700	28.0	11.0
710	35.8	15.0
720	41.0	19.0
730	48.5	25.0
740	51.8	30.0
750	56.-	36.3
760	59.5	40.0
770	61.5	42.0
780	-	42.0
790	-	42.0
800	-	42.0
810	-	42.0
820	-	42.0
830	-	42.0
840	-	42.0
850	-	42.0
860	-	42.0
870	-	42.0
880	-	42.0
890	-	42.0
900	-	42.0

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Table VI Pigmentation

Green 383, 34094	Acid insoluble green pigments composed of zinc, other oxides as permitted, light stable organic yellow or orange, carbazole dioxazine violet, iron oxides, zinc/magnesium ferrite or other mixed metal oxides.
Brown 383, 30051 Tan 686A, 33446	Titanium dioxide, carbon black, carbazole dioxazine violet, iron oxides, zinc/magnesium ferrite or other mixed metal oxides.
Black, 37030	Carbon black, iron oxides.

Table VII Spectral Ordinates for Determining Infrared and Red Reflectance Values from Spectrophotometric Ordinates

Magenta Red Region <u>Nanometers</u>	Infrared Region <u>Nanometers</u>		
620	714	769	816
626	725	773	821
638	730	777	826
645	737	783	831
649	742	787	836
652	747	793	842
653	751	797	848
655	756	802	855
658	760	807	862
663	764	811	873

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Table VIII Quantitative Requirements of All Colors Unless Specifically Indicated

Characteristics Mixed Paint	Minimum	Maximum
Fineness of grind (all colors) Hegman	3	-
Stormer viscosity K. U. (mixed)	65	85
Volatile organic content gr/L	-	216
Contrast Ratio	0.98	-
Drying time		
Set to touch, minutes	-	30
Dry hard, hours	-	1.5
Dry through, hours	-	2.0
Specular gloss		
60 degree	-	1.4
85 degree	-	3.5
Total Solids % mass of paint		
Green 383, 34094 1/	1/	1/
Brown 383, 30051 1/	1/	1/
Tan 686 A, 33446 1/	1/	1/
Black, 37030 1/	1/	1/
Extender Pigments % mass of paint		
Green 383, 30494	-	65
Brown 383, 30051	-	65
Tan 686 A, 33446	-	65
Black, 37030	-	85
		1/
Weight per gallon (density) 1/	1/	1/
Flash point, degrees Fahrenheit (°F) 1/	1/	0.02
Coarse particles and skins, percent weight of mixed paint.	-	
Impact resistance, 1 mil dry film, 20 inch-pounds (After 7 day ambient dry)		
Direct	no damage	
Reverse	no damage	

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Table VIII Quantitative Requirements of All Colors Unless Specifically Indicated - Continued

Characteristics Mixed Paint	Minimum	Maximum
Lead content, percent by weight of total solids	-	0.06
Sag resistance, anti-sag index	6	-
Soluble and total metal content	-	<u>2</u> /

1/ Manufacturer shall supply information with MSDS.

2/ See Section 3.5, Table I, Table II



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Table IX. Test Procedures

Characteristic	Requirement	Applicable Test Method FED-STD-141	ASTM Test Method	Test
Material Requirements	3.8	-	-	-
Mixing properties <u>1</u> /	3.9	3011.2	-	-
Water resistance <u>1</u> /	3.14	-	-	4.15
Hydrocarbon resistance <u>1</u> /	3.15	-	-	4.16
Acid resistance <u>1</u> /	3.16	-	-	4.26
Polish resistance	3.17	-	D 3450	4.21
Accelerated weathering <u>1</u> /	3.18	-	G 53	4.22
Weathering resistance	3.21	-	D 659	4.28
DS2 resistance	3.19	-	-	4.23
Chemical agent resistance	3.20	-	-	4.24
Toxic solvents	3.4	-	D 3272	-
Condition in container <u>1</u> /	3.9	3011.2	-	-
Storage stability	3.24	-	-	4.10.1-2
Spraying properties <u>1</u> /	3.10	4331	-	4.11
Brushing properties <u>1</u> /	3.11	4321	-	4.12
Color	3.6	6241	E 308	4.9
Spectral Reflectance				
Infrared reflectance	Table IV	6241	-	4.9
VOC <u>1</u> /	3.5.1	-	-	4.17
Drying time <u>1</u> /	Table VIII	-	D 1640	4.19
Flexibility <u>1</u> /	3.12	6221	-	4.14
Knife Test <u>1</u> /	3.23	6304.1	-	4.30
Viscosity Kneb Stormer <u>1</u> /	Table VIII	-	D 562	-

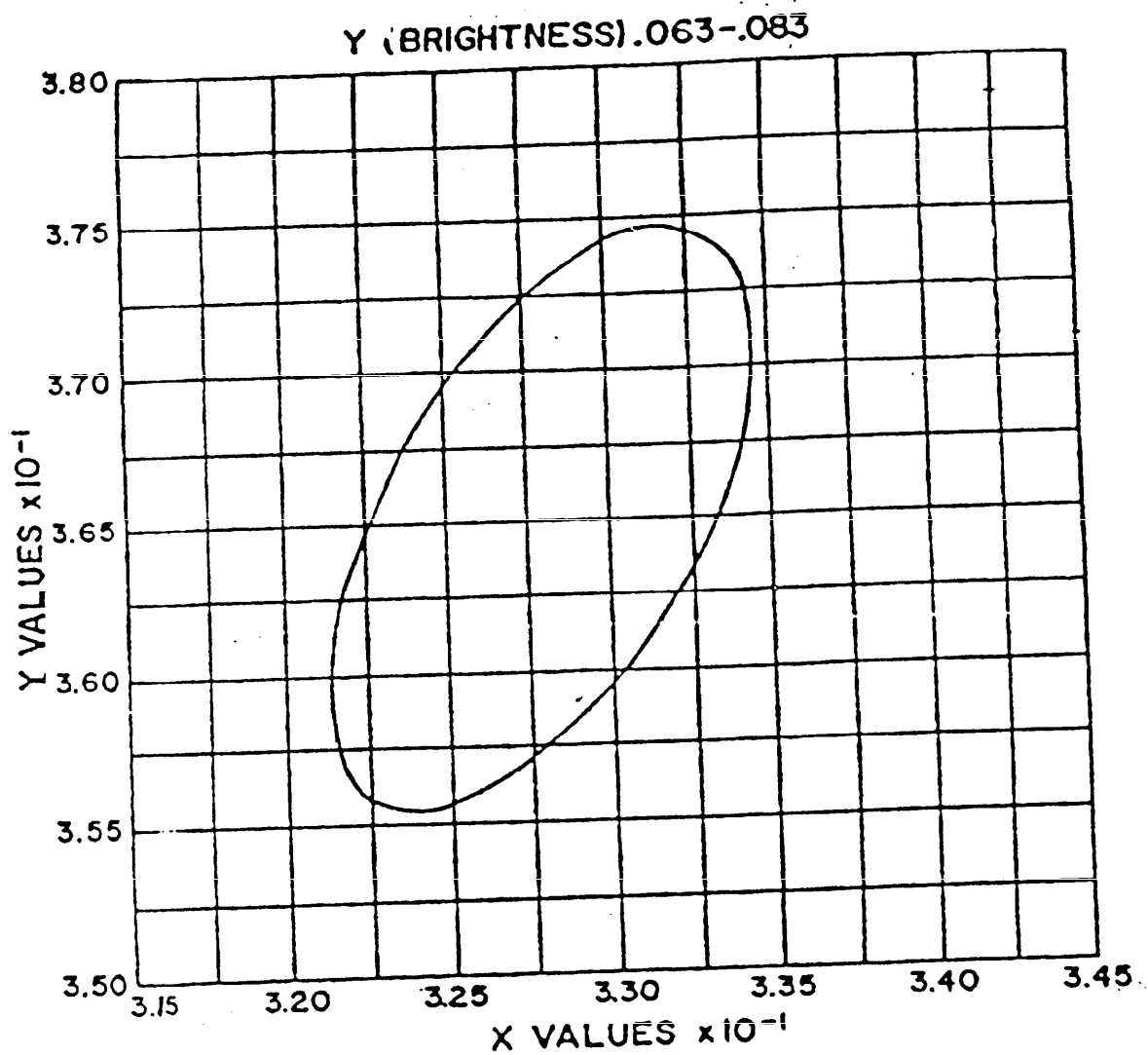
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Table IX. Test Procedures - Continued

Characteristic	Requirement	Applicable Test Method FED-STD-141	ASTM Test Method	Test
Pigment analysis	3.5.2	4021	-	-
Gloss				
60 degree specular <u>1</u> /	Table VIII	-	E 167	4.20
85 degree specular <u>1</u> /	Table VIII	-	E 167	4.20
Coarse particles	Table VIII	4092	-	-
Impact resistance	Table VIII	-	D 2794	-
Lead content	3.5.3	-	D 3335	-
Primer compatibility	3.22	-	-	4.29.1
Contrast ratio <u>1</u> /	Table VIII	-	D 2805	4.18
Sag resistance <u>1</u> /	Table VIII	-	D 4400	-
Fineness of grind <u>1</u> /	Table VIII	-	D 1210	-
Flash point <u>1</u> /	Table VIII	-	D 3278	-
Recoatability <u>1</u> /	3.13	-	-	4.27
Weight per Gallon <u>1</u> /	Table VIII	-	D 1475	-
Metal Content				
Soluble	3.5	-	-	3.4
Total	3.5	-	-	3.4

1/ Quality Conformance Tests per 4.5

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NOTE-COLOR ELLIPSE IS 2.0 NBS UNITS FROM  
CENTER VALUES.

FIGURE

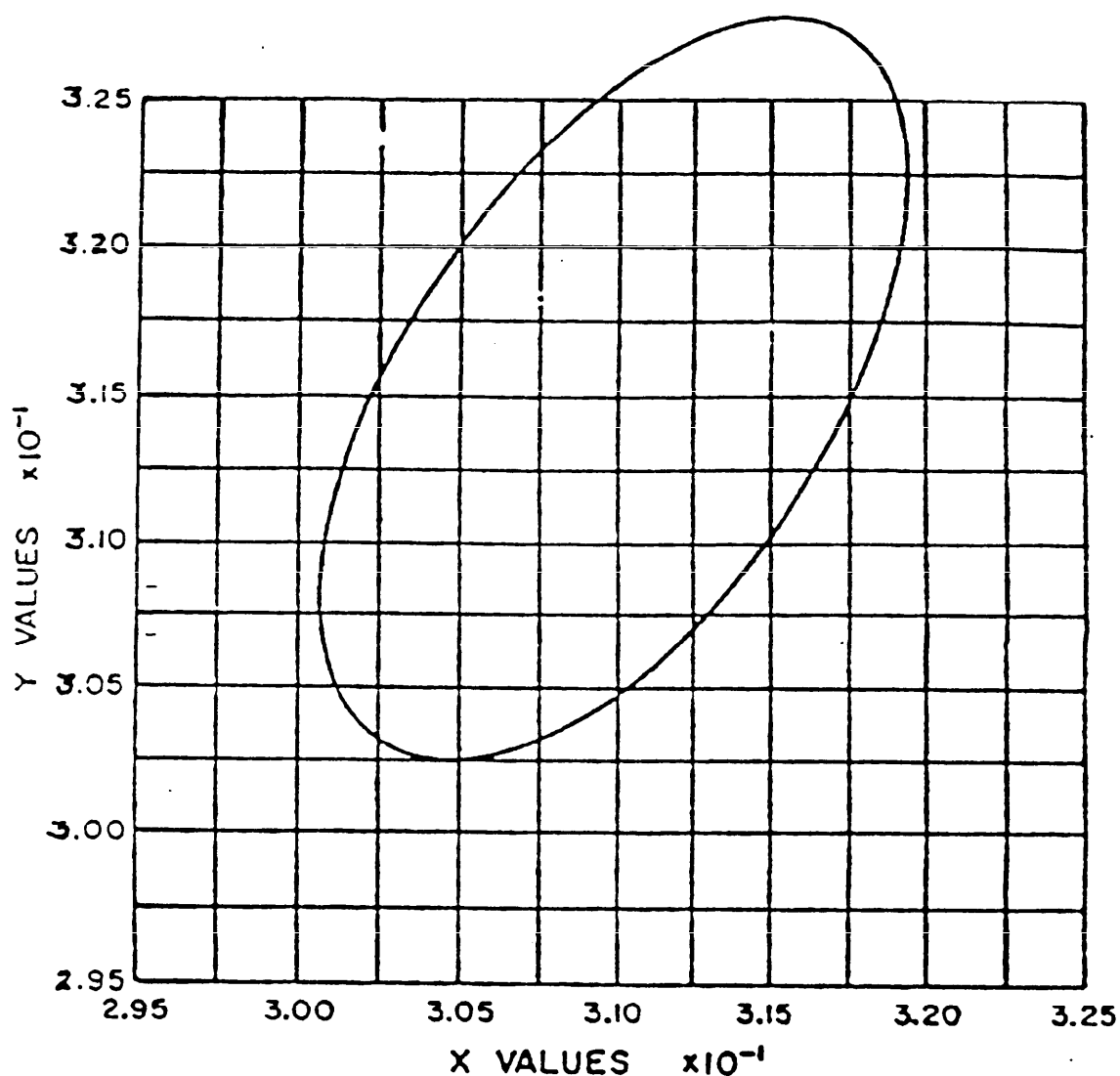
1

Chromaticity diagram for camouflage paint,  
color - green 383, 34094.

X-4266A

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Y (BRIGHTNESS) .030-.041



NOTE-COLOR ELLIPSE IS 2.0 NBS  
UNITS FROM CENTER VALUES.

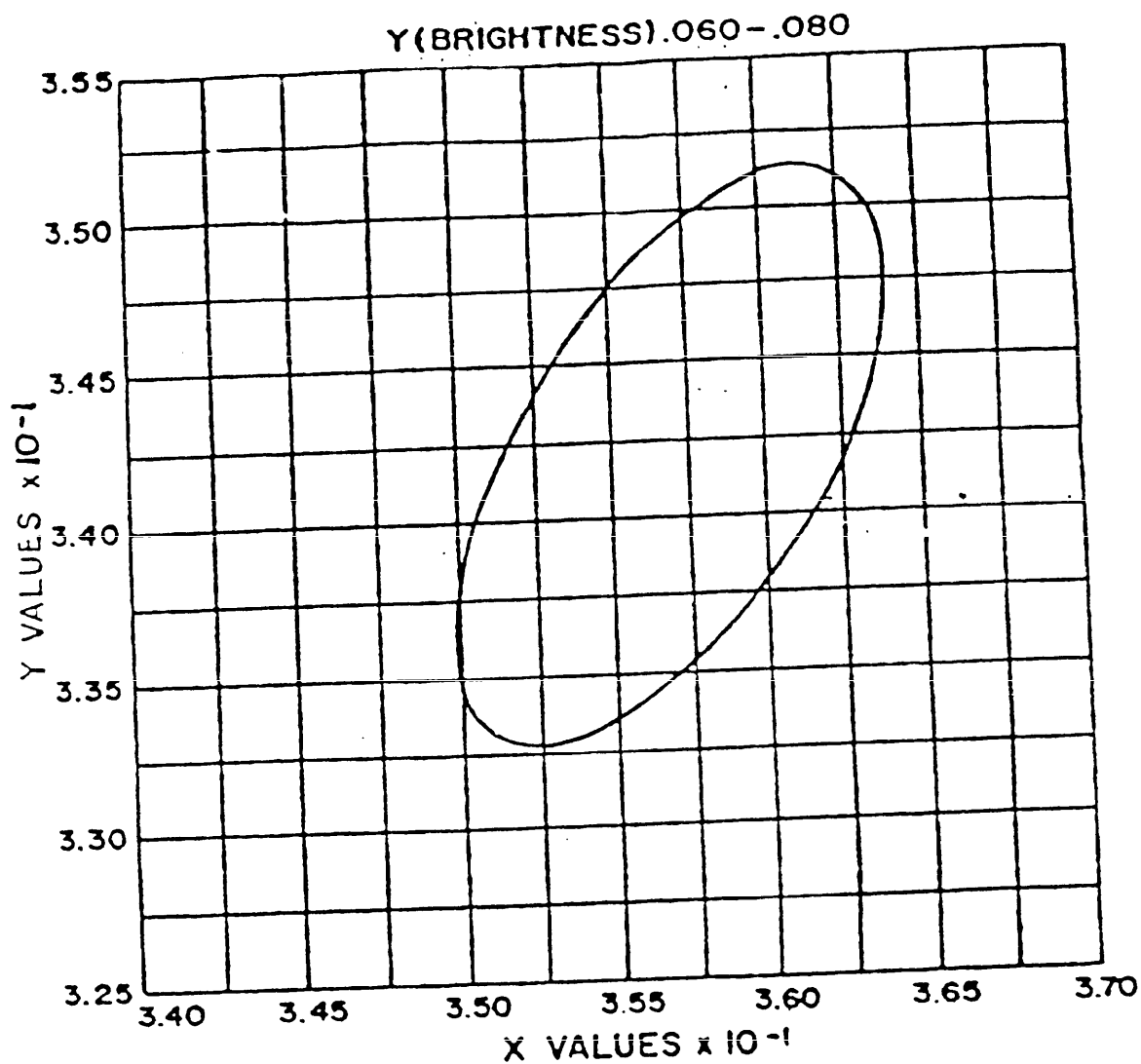
FIGURE

2

Chromaticity diagram for camouflage  
paint, color-black 37030.

X-2804A

MIL-C-29475(MC)



NOTE-COLOR ELLIPSE IS 2.0 NBS UNITS FROM CENTER VALUES.

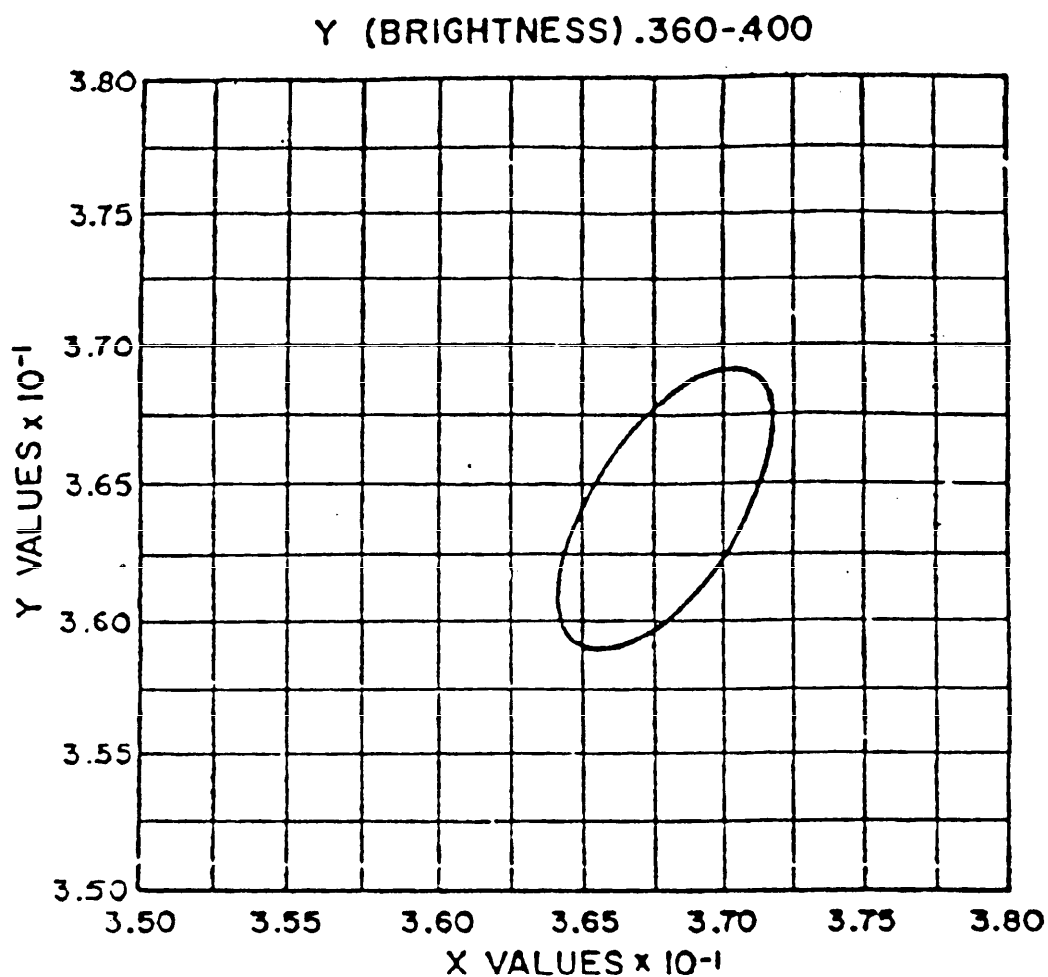
FIGURE

3

Chromaticity diagram for camouflage paint,  
color - brown 383, 3005L

X-4267A

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NOTE - COLOR ELLIPSE IS 2.0 NBS UNITS  
FROM CENTER VALUES.

FIGURE 4 Chromaticity diagram for camouflage  
paint, color - tan 686A, 33446



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## APPENDIX A

## METHOD OF ANALYSIS FOR CHEMICAL AGENTS HD AND GD

10. SCOPE.

10.1 This appendix contains the detailed methods for the analysis of chemical agents HD (Bis-dichloroethyl sulfide) and GD (pinacolylmethyl phosphonofluoridate).

10.2 **CAUTION:** Extremely toxic materials are used in this testing. Appropriate measures to protect individuals at risk of exposure must be taken.

20. ANALYSIS FOR AGENT HD (BIS-DICHLOROETHYL SULFIDE)20.1 Reagents.

20.1.1 BD-3 Solution. Place 200mL of 2-methoxy ethanol in a 500mL volumetric flask. Add 2.0gm DB-3 (4-(p-nitrobenzyl), 0.33gm phthalic acid, and 31.1gm sodium perchlorate monohydrate. Stir well until dissolved. Add 200mL of 2-methoxy ethanol and mix well. Add 0.5mL of 6N sodium hydroxide to 50mL of deionized water (use NaOH low in carbonate) and add to the ethanol solution. A brown color may form but will disappear with thorough mixing. Fill to 500mL with 2-methoxy ethanol and mix well. Transfer to a brown bottle and store in a refrigerator. This solution is stable for one week if kept cool.

20.1.2 Acetone (CP or Reagent Grade).

20.1.3 Piperidine.

20.2 Zeroing the Klett-Summerson Colorimeter. Turn on the colorimeter being sure the filter is a Klett-Summerson number 54 green ( ) = 520 - 580 millimicrons). Adjust the potentiometer to zero. Select a clean, unscratched Klett tube, fill with distilled water, and insert into the holder. With the large dial set on zero adjust slit opening so that the potentiometer reads zero. Empty the water from the tube, dry with acetone, and set aside. Use this tube for all future readings.

20.3 Standard Curve. Place about 20mL of diethyl phthalate in a 50 mL volumetric flask. Weigh into it about 75 milligrams (mg) of HD. Record the exact weight of HD added and dilute to 50 mL with diethyl phthalate. Label the flask "A". Divide the weight of HD added by the 50mL volume and multiply by 1000 to obtain the concentration in micrograms per milliliter (ug/mL). Place 20 mL of diethyl phthalate in a second 50 mL volumetric flask. Add 1 mL of solution "A" and fill to the mark with

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diethyl phthalate. Label this flask "B" and calculate its concentration using the following formula:

$$\text{Concentration of "B"} = \frac{(\text{Volume of "A" used})(\text{Concentration of "A"})}{\text{Volume of flask "B"}}$$

Place 50 mL of diethyl phthalate in a 100 mL volumetric flask. Add 4 mL of Solution "A" and dilute to mark with diethyl phthalate. Label flask "C" and calculate concentration as shown above. Number 10 Klett tubes 1 through 10. Place 2 mL of diethyl phthalate in each of tubes 1 and 2. Place 1mL of "B" and 1mL of diethyl phthalate in each of tubes 5 and 6. Place 1mL of "C" in each of tubes 9 and 10. Place a stirring rod and 5mL of the BE-3 solution (see 20.1.1) in each tube and stir well. Place the tubes in a water bath at 100 °C for 10 minutes, remove, and cool to room temperature<sup>1</sup>. Lift the stirring rods free of the liquid but do not remove them from the tubes. Add acetone to the 10 mL mark on each tube making sure the stirring rod remains above the liquid. Stir well. Add 1 mL piperidine, stir well, transfer to the reading tube (20.2) and read within 1 minute on the zeroed Klett-Summerson colorimeter with number 54 filter<sup>2</sup>. Record the Klett readings and average the duplicates. Subtract the average for the blank (1 and 2) from the other averages. Plot the net Klett readings (vertical axis) versus the ug of agent analyzed (horizontal axis). The result should be a straight line. The slope of this line, net Klett readings (vertical axis) versus the ug of agent analyzed (horizontal axis). The result should be a straight line. The slope of this line, net Klett reading ug, is used in finding the amount of HD in the bubbler samples.

20.4 Analyzing the Bubbler Sample. Transfer the contents of the bubbler to a test tube. Place 2 mL of diethyl phthalate in a separate tube to be used as a blank. Place 2 mL of "B" (20.3) in a Klett tube to serve as a check on the procedure. Add a stirring rod and 5 mL of BD-3 solution (see 20.1.1) to each Klett tube and stir thoroughly. Heat in a water bath at 100 °C for 10 minutes, remove, and cool to room temperature. Lift the stirring rod, dilute to the 10 mL mark with acetone, and stir well. Add 1mL of piperidine, stir well, transfer to the reading tube (20.2) and read on the zeroed Klett-Summerson colorimeter with number 54 filter within 1 minute. Subtract the blank to obtain the net

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<sup>1</sup>/ The cooling period should be the same for each sample since reaction continues to a degree after heating.

<sup>2</sup>/ The reading tube should be rinsed with acetone after each reading to avoid cross contamination of the samples.

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Klett reading, divide by the slope of the standard curve to obtain ug of HD in the sample<sup>3</sup>. Divide by 2 to obtain ug/ml and multiply by 5 to obtain ug of HD collected.

### 30. ANALYSIS FOR AGENT GD (PINACOLYLMETHYL PHOSPHONOFUORIDATE)

#### 30.1 Reagent

30.1.1 O-Dianisidine Solution. Add 1 gm of o-dianisidine (3,3' dimethoxybenzidine) to 50 mL of acetone. If the material does not completely dissolve, filter the solution before continuing. Add 200 mL of pure ethanol (190 or 200 proof), mix well, and transfer to a dark bottle. Place this solution in a refrigerator; it is stable for 1 week if kept cool.

30.1.2 Sodium Perborate Solution. Dissolve 0.1 gm of sodium perborate in 100 mL of deionized water. This may take some time since sodium perborate is not readily soluble in water. Store in a refrigerator; make fresh daily.

30.2 Zeroing the Klett-Summerson Colorimeter. Proceed as in 20.2 except use a Klett-Summerson number 42 blue filter ( = 400 - 450 millimicrons).

30.3 Standard Curve. Place about 20 mL of diethyl phthalate in a 50 mL volumetric flask and weigh into it about 15 mg of GD (pinacolylmethyl phosphonofluonidate). Record the exact weight of GD added. Dilute to the mark with diethyl phthalate and label the flask "A". Divide the weight of GD added by the 50 mL volume and multiply by 1000 to obtain the concentration in ug/mL. Place 20 mL of diethyl phthalate in a second 50 mL volumetric flask. Add 1 mL of "A" and fill to the mark with diethyl phthalate. Label this flask "B" and calculate its concentration using the following formula:

$$\text{Concentration of "B"} = \frac{(\text{Volume of "A" used}) (\text{Concentration of "A"})}{\text{Volume of flask "B"}}$$

Place 20 mL of diethyl phthalate in a third 50 mL volumetric flask and add 5 mL of "A". Dilute to the mark and label "C". Calculate the concentration as shown above. Number 8 Klett tubes 1 through 8. Place 2 mL of diethyl phthalate in each tubes 3 and 4. Place 2 mL of "B" in each of tubes 5 and 6. Place 1 mL of "C" and 1 mL of diethyl phthalate in each of tubes 7 and 8. Place a stirring rod in each tube, add 2.5 mL of o-dianisidine

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<sup>3</sup> Klett readings over 500 are not very accurate. In such cases dilute the original sample and make the appropriate changes to the above calculation.

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solution (30.1) to each tube and stir well. Set a timer to zero. Add 1 mL of sodium perborate solution (30.1.2) to Klett tube 1, start timer, and stir well. When the timer reads 1 minute add 1 mL of sodium perborate to Klett tube 2 and stir well. Continue adding 1 mL of sodium perborate to the Klett tubes at 1 minute intervals until all have received the perborate solution. When the timer reads 20 minutes transfer the contents of Klett tube 1 to the reading tube and read immediately on a zeroed Klett-Summerson colorimeter using a number 42 blue filter<sup>4</sup>. At 21 minutes read the sample in Klett tube 21. Continue reading at 1 minute intervals until all the samples have been read. Average the duplicate reading and subtract the average for the blank (1 and 2) from the other average readings. Plot the net Klett reading (vertical axis) versus the ug of agent (horizontal axis). The result should be a straight line. The slope of this line, net Klett reading/ug GD, is used in finding the amount of GD in the bubbler samples.

30.4 Analyzing the bubbler samples. Transfer the contents of the bubbler to a test tube. Place 2 mL of the sample in a Klett tube. Place 2 mL of diethylphthalate in a separate tube to be used as a blank. Place 2 mL of "B" in a Klett tube to serve as a check on the procedure. Add a stirring rod and 2.5 mL of o-dianisidine solution (30.1.1) to each Klett tube and stir well. Set a timer to zero. Add 1 mL of sodium perborate solution (30.1.2) to the first Klett tube, stir well and start the timer. When the timer reads one minute add 1 mL of the sodium perborate solution to the second Klett tube. Continue adding 1 mL of sodium perborate solution at 1 minute intervals until all have received the perborate solution. When the timer reads 20 minutes transfer the contents of the first Klett tube to the reading tube and immediately read on the zeroed Klett-Summerson colorimeter using a 42 blue filter. At 21 minutes read the sample in the second Klett tube. Continue reading at 1 minute intervals until all samples have been read. Subtract the blank to obtain the net Klett reading, divide by the slope of the standard curve, net Klett/ug, to obtain the ug of GD in the sample. Divide by 2 to obtain ug/mL and multiply by 5 to obtain ug of GD collected.

---

<sup>4</sup> Strict attention must be paid to the 20 minutes reaction time, any deviation will lead to erroneous results.

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