

INCH-POUND

MIL-DTL-64159(MR)
w/INT. AMENDMENT 1
6 March 2007
USED IN LIEU OF
MIL-DTL-64159
30 January 2002

DETAIL SPECIFICATION

COATING, WATER DISPERSIBLE ALIPHATIC POLYURETHANE, CHEMICAL AGENT RESISTANT

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

1. SCOPE

1.1 Scope. This specification covers water-dispersible, chemical agent resistant, aliphatic polyurethane coatings for use as a finish coat on all military tactical equipment, which includes ground, aviation and related support assets. The materials are free of hazardous air pollutants (HAP-free), lead and chromate (hexavalent chromium) free, and have a maximum volatile organic compound (VOC) content of 220 g/l (1.8 lb/gal) as packaged.

1.2 Classification. Coating type and color will be as specified below.

1.2.1 Types. The coating will be furnished in the following types as specified (see 6.2). Whenever Type I or Type II are not specifically required in a relevant contractual document, either type of coating is acceptable.

Type I - Silica-based flattening agents

Type II - Polymeric flattening agents

Type III - Self contained portable kits. The kits contain the Type II CARC coating in a touch-up system.

Comments, suggestions, or questions on this document should be addressed to: Director, U.S. Army Research Laboratory, Weapons and Materials Research Directorate, Materials Applications Branch, Attn: AMSRD-ARL-WM-MC, Aberdeen Proving Ground, MD 21005-5069 or emailed to bhart@arl.army.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://assist.daps.dla.mil/>.

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1.2.2 Colors. The coating color will be one of the following FED-STD-595 colors as specified (see 6.2).

Aircraft Black, 37038	Black, 37030	Interior Aircraft Black, 37031
Aircraft Gray, 36300	Brown 383, 30051	Interior Aircraft Gray, 36231
Aircraft Green, 34031	Dark Green, 34082	Olive Drab, 34088
Aircraft Insignia Blue, 35044	Dark Sandstone, 33510	Sand, 33303
Aircraft Red, 31136	Earth Yellow, 33245	Tan 686A, 33446
Aircraft White, 37875	Field Drab, 33105	Tan, 33531
Aircraft Yellow, 33538	Green 383, 34094	

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 SPECIFICATIONS

TT-C-490 - Chemical Conversion Coatings and Pretreatments for Ferrous Surfaces (Base for Organic Coatings).

FEDERAL STANDARDS

FED-STD-141 - Paint, Varnish, Lacquer and Related Materials: Methods Of Inspection, 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

Color Chips 30051, 31136, 33105, 33245, 33303, 33446, 33510, 33531, 33538, 34031, 34082, 34088, 34094, 35044, 36231, 36300, 37030, 37031, 37038, 37875.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-12468 - Decontaminating Agent, STB.

MIL-P-53022 - Primer, Epoxy Coating, Corrosion Inhibiting, Lead and Chromate Free.

MIL-P-53030 - Primer Coating, Epoxy, Water Reducible, Lead and Chromate Free.

MIL-P-53084 - DELETED.

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

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA Method 311 - Analysis of Hazardous Air Pollutant Compounds in Paints and Coatings by Direct Injection into a Gas Chromatograph.

(Copies of these documents are available online at www.epa.gov/ttn/emc/ 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 D476 - Standard Classification for Dry Pigmentary Titanium Dioxide Products. (DoD adopted)
- ASTM D522 - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings. (DoD adopted)
- ASTM D523 - Standard Test Method for Specular Gloss. (DoD adopted)
- ASTM D562 - Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer. (DoD adopted)
- ASTM D1014 - Standard Practice for Conducting Exterior Exposure Tests of Paints and Coatings Metal Substrates. (DoD adopted)
- ASTM D1210 - DELETED.
- ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes. (DoD adopted)
- ASTM D1475 - DELETED.
- ASTM D1849 - Standard Test Method for Package Stability of Paint. (DoD adopted)
- ASTM D2369 - Standard Test Method for Volatile Content of Coatings. (DoD adopted)
- ASTM D2805 - Standard Test Method for Hiding Power of Paints by Reflectometry. (DoD adopted)
- ASTM D3335 - Standard Test Method for Low Concentration of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy. (DoD adopted)
- ASTM D3359 - Standard Test Methods for Measuring Adhesion by Tape Test.
- ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test. (DoD adopted)
- ASTM D3723 - Standard Test Method for Pigment Content of Water-Emulsion Paints by Low-Temperature Ashing.
- ASTM D3951 - DELETED.
- ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings. (DoD adopted)

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- ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films. (DoD adopted)
- ASTM E97 - DELETED.
- ASTM E167 - DELETED.
- ASTM E308 - Standard Practice for Computing the Colors of Objects Using the CIE System. (DoD adopted)
- ASTM G154 - Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.

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

- ASQC Z1.4 - DELETED.

2.4 Order of precedence. 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 which is qualified for listing on the applicable qualified products list at the time of contract award (see 4.2 and 6.4). Any change in the formulation of a qualified product shall necessitate its requalification. The material supplied under contract shall be identical, within manufacturing tolerances, to the product receiving qualification.

3.2 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.

3.3 Color and spectral reflectance. All camouflage colors listed in table I 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 table I, and color chips are available from the address provided below. The colors of the camouflage system shall fall within 2.0 National Bureau of Standards (NBS) units under Standard Illuminant C of the values listed in table I. Figures 1 through 8 shall be used as approximate guidelines for the appropriate color. The color Dark Green, 34082 and Green 383, 34094 shall meet the infrared reflectance requirements of table I and spectral reflectance limits plotted in figure 9 and specified in table III. Aircraft Green, 34031, Interior Aircraft Black, 37031, Aircraft Gray, 36300 and Dark Sandstone, 33510 shall visually match color chips furnished by the U.S. Army Research Laboratory, ATTN: AMSRD-ARL-WM-MC, Aberdeen Proving Ground, MD 21005-5069, and these colors shall meet the infrared reflectance requirements of table I when tested as in 4.4.11. All other colors listed in 1.2.2 shall visually match the appropriate chip from FED-STD-595.

3.4 Composition. The material shall be furnished in two components: Component A shall consist of a hydroxyl functional polyurethane dispersion that may be combined with prime and extender pigments, additives and solvents; Component B shall consist of an aliphatic isocyanate prepolymer type that is dispersible in water that may be combined with volatile solvents. The mixing ratio shall be two parts of Component A to one part of Component B.

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TABLE I. Color and reflectance requirements.

Color	Brightness (Y)	Chromaticity		Infrared ^{1/}		Allowable ^{2/} Ratio
		X	Y	Min.	Max.	
Dark Green, 34082	0.071 – 0.091	0.339	0.390	-	60.0	5.2
Green 383, 34094	0.063 – 0.083	0.328	0.365	-	60.0	5.2
Field Drab, 33105	0.093 – 0.117	0.390	0.383	25.0	35.0	-
Earth Yellow, 33245	0.228 – 0.263	0.420	0.395	30.0	40.0	-
Sand, 33303	0.284 – 0.323	0.360	0.366	55.0	65.0	-
Brown 383, 30051	0.060 – 0.080	0.357	0.342	8.0	20.0	-
Black, 37030	0.030 – 0.041	0.310	0.315	0.0	15.0	-
Tan 686A, 33446	0.360 – 0.400	0.368	0.364	62.0	72.0	-
Aircraft Green, 34031	VM ^{3/}	VM ^{3/}		-	7.0	-
Interior Aircraft Black, 37031	VM ^{3/}	VM ^{3/}		-	7.0	-
Aircraft Gray, 36300	VM ^{3/}	VM ^{3/}		-	15.0	-
Dark Sandstone, 33510	VM ^{3/}	VM ^{3/}		-	45.0	-

^{1/} See table II or 4.4.11.

^{2/} The ratio is calculated by dividing the average infrared reflectance by the average red region reflectance.

^{3/} Visual Match(es) (VM) as stated in 3.3 are to be used for Aircraft Green, 34031, Interior Aircraft Black, 37031, Aircraft Gray, 36300, and Dark Sandstone, 33510.

TABLE II. Selected wavelengths for determining red and infrared values from reflectance data.

Red Region ^{1/} (Nanometers)	Infrared region ^{2/} (Nanometers)
620.0	720.0
630.0	740.0
640.0	760.0
640.0	770.0
650.0	780.0
650.0	800.0
650.0	810.0
660.0	830.0
660.0	840.0
660.0	860.0

^{1/} The red value is the average reflectance for the ten wavelengths listed.

^{2/} The infrared value is the average reflectance for the ten wavelengths listed.

3.4.1 Pigment. The pigments listed in table IV, 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 a rutile chalk resistant type conforming to ASTM D476, type III. If other tinting pigments are used to match the spectral characteristics, these additional pigments shall have good color stability. No lead or chromate (hexavalent chromium) pigments shall be used and antimony sulfide shall be absent. The extender pigments (flattening agents) shall be composed of siliceous matter such as diatomaceous silica, and talc for type I. For type II, materials shall be polymeric based of polyurethane or urea

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formaldehyde condensation type polymers or other polymeric composition. The amount shall not exceed the limits of table VIII.

TABLE III. Spectral reflectance limits for Dark Green, 34082 and Green 383, 34094.

Wavelength Nanometers	% Reflectance		Wavelength Nanometers	% Reflectance	
	Max.	Min.		Max.	Min.
600	10.2	-	760	59.5	40.0
610	9.8	-	770	61.5	42.0
620	9.8	-	780	-	42.0
630	9.8	-	790	-	42.0
640	9.5	-	800	-	42.0
650	9.5	-	810	-	42.0
660	10.0	-	820	-	42.0
670	10.5	4.0	830	-	42.0
680	13.0	5.8	840	-	42.0
690	21.5	8.5	850	-	42.0
700	28.0	11.0	860	-	42.0
710	35.8	15.0	870	-	42.0
720	41.0	19.0	880	-	42.0
730	48.5	25.0	890	-	42.0
740	51.8	30.0	900	-	42.0
750	56.0	36.3			

3.4.1.1 Lead content. The lead content shall not exceed 0.05 percent by weight of total nonvolatile content upon analysis as specified in 4.4.4.1.

3.4.2 Nonvolatile vehicle.

3.4.2.1 Component A.

3.4.2.1.1 Hydroxyl functional polyurethane dispersion. When evaluated as specified in 4.4.5, the hydroxyl functional polyurethane dispersion shall contain sufficient reactivity/hydroxyl functionality to meet the specification performance requirements using a two to one mixing ratio of part A to part B.

3.4.2.2 Component B. When tested as specified in 4.4.6, the nonvolatile vehicle in component B shall be an aliphatic isocyanate prepolymer. It shall contain no toluene diisocyanate.

3.4.3 Volatile content for type I and II. The volatile content of components A and B admixed shall consist of a nonphotochemically reactive solvent blend. The admixed portion shall not contain any Hazardous Air Pollutants in the volatile portions when tested in accordance with EPA method 311 as specified in 4.4.7.1.

3.4.4 Volatile organic compound content for types I and II. The volatile organic compound content shall not exceed 220 g/l (1.8 lb/gal) when tested as specified in 4.4.7.1.

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TABLE IV. Pigmentation.

Dark Green, 34082 Green 383, 34094	Acid insoluble green pigment predominately composed of cobalt, zinc, and chromium oxides with other oxides permitted, carbazole dioxazine violet, iron oxides, chromium oxide, light stable organic yellow and orange, zinc/magnesium ferrite or other mixed metal oxides.
Field Drab, 33105 Brown 383, 30051 Earth Yellow, 33245 Sand, 33303 Tan 686A, 33446 Dark Sandstone, 33510	Chromium oxide, titanium dioxide, carbon black, carbazole dioxazine violet, iron oxides, zinc/magnesium ferrite or other mixed metal oxides.
Aircraft Green, 34031 Olive Drab, 34088	Iron oxides, carbon black, zinc/magnesium ferrites, titanium dioxide, chromium oxide or other mixed metal oxides.
Black, 37030 Aircraft Black, 37038 Interior Aircraft Black, 37031	Carbon black, iron oxides.
Aircraft White, 37875	Titanium dioxide.
Aircraft Red, 31136	Titanium dioxide, light stable organic red.
Aircraft Gray, 36300 Interior Aircraft Gray, 36231	Titanium dioxide, carbon black, iron oxides.
Aircraft Insignia Blue, 35044	Copper phthalocyanine blue, carbon or lampblack, black iron oxide, titanium dioxide.

3.5 Quantitative requirements.

3.5.1 Component A (polyol). Component A shall conform to the quantitative requirements of table V when tested as specified in 4.4.5.

3.5.2 Component B (isocyanate). Component B shall conform to the quantitative requirements of table VI when tested as specified in 4.4.6.

3.5.3 Mixed coating. When mixed 2 parts component A to 1 part component B by volume, the coating shall conform to the quantitative requirements of table VII when tested as specified in 4.4.1.1.

3.5.4 Specific quantitative requirements.

3.5.4.1 Specific quantitative requirements. Each color shall conform to its specific requirements in table VIII when tested as specified in 4.4.1.1. Total solids, pigment solids, and vehicle solids are percent by weight of component A. Extender pigment is percent by weight of pigment.

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TABLE V. Component A requirements.

Characteristic	Minimum		Maximum	
Viscosity, Krebs Units (K.U.)	55		100	
	Type I	Type II	Type I	Type II
All camouflage colors	3	0	-	-
Aircraft green, 34031	0	0	2	-
Aircraft gray, 36300	5	0	-	-

TABLE VI. Component B requirements.

Characteristic	Minimum
Nonvolatile, percent by weight of component B	70

TABLE VII. Mixed coating requirements.

Characteristic	Minimum	Maximum	
<u>Hiding power (contrast ratio)</u>			
Aircraft Red, 31136	.94	-	
Aircraft White, 37875	.92	-	
Other colors	.98	-	
<u>Specular gloss for Dark Sandstone, 33510 and Sand, 33303, Earth Yellow, 33245 and Tan 686A, 33446</u>			
60 degree	-	1.5	
85 degree	-	3.5	
<u>Other camouflage colors including Aircraft Black</u>			
60 degree	-	1.0	
85 degree	-	3.5	
<u>Aircraft Green, 34031 and Interior Aircraft Black, 37031</u>			
60 degree	-	0.5	
85 degree	-	1.0	
<u>Other colors</u>			
60 degree	-	3.0	
85 degree	-	8.0	
<u>Drying time</u>		<u>Type I</u>	<u>Type II</u>
Set to touch, minutes	-	50	60
Dry hard, hours	-	4	6
Dry through, hours	-	5	8

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TABLE VIII. Specific quantitative requirements.

Color	Total Solids (minimum) Type		Pigment Solids (minimum) Type		Vehicle Solids (minimum) Type		Extender pigment (maximum) Type	
	I	II	I	II	I	II	I	II
Green 383, 34094	55	47	40	29	15	16	60	42
Brown 383, 30051	52	43	30	22	15	15	70	48
Tan 686A, 33446	52	47	34	28	16	15	57	43
Black, 37030	48	37	30	16	15	13	83	67
Aircraft Green, 34031	47	45	29	26	18	13	65	45
Aircraft Gray, 36300	45	40	28	26	15	13	60	50

3.6 Qualitative requirements.

3.6.1 Condition in container.

3.6.1.1 Component A. When tested as specified in 4.4.12.1, a freshly opened container of component A shall be free from grit, seeds, skins, abnormal thickening, or livering and shall show no more pigment settling or caking than can be easily and completely reincorporated to a smooth homogeneous state.

3.6.1.2 Component B. When tested as specified in 4.4.12.2, component B shall be clear and free from sediment and suspended matter when examined by transmitted light. A freshly opened, full container shall show no livering, curdling, gelling, or skinning.

3.6.2 Storage stability.

3.6.2.1 Component A. When tested as specified in 4.4.13.1, a full quart can of component A shall show no skinning, livering, curdling, hard dry caking, or tough gummy sediment. It shall remix readily to a smooth homogeneous state, shall have a maximum viscosity of 95 K.U. for type I and II, and shall meet all other requirements of this specification.

3.6.2.2 Component B. When tested as specified in 4.4.13.2, a full can of the component B shall be clear and free from sediment and suspended matter when examined by transmitted light. A freshly opened container shall show no livering, curdling, gelling, or skinning, and shall meet all other requirements of this specification.

3.6.3 Mixing properties. When tested as specified in 4.4.14, a smooth, homogeneous mixture shall result. The coating shall be free from grit, seeds, skins, or lumps. After aging as specified in 4.4.14, the coating shall show no signs of gelation.

3.6.4 Spraying properties. When tested as specified in 4.4.15, 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. Furthermore, the dry film shall present a smooth lusterless flat finish, free from voids, seediness or pinholes or any film defects that may undermine the performance of the Chemical Agent Resistant Coating (CARC) system. Texturing or surface roughness is permitted for Aircraft Green, 34031, provided all performance requirements of the specification are met.

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3.6.5 Brushing properties. When tested as specified in 4.4.16, the coating shall brush satisfactorily and shall dry to a smooth, uniform film, free from seeds, runs, sags, or streaks. The dried film shall show no discernible brush marks.

3.6.6 Flexibility. When tested as specified in 4.4.17, a film of the coating shall withstand bending without cracking or flaking.

3.6.7 Recoatibility. When tested as specified in 4.4.18, recoating of a dried film shall produce no lifting, softening, or other film irregularity.

3.6.8 Adhesion. The assessment of the adhesion of the coating film shall be determined by its ability not to peel from the substrate when tested in accordance with ASTM D3359 as specified in 4.4.19. The resultant test rating shall be classified as scale 4B or better.

3.6.9 Water resistance. When tested as specified in 4.4.20, a film of the coating shall show no blistering or wrinkling and no more than a slight whitening or softening immediately upon removal from the water. Film softening shall not exceed a 2 pencil hardness difference from an unexposed film with identical cure history prior to water exposure. After 2 hours air drying, the portion of the panel that was immersed shall be almost indistinguishable with regard to adhesion, hardness, color, and gloss from an unexposed film with identical cure history prior to water exposure.

3.6.10 Hydrocarbon resistance. When tested as specified in 4.4.21, a film of the coating 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. Film softening shall not exceed a 2 pencil hardness difference from an unexposed film with identical cure history prior to water exposure. After 24 hours drying, the portion of the panel which was immersed shall be almost 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 gloss values.

3.6.11 Acid resistance. When tested as specified in 4.4.22, a film of Green 383, 34094 shall have no blistering and show no change from the original color.

3.6.12 Accelerated weathering. When tested as specified in 4.4.23, samples of aircraft colors shall show no cracking, chalking, loss of adhesion and shall meet the color, infrared reflectance, 60 and 85 degree gloss requirements of this specification. When tested as specified in 4.4.22, camouflage colors shall show no cracking, chalking, loss of adhesion, or increase in the 60 and 85 degree gloss and the color change shall be less than 2.5 NBS units. In addition, after accelerated weathering the color change shall remain within 2.5 NBS units of the value specified in table I (difference from nominal values or center of color ellipse). The infrared reflectance and allowable ratio shall remain within those limits originally specified.

3.6.13 DS2 resistance. DELETED.

3.6.13 Super tropical bleach (STB) resistance. When tested as specified in 4.4.24, a film of the coating shall show no blistering, wrinkling, or film softening when examined immediately after washing with water. Film softening shall not exceed a 2 pencil hardness difference (see ASTM D3363) from an unexposed film with identical cure history prior to STB exposure. After drying, there shall be a maximum color change of 2.5 NBS units when comparing a portion of the untested panel to that of the tested area. The STB composition shall be in accordance with MIL-DTL-12468.

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3.6.14 Chemical agent resistance. When tested as specified in 4.4.25, a film of the coating shall desorb a maximum of 40 micrograms of agent GD and 180 micrograms of agent HD.

3.6.15 Weather resistance. When tested as specified in 4.4.26, films of the coating shall show no checking, cracking, or appreciable film deterioration. There shall be no more than light chalking (see ASTM D4214). The color shall show no excessive change in value and chroma and no change in hue. After removal of any chalking which has occurred, the original color shall be substantially restored and the washed area shall show no more than slight fading or darkening.

3.6.16 Freeze-Thaw resistance (Component A). After being tested as in 4.4.27, the coating shall mix readily to a smooth, homogeneous state and there shall be no apparent change in the appearance of the dried film, when compared to one prepared from an untested sample. The viscosity change shall not exceed 10%, and the hiding power, gloss, and color shall meet the requirements of the specification.

3.6.17 Exclusion of toxic solvents. The product shall contain no benzol (benzene), chlorinated compounds, hydrolyzable chlorine derivatives, or ethylene based glycol ethers and their acetates.

3.7 User instruction marking. In addition to the markings specified herein, 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. Safety recommendations required for shipment of material. Keep containers tightly closed. Component B is very water sensitive and caution shall be taken to insure that water or high humidity do not come in contact with component B at any time during reduction, application, or drying.

INSTRUCTIONS FOR USE:

Mix component A well, then add 1 part by volume of component B to 2 parts by volume of component A and mix well with a mechanical mixer. Reduce with deionized water or as specified by manufacturer's instructions for spray application. Material shall be used within 4 hours after mixing.

3.8 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 6.6).

3.9 Material safety data sheet (MSDS). A MSDS shall be prepared for the coating in accordance with FED-STD-313 and forwarded to the qualifying activity (see 6.5.1). 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.

4. VERIFICATION

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

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

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4.2 Qualification inspection. The qualification inspection shall consist of tests for all requirements specified in section 3 and table IX (see 6.4). The results of each test shall be compared with the applicable requirement in section 3. Failure to conform to any requirement shall be counted as a defect, and paint represented by the sample test shall not be approved for inclusion on the qualified products list (QPL) under this specification.

4.3 Conformance inspection.

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.

4.3.2 Conformance tests. When approved by the cognizant activity, acceptance of lots for use as a component on an end item shall be based on conformance with specified requirements for color and spectral reflectance, 60° and 85° specular gloss, acid resistance, hydrocarbon fluid resistance, and water resistance.

4.3.3 Acceptance tests. Acceptance testing of individual lots shall consist of condition in container, hiding power, total solids, infrared reflectance, viscosity, specular gloss, drying time, color and spectral reflectance, spraying properties, and mixing properties as specified in sections 3 and 4.

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

4.3.5 Validation. The contracting officer shall require that a sprayed sample from each production lot be forwarded to the U.S. Army Research Laboratory, ATTN: AMSRD-ARL-WM-MC, Aberdeen Proving Ground, MD 21005-5069, for validation of spectral reflectance characteristics to include color, STB resistance and gloss at 60 and 85 degrees.

4.4 Test methods.

4.4.1 Test conditions. Except as otherwise specified herein, the routine testing conditions for qualification testing and the referee testing for validation testing shall be performed in accordance with the test conditions specified in FED-STD-141, section 9 or in accordance with the appropriate ASTM method cited herein. A dry film thickness of 0.002 ± 0.0002 inches (0.0508 ± 0.00508 mm) shall be used whenever film thickness is requested in any test, unless otherwise required by the test.

4.4.1.1 Test procedures. The following tests shall be conducted in accordance with table IX. Unless otherwise specified, steel test panels shall be pretreated with a zinc phosphate coating conforming to TT-C-490, type I. The right is reserved to make any additional tests deemed necessary to determine that the coating meets the requirements of this specification.

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TABLE IX. Index.

Item	Applicable Tests In FED-STD-141 or EPA Test Method	ASTM Method	Test Paragraph	Requirement Paragraph or Table
Color and spectral reflectance	6241.2	E308	4.4.2	3.3
Total nonvolatile	-	D2369	4.4.3	Tables VI and VIII
Pigment analysis	-	D3723	4.4.4	3.4.1, Tables IV and VIII
Lead content	-	D3335	4.4.4.1	3.4.1.1
Hexavalent chromium	-	-	4.4.4.2	3.4.1
Antimony sulfide	-	-	4.4.4.3	3.4.1
Solvent analysis	EPA Method 311	-	4.4.7	3.4.3
Volatile organic compounds	EPA Method 311	D3960	4.4.7.1	3.4.4
Viscosity, Krebs-Stormer	-	D562	-	Table V
Hiding-power (contrast ratio)	-	D2805	4.4.8	Table VII
Fineness of Grind-DELETED	-	D1210	-	Table V
Drying time	4061.3	-	4.4.9	Table VII
Specular gloss	-	D523	4.4.10	Table VII
<u>Infrared reflectance</u>			4.4.11	
Camouflage colors	6241.2	-	-	Tables I and II
Noncamouflage colors	6242.2	-	-	Table I
<u>Condition in container</u>				
Component A	3011.3	-	4.4.12.1	3.6.1.1
Component B	4261.1	-	4.4.12.2	3.6.1.2
<u>Storage stability</u>				
Component A	-	-	4.4.13.1	3.6.2.1
Component B	-	-	4.4.13.2	3.6.2.2
Mixing properties	-	-	4.4.14	3.6.3
Spraying properties	4331.2/2131.2	-	4.4.15	3.6.4
Brushing properties	4321.3	-	4.4.16	3.6.5
Flexibility	-	D522	4.4.17	3.6.6
Recoatability	-	-	4.4.18	3.6.7
Adhesion	-	D3359	4.4.19	3.6.8
Water resistance	-	D1308	4.4.20	3.6.9
Hydrocarbon resistance	-	D1308	4.4.21	3.6.10
Acid resistance	-	-	4.4.22	3.6.11
Accelerated weathering	-	G154	4.4.23	3.6.12
DS2 resistance-DELETED	-	-	4.4.24	3.6.13
STB resistance	-	-	4.4.24	3.6.13
Chemical agent resistance	-	-	4.4.25	3.6.14

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TABLE IX. Index - Continued.

Item	FED-STD-141 or EPA Method	ASTM Method	Test Paragraph	Requirement Paragraph or Table
Weather resistance	-	D1014	4.4.26	3.6.15
Freeze-Thaw resistance	-	-	4.4.27	3.6.16
Toxic solvents	-	-	-	3.6.17

4.4.2 Color and spectral reflectance. Prepare two sprayed samples of the coating on black and white Moresst cards to a dry film thickness of 0.002 ± 0.0002 inches. Dry for a minimum of 48 hours according to the test conditions in 4.4.1. Determine the color from the spectral reflectance curves using the recording spectrophotometer method in accordance with ASTM E308. Determine infrared reflectance in accordance with FED-STD-141, method 6241.2. Measurements shall be made over the black portion of the Moresst card. For aircraft colors, compare color as specified in 3.3. Nonconformance to 3.3 shall constitute failure of this test.

4.4.3 Nonvolatile. Place a portion of the thoroughly mixed sample in a dropping bottle and weigh to the nearest one-tenth mg. Weigh a 60 mm diameter aluminum dish to 0.1 mg. Transfer a small sample that does not exceed 0.3 g to the dish, determine its exact weight by loss of weight of the bottle. Dissolve the sample in 2 mL of A.C.S. reagent grade acetone and dry in a gravity convection oven at 105 °C for 60 minutes. Upon cooling, re-weigh the dish to the nearest one-tenth mg. From the weight of the residue in the dish and the weight of the sample taken, calculate the percent nonvolatile or volatile as required. Check for compliance with tables VI and VIII.

4.4.4 Pigment analysis. Determine the pigment content of the coating in accordance with ASTM D3723. The pigment generated by this method shall be used for the screening tests of the coating's heavy metal content as listed below.

4.4.4.1 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 HNO₃ 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 17000 rpm - balancing the centrifuge with a tube containing one ml. of the dilute HNO₃ solution. This tube shall also act as the test "blank". Immerse a lead 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 any color change is apparent from the "blank" strip rerun the test using fresh, lead-free reagents. For the "Sample" strip, the appearance of a bright red color is indicative of lead at a concentration level above the specification limit, while no color change or a faint pink color change is indicative of lead concentrations below the specification limit. Confirmation of the exact lead concentration in the coating's solids can be determined using any authoritative quantitative method, such as ASTM D3335.

4.4.4.2 Chrome (VI). Determine the presence or absence of hexavalent chrome 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 one ml aliquot into a plastic micro-centrifuge tube and centrifuge for five (5) minutes at 17000 rpm - balancing the centrifuge with a tube containing one ml of the KOH solution. The resulting supernatant liquid shall be nearly colorless. Use the tube containing

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the KOH solution as a reference. A distinct yellow color indicates the presence of hexavalent chrome 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 H₂SO₄ 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 17000 rpm - balancing the centrifuge with a tube containing one mL of the H₂SO₄ solution. This tube shall also act as the test “blank”. Immerse a chromate 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 chrome and therefore shall constitute failure of the test requirement. If a color change is apparent from the “blank” strip, rerun the test using fresh chromate-free reagents.

4.4.4.3 Antimony sulfide. Manufacturers need to review applicable environmental and safety regulations and comply with material shipment requirements (see 6.2). The Material Safety Data Sheet (MSDS) needs to include a notarized statement that verifies that the composition of the material (coating formulation) is free of the pigment antimony sulfide.

4.4.5 Analysis of component A vehicle.

4.4.5.1 Nonvolatile vehicle. The vehicle solids of component A shall be obtained according to the method in 4.4.3. Check for compliance with table VIII (see 3.5.4.1).

4.4.6 Analysis of component B.

4.4.6.1 Nonvolatile. Determine nonvolatile content according to ASTM D2369. Check for compliance with table VI (see 3.5.2).

4.4.7 Solvent analysis.

4.4.7.1 Volatile content. The volatile content of the admixture (see 3.4.3) determined by EPA Method 311 and the volatile organic compound (VOC) analysis (see 3.4.4) determined in accordance with ASTM D3960 shall comply with 3.4.4. Nonconformance to the VOC limit in 3.4.4 shall constitute failure of this test.

4.4.8 Hiding power (contrast ratio). Using a sprayed sample from the color determination (see 4.4.2), determine the reflectance using the daylight reflectance factor of ASTM D2805 over the black and white portion of the card and record the values as R_B/R_w and check for compliance with table VII.

4.4.9 Drying time. Spray the mixed coating to a dry film thickness of 0.002 ± 0.0002 inches and determine the drying under ambient conditions as described in table VII. Check for compliance with table VII.

4.4.10 Specular gloss. Spray the mixed coating to a dry film thickness of 0.002 ± 0.0002 inches. Test for 60-degree gloss and 85-degree gloss (sheen) as specified in table IX and check for compliance with table VII.

4.4.10.1 Spectral reflectance. Spectral reflectance is outlined in table III.

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4.4.11 Infrared reflectance. Determine the infrared reflectance on the black portion of the sprayed sample made in 4.4.2. For Aircraft Green, 34031 determine the infrared reflectance value at 870 nanometers. Determine the infrared reflectance for Aircraft Gray, 36300 at 1500 nanometers. In all evaluations, use a spectrophotometer which is capable of measuring the total diffuse reflectance. Nonconformance with table I shall constitute failure of this test.

4.4.12 Condition in container.

4.4.12.1 Component A. Determine package condition of component A in accordance with FED-STD-141, method 3011.3 and observe for compliance with 3.6.1.1. On qualification testing determine pigment settling by proceeding as specified in FED-STD-141, method 3011.3, but do not stir. Reseal and then agitate the can for 3 minutes on a paint shaker (see 6.7). On reexamination of the contents, the disclosure of any gel bodies or undispersed pigment indicates unsatisfactory settling properties. Observe for compliance with 3.6.1.1.

4.4.12.2 Component B. Determine package condition of component B in accordance with FED-STD-141, method 4261.1 and observe for compliance with 3.6.1.2.

4.4.13 Storage stability.

4.4.13.1 Component A. Allow a full quart can of component A to stand undisturbed for 1 year in accordance with ASTM D1849 and then examine the contents. Evaluate the pigment settling as specified in 4.4.12.1 except agitate the can for 5 minutes on a paint shaker prior to reexamination. Determine viscosity and other applicable tests for compliance with 3.6.2.1.

4.4.13.2 Component B. Allow a full 8-ounce can of component B to stand undisturbed for 1 year under standard laboratory conditions. At the end of this period examine the contents in accordance with FED-STD-141, method 4261.1 for compliance with 3.6.2.2.

4.4.14 Mixing properties. Using high-shear mechanical equipment, thoroughly mix 2 parts by volume of component A with 1 part by volume of component B, reduce as specified in 4.4.15, and examine for compliance with 3.6.3. Place 3 ounces of the material in a 4-ounce glass jar (lid not tightened to allow CO₂ to escape) and do not agitate or disturb for 4 hours. At the end of this period examine for compliance with 3.6.3.

4.4.15 Spraying properties. Reduce admix coating to sprayable viscosity with water (3 parts by volume of the admix coating material with up to 1 part by volume of water) or follow manufacture's recommendations for proper thinning. Material shall be sprayed on a clean steel panel to a dry film thickness between 0.0018 and 0.0022 inches. The coating properties of the dry sprayed surface shall be observed and evaluated in accordance with FED-STD-141, method 4331.2 for compliance with 3.6.4. A referee test, for use in automatic applications, shall be conducted in accordance with FED-STD-141, method 2131.2.

4.4.16 Brushing properties. Apply the coating after mixing 2 parts by volume of component A with 1 part by volume of component B. Thin as specified in 4.4.15 if necessary. Use a 1 1/2 inch brush in accordance with FED-STD-141, method 4321.3. Check for compliance with 3.6.5.

4.4.17 Flexibility. Determine flexibility in accordance with ASTM D522. Spray the coating to a dry film thickness of 0.0018 to 0.0022 inches. Air dry for 168 hours. Bend over a 1/4 inch mandrel. Examine the coating for cracks over the area of the bend for compliance with 3.6.6.

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4.4.18 Recoatibility. Prepare two steel panels pretreated as specified in 4.4.1.1 and apply epoxy primer conforming to MIL-P-53022 or MIL-P-53030 to a dry film thickness between 0.0009 and 0.0011 inches. Air dry two hours. Mix the coating as specified in 4.4.15 and spray to a dry film thickness of 0.0018 to 0.0022 inches. Apply a second coat of paint to one of the above panels after 2 hours (air dry) and a second coat to the other after air drying for 24 hours. Air dry both panels 24 hours. Examine for lifting, softening, and evidence of other film irregularity, for compliance with 3.6.7.

4.4.19 Adhesion. Prepare a steel panel pretreated and primed as specified in 4.4.18 and mix the coating as specified in 4.4.15. Spray the coating to a dry film thickness of 0.0018 to 0.0022 inches and air dry for 168 hours. Perform adhesion testing as specified in ASTM D3359, method B, and examine for compliance with 3.6.8.

4.4.20 Water resistance. Prepare a steel panel pretreated and primed as specified in 4.4.18 and mix the coating as specified in 4.4.15. Spray the coating to a dry film thickness of 0.0018 to 0.0022 inches and air dry for 168 hours. Coat all exposed unpainted metal surfaces with wax or suitable protective coating and immerse in water at 25 ± 1 °C (77 ± 2 °F) for 168 hours as specified in ASTM D1308. At the end of the test period, remove and examine for compliance with 3.6.9.

4.4.21 Hydrocarbon resistance. Prepare a film of the coating as specified in 4.4.20. Air dry the specimen for 168 hours and then immerse for 168 hours in a hydrocarbon fluid conforming to JP8 at 25 ± 1 °C (77 ± 2 °F). At the end of the test period, remove and examine for compliance with 3.6.10.

4.4.22 Acid resistance. Using the film prepared and dried as specified in 4.4.20, 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 thoroughly with water, allow to dry, and examine for blistering and color change for compliance with 3.6.11.

4.4.23 Accelerated weathering. Spray four panels as specified in 4.4.20 and air dry for 168 hours. Three panels are to be tested and one retained as control. Determine the color and infrared reflectance as specified in 4.4.2 and measure the 60 and 85 degree gloss. Expose three panels for 1000 hours to accelerated weathering in accordance with ASTM G154. Measure the 60 and 85 degree gloss and determine the color and infrared reflectance of the exposed film. Examine the panel for chalking by rubbing with a piece of velvet or cheese cloth. Check for compliance with 3.6.12.

4.4.24 DS2 resistance. DELETED.

4.4.24 Super tropical bleach (STB) resistance. Prepare a film of primer on steel as specified in 4.4.20. Air dry the panel a minimum of 168 hours. Scribe a 1 inch diameter wax ring using a china marker on the painted surface of the panel. Place approximately 1 ml of STB agent on the panel surface. Do not cover. Allow to stand 30 minutes then thoroughly wash with water. An STB slurry mix of 40 parts STB and 60 parts water by weight shall be used. Examine for compliance with 3.6.13.

4.4.25 Chemical agent resistance.

4.4.25.1 Panel preparation. Spray eight 3 by 3 inch steel panels, zinc phosphate pretreated according to TT-C-490 type 1, with epoxy primer conforming to MIL-P-53022 or MIL-P-53030 to a dry film thickness between 0.0009 and 0.0011 inches. Air dry 2 hours and spray the coating to be tested to a dry film thickness between 0.0018 and 0.0022 inches. Air dry the panels for 7 days.

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4.4.25.2 Test conditions. Because the desorption rate of agents from paint is temperature dependent, all agent tests shall be conducted at 25 °C. Extremely toxic materials are used in this testing. Agent HD, a vesicant agent, is also a known carcinogen. Agent GD is a toxic nerve agent, exposure to which is difficult to treat. Consequently, all work shall be performed in an approved fume hood, and appropriate measures to protect individuals at risk of exposure shall be taken.

4.4.25.3 Test apparatus. The test apparatus used for both HD and GD testing consists of a temperature controlled Plexiglas box (approximately 0.5 m x 0.5 m x 1 m) containing five separate test cells. Four of these cells are used to test sample CARC panels; the fifth is used to test a control panel. All five tests shall be run simultaneously. The test cells are machined from aluminum and consist of two parts that are clamped together to hold the test panels in place. A gastight seal is maintained by means of O-rings. Agent desorbed from the test panels is entrained by dry nitrogen that passes through a Miller-Nelson HCS4OI temperature-humidity-flow controller, with final temperature controlled by a YSI Model 72 proportional temperature controller. The nitrogen passes through an external chamber fitted with a bleed valve before entering the test cells. Determine the agent recovered in micrograms for compliance with 3.6.13.

4.4.25.4 Test procedure. Place a 5 cm² circular template on the area of the test panel to be contaminated with agent. Use a grease pencil to mark a circle around the template; the grease mark serves to keep the agent from spreading out of the designated area. Place 50 microliters of agent (HD or GD) on the test area using a microliter syringe. Place a glass cover slip (microscope slide) over the test area to minimize evaporation of the agent. After 30 minutes remove the cover slip, rinse the agent from the panel with isopropanol and allow to air dry for approximately 45 seconds. Place the panel in the test cell, which has been maintained at 25 °C, with the coated area positioned such that the nitrogen stream shall pass across the contaminated area. Nitrogen is used instead of air to eliminate the possibility of reaction of the desorbed agent over the time of the test, which is 22 hours. Pass the nitrogen through an impinger containing the appropriate solvent, n-decane for HD and iso-octane (2,2,4 - trimethylpentane) for GD. The flow of nitrogen across each sample shall be 200 ml/min, maintained by mass flow controllers. Terminate the test at the end of 22 hours.

4.4.25.5 Analysis. Transfer the contents of each impinger to a 25-ml volumetric flask. Rinse the impinger twice with the same solvent and add the rinse to the flask. Bring the volume up to the mark with solvent and mix well. Transfer a 1ml portion to a GC vial for analysis. Perform the analysis on a Finnigan-MAT GQC ion-trap mass spectrometer equipped with a 25 m MS-S capillary column, using helium as the carrier gas. Standardize the mass spectrometer by serial dilutions of an agent solution in the appropriate solvent, analyzed in the same conditions. The instrument conditions are as follows: introduce the samples from an AST 2000 autosampler, volume of 1 microliter, onto the GC column in splitless mode; injector temperature of 280 °C. Temperature program the column from an initial temperature of 50 °C to 120 °C at a rate of 10°/min; followed by an increase of 25 °C/min to a final temperature of 200 °C. Acquire mass spectra in electron impact mode over the mass range of 50-150 for HD and 50-200 for GD. Under these conditions, HD has a retention time of 8.15 minutes. Integrate the peak areas of the relevant portion of the reconstructed ion chromatograms for the ion at m/z 109. Under the cited conditions GD elutes as a pair of completely resolved diastereomeric enantiomers with retention times of 9.56 and 10.04 minutes. Integrate the peak areas of the relevant portion of the reconstructed ion chromatograms for the ion at m/z 99. Construct the standard response curve for HD and GD using the integrated area on the y axis and concentration (µg/ml) on the x axis. Use the linear regression analysis function of an Excel spreadsheet, which shall calculate the slope, intercept, and correlation coefficient of the standard response curve. The slope and intercept of the standard response curve are used to calculate concentration of agent (HD or GD) in the impinger solutions. Calculate the total amount of agent (in micrograms) that outgassed from the CARC panel by multiplying the concentration of agent in the impinger

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solution (micrograms per milliliter read from the standard curve) by the volume of the impinger solution (25 ml).

4.4.26 Weather resistance. Prepare five 3 by 6 inch steel panels as specified in 4.4.1.1. Air dry the panels a minimum of 7 days. The chemical agent resistant coating that is flattened with polymeric materials shall be placed outdoors, for the equivalent of 560 MJ/m² of total UV irradiance, in an accelerated outdoor exposure according to ASTM G90. The chemical agent resistant coating that is flattened with siliceous materials shall be placed outdoors, for the equivalent of 280 MJ/m² of total UV irradiance, in an accelerated outdoor exposure according to ASTM G90. At 70 MJ/m² intervals examine the panels for compliance 3.6.15. Determine chalking according to ASTM D4214. Wash the panels with a warm soap solution using a soft sponge or cloth, rinse, dry and examine for color change at each interval. The exposure racks shall be angled at a latitude of 33° 23' North and 112° 35' West.

4.4.27 Freeze-Thaw resistance (Component A). Prepare samples for testing by filling 1 pint (500 ml) resin-lined cans, two thirds full. Ensure that the bulk sample from which the cans are filled is well stirred and uniform, that the containers used are clean, and that the lids are applied promptly to the cans to prevent evaporation losses. Two such samples are required for each test.

4.4.27.1 Test conditions. Store one can at room temperature and identify this as the control sample. Place the can with the test coating in the chamber maintained at 0 °F (-18 °C) in such a manner that it does not touch the walls or bottom of the chamber and so that free circulation of air around it is permitted. Maintain a minimum of 1 inch (25 mm) of air space between adjacent cans and between cans and the chamber walls. Keep the test sample in the chamber for 17 hours and then remove and allow it to stand for 7 hours undisturbed at room temperature, adjacent to the control sample. This shall complete one freeze-thaw cycle of 24 hours. Repeat for three additional freeze-thaw cycles.

4.4.27.2 Examination and recording test results. After completion of the four cycles and before stirring, examine both samples for condition in the can, observing any evidence of settling, gelation, coagulation, or lumpiness. Then stir the samples and determine their viscosity. Immediately following the viscosity determinations, apply both specimens of paint to steel test panels pretreated and primed as in 4.4.18. Allow the coatings to dry at least 24 hours and then compare the test specimen to the control. Note any changes in hiding power, gloss, agglomeration, coagulation, or color and check for compliance with 3.6.15.

4.5 Kit samples.

4.5.1 Inspection for quality conformance. All testing and conformance inspections shall be as specified herein and summarized in 4.4.1 and table IX.

4.5.2 Quality conformance inspection of kit samples. Samples shall consist of two quart kits of each material to be tested (type and FED-STD-595 color) for each unit size container or package. Essential sample information includes the following:

Copy of the manufacturer's approval letter to qualify for qualification listing.

Sample size and kits shall be made available for each 64159 type and color.

Special marking required by regulation if applicable.

Manufacturer's name and product number conforming to this "Water Dispersible Aliphatic

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Polyurethane CARC” product.

Name and date of product (sample) submitted for qualification listing.

4.5.3 Certification. The manufacturer shall certify that the material conforms to the requirements of this specification and that the material is free from hazardous materials such as lead, chromate (hexavalent chromium), hazardous air pollutants (HAPs), benzol (benzene), chlorinated compounds, hydrolyzable chlorine derivatives, or ethylene based glycol ethers and their acetates.

4.5.4 Lot and batch formation. Lot and batch formation shall be as specified in 4.3.1.

4.5.4.1 Unit of product. For the purpose of inspection, a complete kit (pack) prepared for shipment shall be considered a unit of product.

4.5.4.2 Sampling. Sampling for examination shall be as specified in 4.3.4.

4.5.5 Retention sample. When required (see 6.2), a minimum of one complete kit of the coating shall be selected at random from each batch by an authorized government representative and forwarded to the laboratory designated by the procuring activity.

4.5.6 Visual inspection of filled containers. Samples shall be selected at random from each lot in accordance with FED-STD-141, section 1000. The lot size for this examination shall be the number of kits fully prepared for delivery; examination shall be for container fill, weight, and marking.

4.5.7 Rejection and retest. Failure in any conformance test shall result in rejection of that batch and shall constitute justification for removal from the qualified products list. Rejected material shall not be resubmitted for acceptance without written approval from the qualification activity (see 6.4). The application for resubmission shall contain full particulars concerning previous rejections and measures taken to correct these deficiencies. Samples for retest shall be randomly selected as in 4.5.5 and forwarded to the testing activity.

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. Use of this coating is intended to provide surfaces that are easily and effectively decontaminated after exposure to liquid chemical agents. This coating may be used in areas where air pollution regulations are in force. It is applied over epoxy primers MIL-PRF-23377, MIL-PRF-85582, MIL-P-53022, MIL-P-53030 or electrodeposited primer MIL-P-53084 depending on the substrate or regulatory requirements.

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For adequate camouflage properties, it is necessary to apply the coatings to a minimum dry film thickness of 0.0018 inches.

6.1.1 Marking. Use CARC marking paint on CARC coatings.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Type and color of coating (see 1.2.1 and 1.2.2).
- c. If a toxicity clearance is required (see 3.8).
- d. Kit desired, including the quantity and size of containers (see 4.5.4.1 and 6.5.3).
- e. Test/inspection conformance criteria, special marking and certifications required for kit samples (4.5.2 and 4.5.3).
- f. Retention sample if required and where to send it (see 4.5.5 and 6.4).
- g. Special environmental incentives for consideration of CARC paint removal that will reduce pollution. Proprietary techniques that do not utilize the use of methylene chloride, especially when technique is employed for large scale removal of CARC.
- h. Preparation of material safety data sheets (MSDS) in accordance with FED-STD-313 for the aliphatic polyurethane coating and inclusion of MSDS with shipment of material.
- i. Packaging requirements (see 5.1).

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 of contract award, 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 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 U.S. Army Research Laboratory, ATTN: AMSRD-ARL-WM-MC, Aberdeen Proving Ground, MD 21005-5069 and information pertaining to qualification of products may be obtained from that activity (see section 4).

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.

6.5 Product Identification.

6.5.1 Material safety data sheets (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.

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6.5.2 Part or Identifying Number (PIN). The PIN to be used for coatings acquired to this specification is created as follows:

Example:	M64159	-	X	-	XXX	-	XXXXX
	Specification identifier		Coating type designator		Kit size designator		Color designator
			1 = Type I 2 = Type II		(see 6.5.3)		

6.5.3 Kit size designation codes. When this part numbering system is used, the kit size is to be identified as:

Kit size	Kit size designator
X pint (X liter)	0XP
X quart (X liter)	0XQ
X gallon (X liter)	0XG
50 gallon (XX liter)	50G
X case (Aerosol)	0XA
X case (Brush)	0XB
X case (Roller)	0XR

Note: Kit size and designator may be modified for ease of procurement and is not otherwise limited.

6.6 Color chips and color difference equation. DELETED.

6.6 Toxicity 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, US Army Center For Health Promotion And Preventive Medicine (MCHB-TS-T), 5158 Blackhawk Road, Aberdeen Proving Ground, MD 21010-5403.

6.7 Paint shaker. DELETED.

6.7 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 6.4). The application for resubmission will contain all details concerning previous rejections and measures taken to correct these deficiencies.

6.8 Test strips. DELETED.

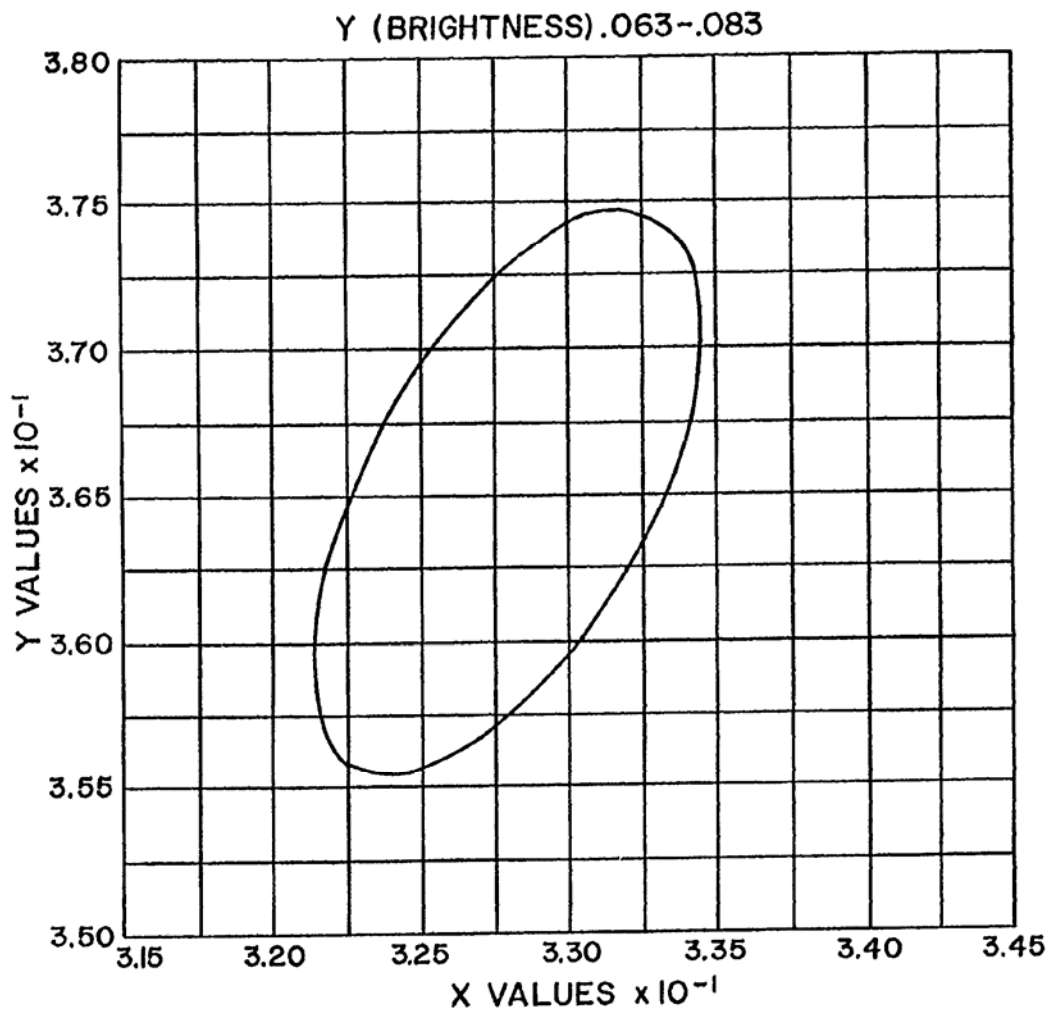
6.8 Subject term (key word) listing.

Camouflage
CARC
Color
Finish coat
Tactical equipment

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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.

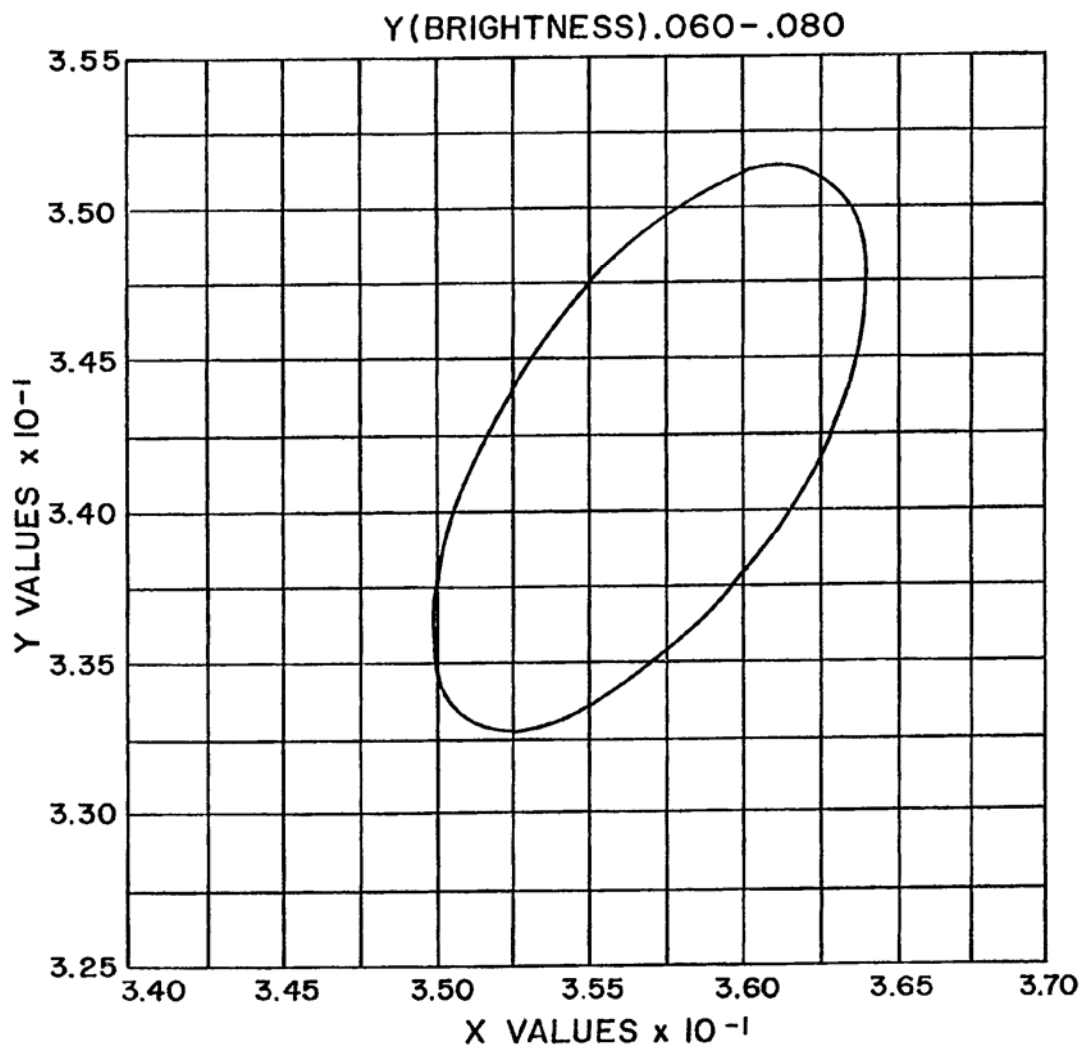
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NOTE – COLOR ELLIPSE IS 2.0 NBS UNITS FROM CENTER VALUE.

FIGURE 1. Chromaticity diagram for camouflage paint, color – Green 383, 34094.

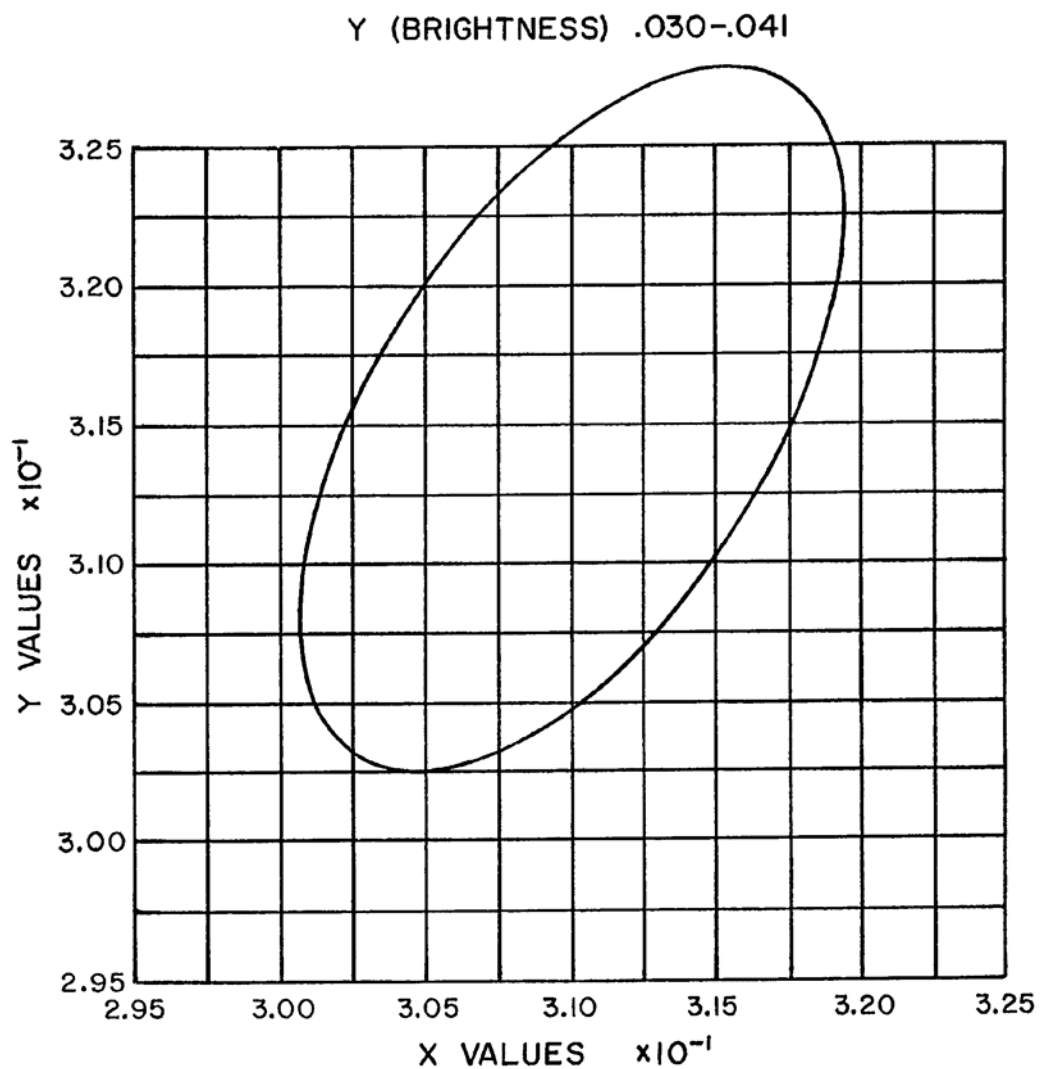
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NOTE - COLOR ELLIPSE IS 2.0 NBS UNITS FROM CENTER VALUE.

FIGURE 2. Chromaticity diagram for camouflage paint, color - Brown 383, 30051.

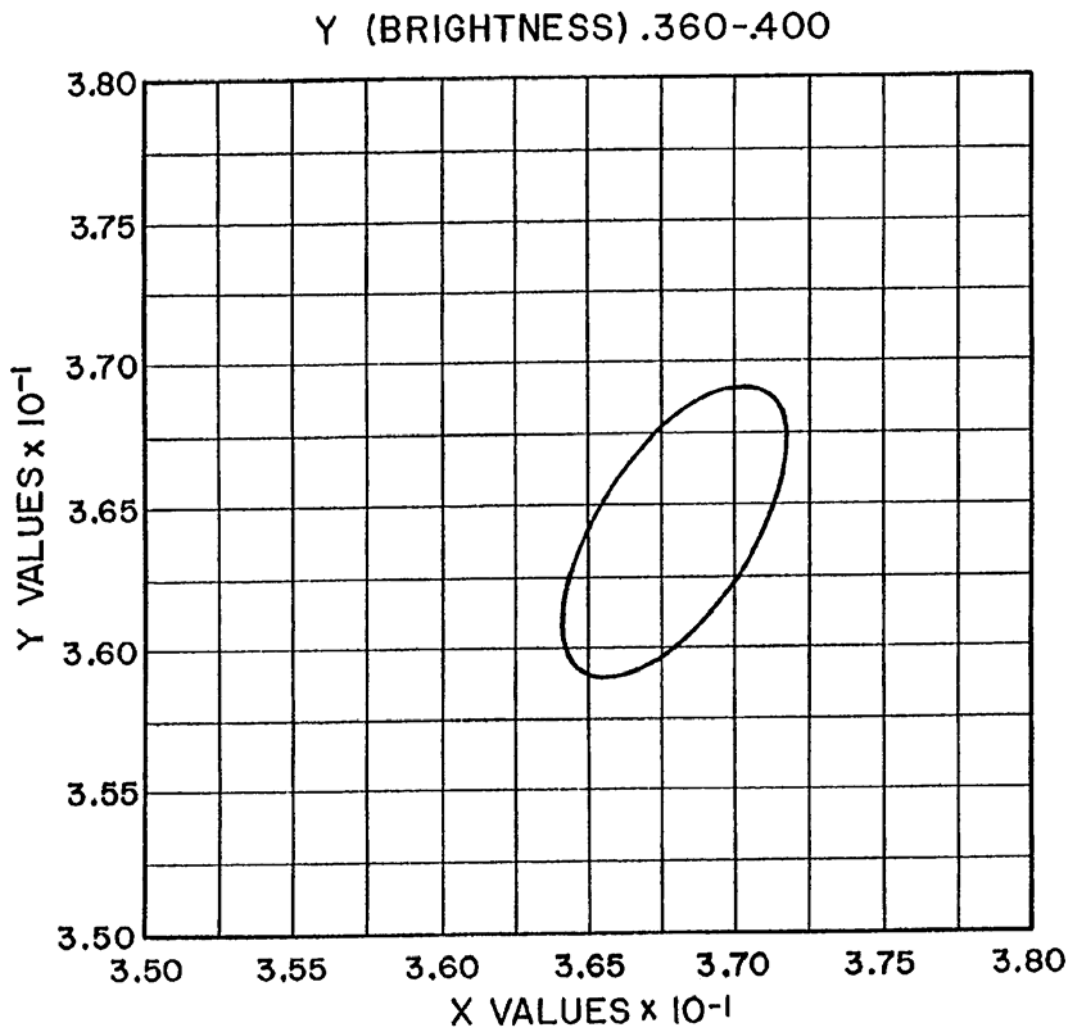
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NOTE – COLOR ELLIPSE IS 2.0 NBS UNITS FROM CENTER VALUE.

FIGURE 3. Chromaticity diagram for camouflage paint, color – Black, 37030.

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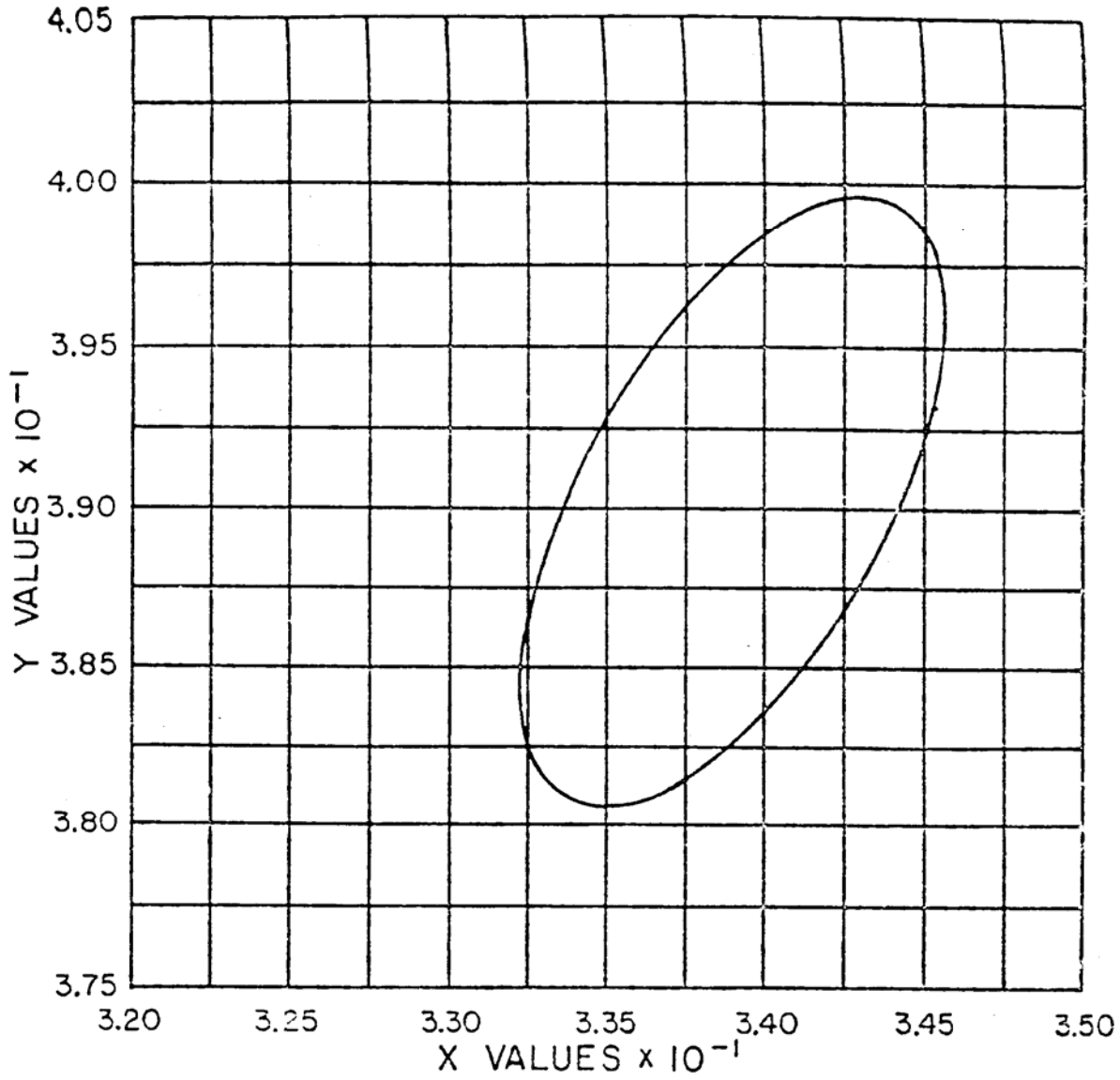


NOTE – COLOR ELLIPSE IS 2.0 NBS UNITS FROM CENTER VALUE.

FIGURE 4. Chromaticity diagram for camouflage paint, color – Tan 686A, 33446.

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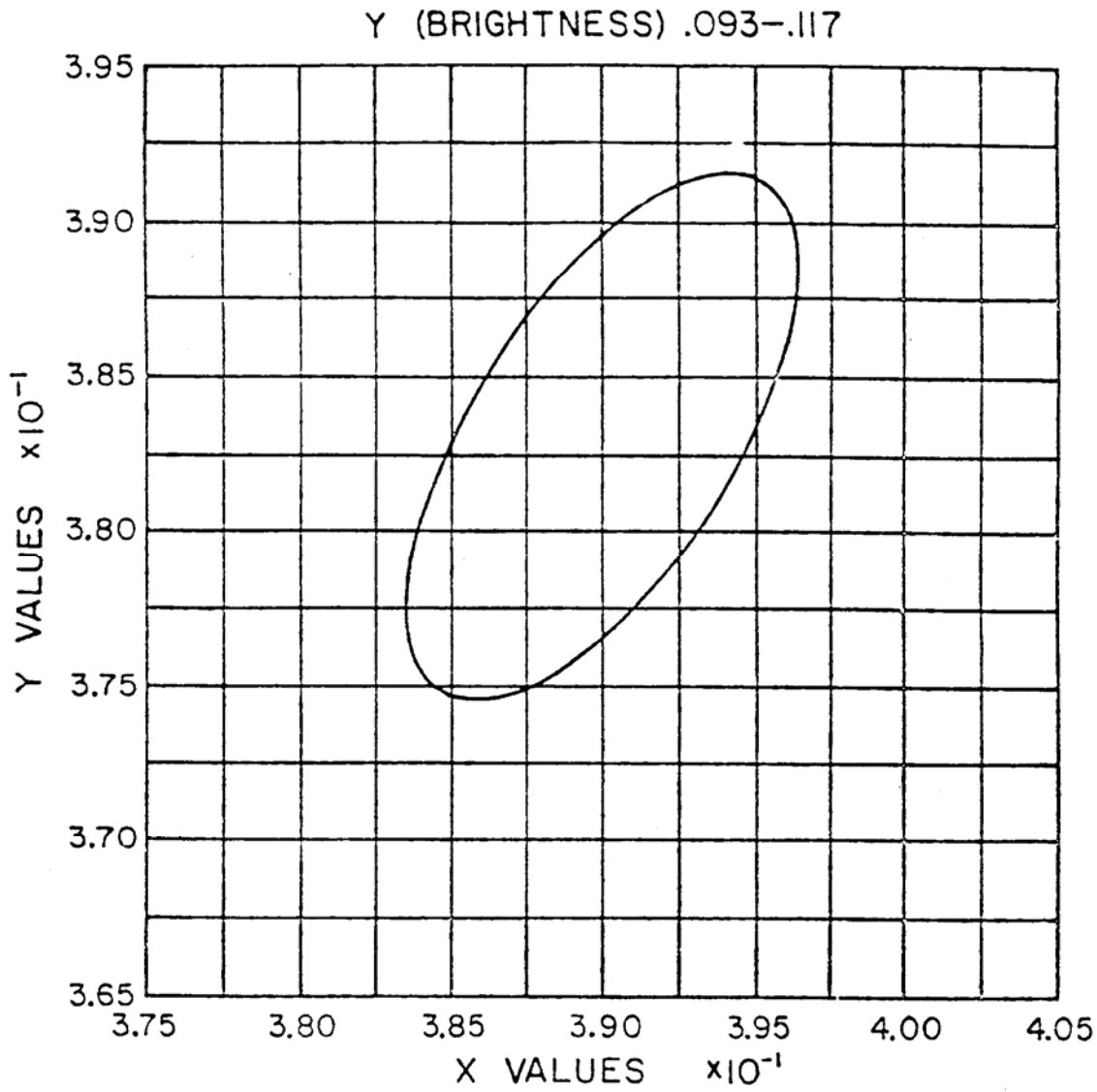
Y (BRIGHTNESS) .071-.091



Note – Color Ellipse is 2.0 NBS Units From Center Values.

FIGURE 5. Chromaticity diagram for camouflage paint, color – Dark Green, 34082.

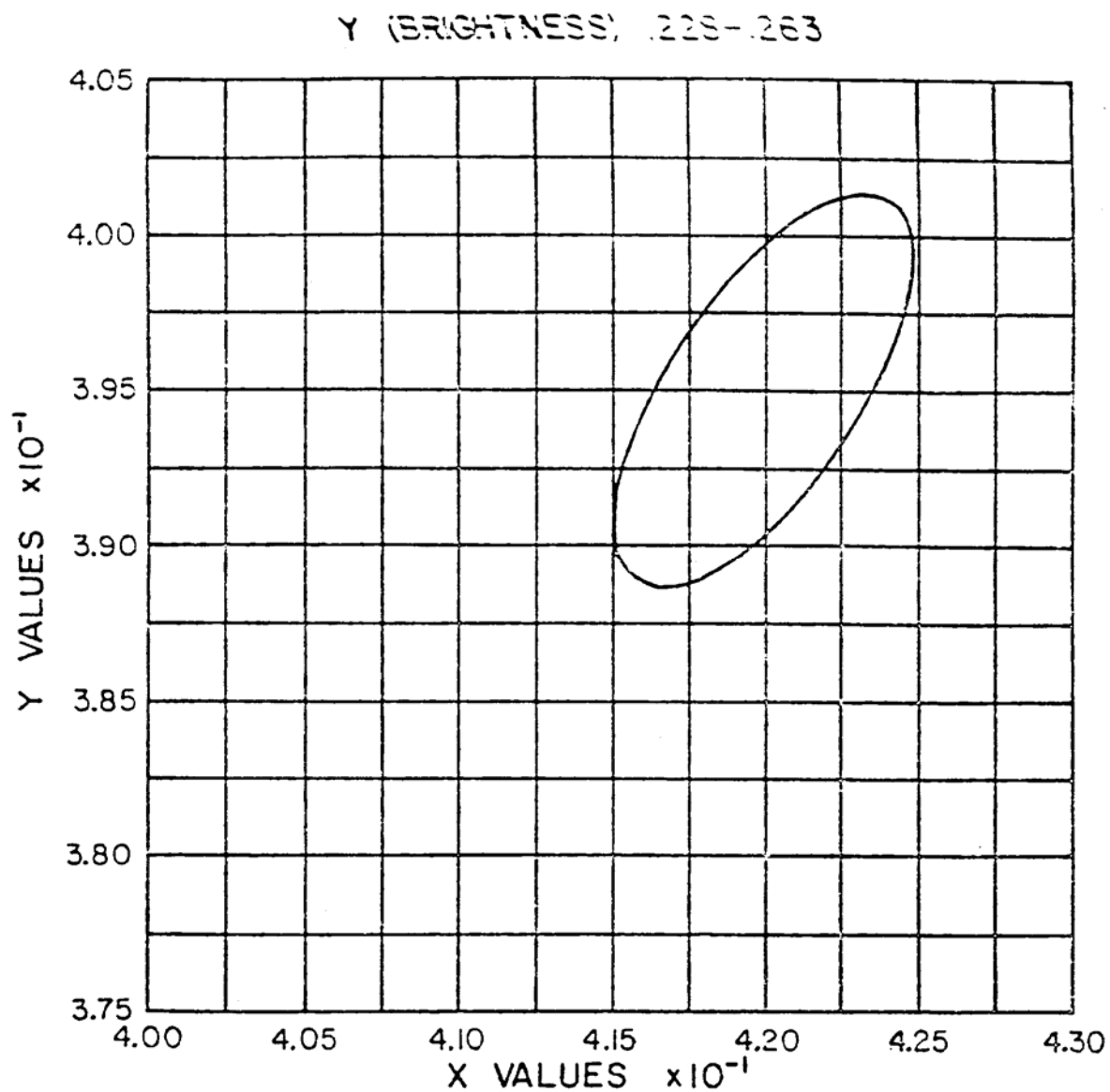
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Note – Color Ellipse is 2.0 NBS Units From Center Values.

FIGURE 6. Chromaticity diagram for camouflage paint, color – Field Drab, 33105.

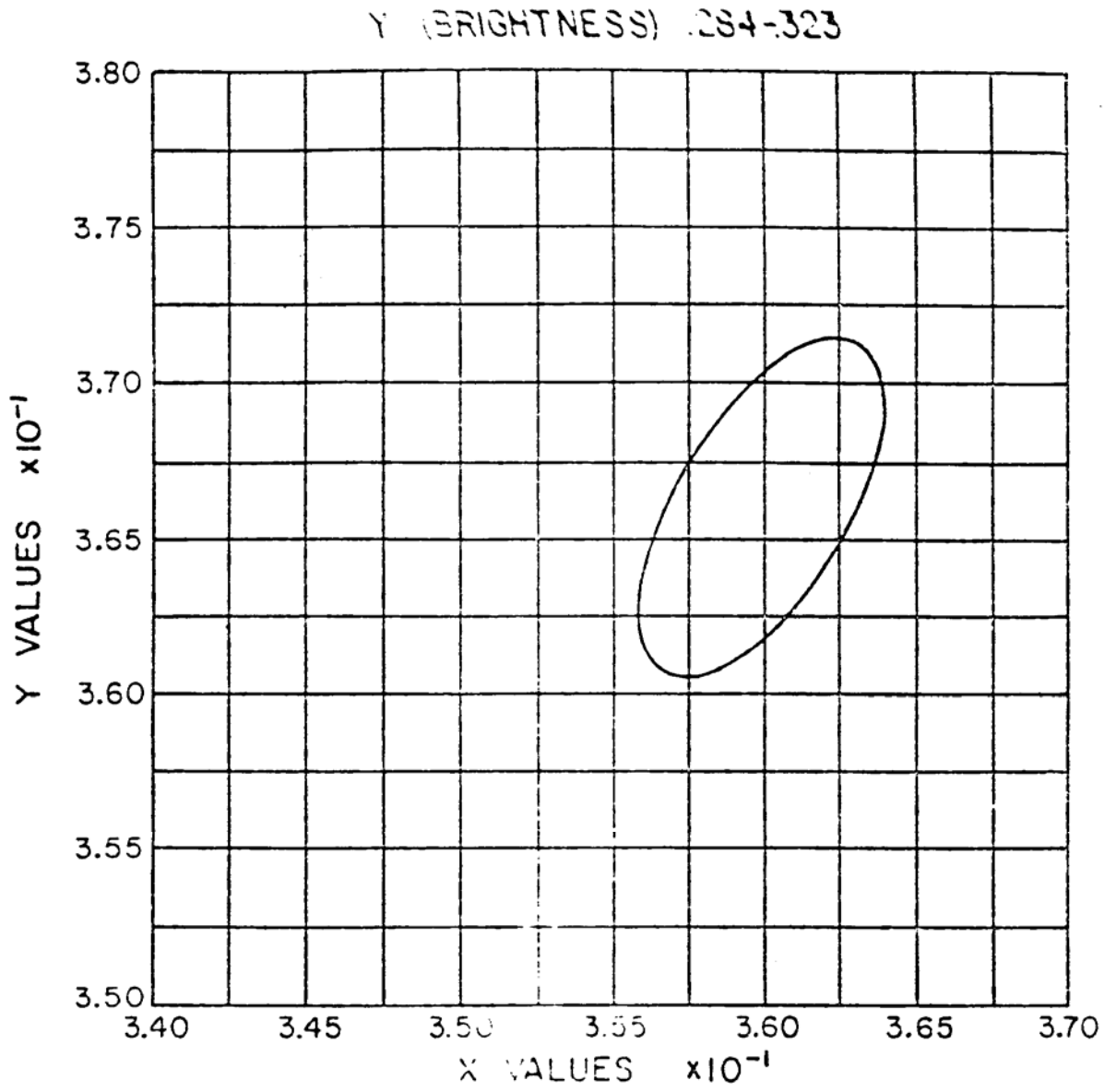
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Note - Color Ellipse is 2.0 NBS Units From Center Values.

FIGURE 7. Chromaticity diagram for camouflage paint, color - Earth Yellow, 33245.

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Note – Color Ellipse is 2.0 NBS Units From Center Values.

FIGURE 8. Chromaticity diagram for camouflage paint, color – Sand, 33303.

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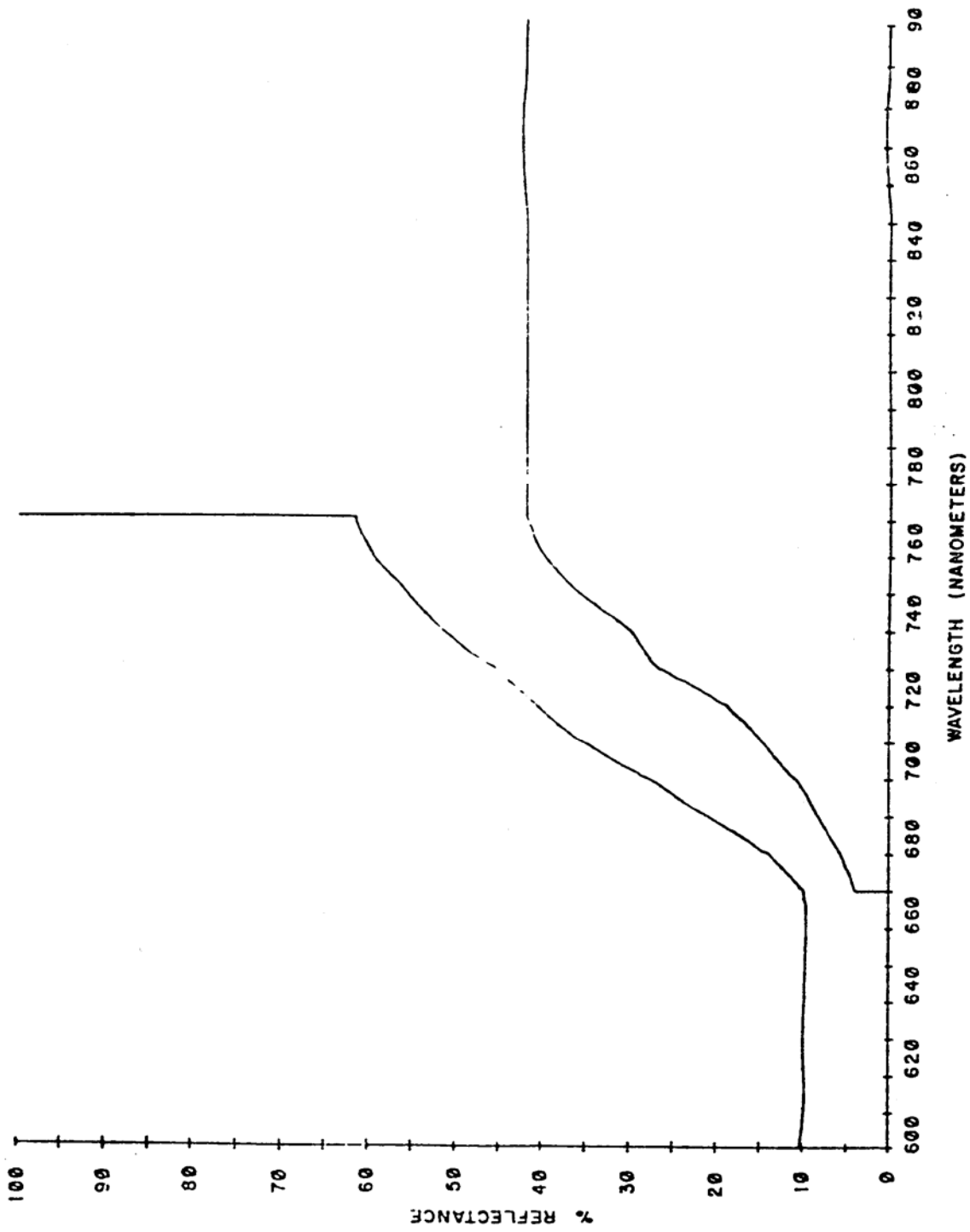


Figure 9. Spectral reflectance limits.

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CONCLUDING MATERIAL

Custodian:
Army – MR

Preparing activity:
Army - MR

Project 8010-2007-004

Review activities:
Army - AR, AT, CR, EA, MD1, MI

Civil agency:
GSA/FSS - 6FEE

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 <http://assist.daps.dla.mil/>.