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INCH-POUND

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):

Type I - Silica-based flattening agents

Type II - Polymeric flattening agents

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: U.S. Army Research Laboratory, ATTN: AMSRL-WM-MA, APG MD 21005-5069 by using the 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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1.2.2 Colors. The coating color will be one of the following FED-STD-595 colors as specified (see 6.2).

Green 383, 34094
Black, 37030
Brown 383, 30051
Tan 686A, 33446
Aircraft Green, 34031
Aircraft Gray, 36300

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents 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 documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those 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 AND STANDARDS

FEDERAL

TT-C-490 - Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings

FED-STD-141 - Paint, Varnish, Lacquer and Related Materials; Methods of Inspection, Sampling and Testing
FED-STD-313 - Material Safety Data Sheets, Preparation and Submission of
FED-STD-595 - Colors Used in Government Procurement

DEPARTMENT OF DEFENSE

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 - Primer, Cathodic Electrodeposition, Chemical Agent Resistant

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 are those cited in the solicitation.

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DEPARTMENT OF TRANSPORTATION (DOT)

Code of Federal Regulations
49 CFR, 171-178 - Hazardous Materials Regulations.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

Code of Federal Regulations
40 CFR, 260 - Hazardous Waste Management System: General.

CFR Promulgated Test Methods, Part 63 Method 311 on Hazardous Air Pollutants
Method 311 – HAPS in Paints and Coatings

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, DC 20402.)

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 the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z129.1 - American National Standard for the Precautionary Labeling of Hazardous Industrial Chemicals

(Application for copies should be addressed to the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 476 - Titanium Dioxide Pigments, Specification for
D 522 - Mandrel Bend Test of Attached Organic Coatings
D 523 - Specular Gloss, Standard Test Method for
D 562 - Consistency of Paints Using the Stormer Viscosimeter, Method of Test for
D 1014 - Conducting Exterior Exposure Tests of Paints on Steel, Standard Method of
D 1210 - Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
D 1308 - Effect of Household Chemicals on Clear and Pigmented Organic Finishes, Standard Method of Test for
D 1475 - Density of Paint, Varnish, Lacquer, Inks and Related Products, Test Method
D 1849 - Package Stability of Paint, Standard Test Method for
D 2369 - Volatile Content of Paints, Standard Method of Test for
D 2805 - Hiding Power of Paints, Standard Test Method for
D 3335 - Test for Low Concentration of Lead, Cadmium and Cobalt in Paint by Atomic Absorption Spectroscopy
D 3359 - Measuring Adhesion by Tape Test, Standard Test Methods for
D 3951 - Standard Practices for Commercial Packaging
D 3960 - Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
D 4214 - Evaluating Degree of Chalking of Exterior Paint Films, Standard Test Method for
E 97 - Directional Reflectance Factor, 45-Degree, 0-deg, of Opaque Specimens by Broad-Band Filter Reflectometry

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E 167 - Goniophotometry of Reflecting Objects and Materials
E 308 - Spectrophotometry and Description of Color in CIE 1931 System, Standard Recommended Practice for
G 154 - Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials, Standard Practice for

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

AMERICAN SOCIETY FOR QUALITY CONTROL (ASQC)

ASQC Z1.4 - Sampling Procedures and Tables for Inspection by Attributes

(Application for copies of ASQC documents should be addressed to the American Society for Quality Control, PO Box 3005, 611 East Wisconsin Avenue, Milwaukee, WI 53201-4606.)

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 4.3 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.

3.2 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 (see 6.6). 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 III and in figure 1. Aircraft Gray 36300 and Aircraft Green 34031 shall match color chips furnished by the U.S. Army Research Laboratory, ATTN: AMSRL-WM-MA, 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.

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TABLE I. Color and reflectance and requirements.

Color	Brightness Y	Chromaticity x	Chromaticity y	Infrared[1] Min.	Infrared[1] Max.	Allowable Ratio[2]
Green 383, 34094	0.063 – 0.083	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, 37030	0.030 – 0.041	0.310	0.315	0.0	15.0	–
Aircraft Green, 34031	VM[3]	VM[3]		–	7.0	–
Aircraft Gray, 36300	VM[3]	VM[3]		–	15.0	–

1/ For wavelength definition, see table II or 4.4.11, as applicable.
2/ The ratio is calculated by dividing the value of the infrared by the value of the red spectral range.
3/ Visual Match(es) (VM) as stated in 3.3 are to be used for Aircraft Green and Aircraft Gray.

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.

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TABLE III. Spectral reflectance limits for Green 383, 34094.

Wavelength Nanometers	% Reflectance Max.	Min.	Wavelength Nanometers	% Reflectance 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 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.

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 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 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, talc, etc. for type I. For type II, materials shall be polymeric based of polyurethane or urea formaldehyde condensation type polymers or other polymeric composition. The amount shall not exceed the limits of table VIII.

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TABLE IV. Pigmentation.

Green 383, 34094	Acid insoluble green pigments predominately composed of cobalt, zinc, and chromium oxides with other oxides permitted, chromium oxide, 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	Chromium oxide, titanium dioxide, carbon black, carbazole dioxazine violet, iron oxides, zinc/magnesium ferrite or other mixed metal oxides.
Black, 37030	Carbon black, iron oxides.
Aircraft Green, 34031	Carbon black, iron oxides, zinc/magnesium ferrites or other mixed metal oxides.
Aircraft Gray, 36300	Titanium dioxide, carbon black.

3.4.1.1 Lead content. The lead content shall not exceed 0.06 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, when tested as specified in 4.4.3, 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.

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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.

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.

TABLE V. Component A requirements.

Characteristic	Minimum		Maximum	
Viscosity, Krebs Units (K.U.)	55		85	
	Type I	Type II	Type I	Type II
Fineness of Grind, Hegman				
All camouflage colors	3	0	-	-
Aircraft Green, 34031	0	0	2	-
Aircraft Gray, 36300	5	0	-	-

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.

TABLE VI. Component B requirements.

Characteristic	Minimum
Nonvolatile, percent by weight of component B	70

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 VII. Mixed coating requirements.

Characteristic	Minimum	Maximum	
Hiding Power (Contrast Ratio)	0.98	-	
Specular Gloss, Green 383, Brown 383, Black			
60 degree	-	1.0	
85 degree	-	3.5	
Specular Gloss, Tan 686A			
60 degree	-	1.5	
85 degree	-	3.5	
Specular Gloss, Aircraft Green			
60 degree	-	0.5	
85 degree	-	1.0	
Specular Gloss, Aircraft Gray			
60 degree	1.5	3.0	
85 degree	4.0	8.0	
Drying Time		Type I	Type II
Set to touch, minutes	-	50	60
Dry hard, hours	-	4	6
Dry through, hours	-	5	8

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

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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.

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

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3.6.8 Adhesion. The assessment of the adhesion of the coating film shall be determined by its ability not peel from the substrate when tested in accordance with ASTM D 3359 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 N.B.S. units. In addition, after accelerated weathering they shall remain within 2.5 N.B.S. 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. 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 from an unexposed film with identical cure history prior to DS2 exposure 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.

3.6.14 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 D 4214). 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.

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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 must 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 should be used within 4 hours after mixing.

4. VERIFICATION

4.1 Clarification of inspections. The inspection requirements specified herein are classified as conformance inspection (see 4.2).

4.2 Conformance inspection. Test for acceptance of individual lots consist of testing all requirements specified in section 3. Verification conformance inspection is in accordance with the provisions herein.

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

4.3 Classification of inspection. Testing under this specification shall be for the following:

a. Qualification (see 3.1 and 6.4).
b. Acceptance of individual lots (see 4.3.2).
c. Acceptance for use as component on end item (see 4.3.3).
d. Validation of spectral reflectance characteristics (see 4.3.4).
e. Inspection for quality conformance (see 4.5 – 4.5.2).

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4.3.1 Qualification tests. Qualification testing shall consist of tests for all requirements specified in section 3.

4.3.2 Acceptance tests. Acceptance testing of individual lots shall consist of the following tests: Condition in container, hiding power, total solids, infrared reflectance, viscosity, fineness of grind, specular gloss, drying time, color and spectral reflectance, spraying properties, and mixing properties as specified in sections 3 and 4.

4.3.3 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 the following characteristics:

Color - spectral reflectance
Fineness of grind
60 degree gloss
85 degree gloss
Acid resistance
Hydrocarbon fluid resistance
Water resistance

4.3.4 Validation. The contracting officer shall require that a sprayed sample from each production lot be forwarded to the U.S. Army Research Laboratory, ATTN: AMSRL-WM-MA, APG MD 21005-5069, for validation of spectral reflectance characteristics to include color, DS2 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 in accordance with FED-STD-141, section 9 or in accordance with the appropriate ASTM method cited herein.

4.4.1.1 Test procedures. The following tests (see table IX) shall be conducted in accordance with FED-STD-141 or ASTM as specified. 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	FED-STD-141 Method	ASTM Method	Test Paragraph	Requirement Paragraph
Color and Spectral Reflectance	6241	E308	4.4.2	3.3
Total Nonvolatile			4.4.3	Tables VI & VIII
Pigment Analysis		D2371	4.4.4	3.4.1, Tables IV & VIII
Lead Content			4.4.4.1	3.4.1.1
Chromium, Hexavalent			4.4.4.2	3.4.1
Antimony Sulfide			4.4.4.3	3.4.1
Solvent Analysis	EPA M311	D3272	4.4.7	3.4.3
Volatile Organic Compounds			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		D1210		Table V
Drying Time	4061		4.4.9	Table VII
Specular gloss		D523	4.4.10	Table VII
Specular Reflectance		E167	4.4.10.1	Table III
Infrared Reflectance			4.4.11	
Camouflage Colors	6241			Tables I & II
Noncamouflage Colors	6242			Table I
Condition in Container				
Component A	3011		4.4.12.1	3.6.1.1
Component B	4261		4.4.12.2	3.6.1.2
Storage Stability				
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	4331/2131		4.4.15	3.6.4
Brushing Properties	4321		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			4.4.24	3.6.13
Chemical Agent Resistance			4.4.25	3.6.14
Weather Resistance		D1014	4.4.26	3.6.15
Freeze-Thaw Resistance			4.4.27	3.6.16
Toxic Solvents				3.6.17

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4.4.2 Color and spectral reflectance. Prepare two sprayed samples of the coating on black and white Morest 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 E 308. Determine infrared reflectance in accordance with FED-STD-141, method 6241. Measurements shall be made over the black portion of the Morest 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 HNO_3 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 HNO_3 solution. This tube will also act as the test "blank" . Immerse a Merckoquant* Lead Test Strip (see 6.8) 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 test method D3335.

4.4.4.2 Chrome (VI). Determine the presence or absence of hexavalent chrome by either of the following chemical reagent screening techniques:

4.4.4.2.1 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 should be nearly colorless. Use the tube containing 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.

4.4.4.2.2 Weigh approximately 50 mg of pigment into a small glass test tube. Add 5mL of 10 percent aqueous H_2SO_4 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 H_2SO_4 solution. This tube will also act as the test "blank". Immerse a Merckoquant* Chromate Test Strip (see 6.8) 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.

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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 D 2369. 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 must comply with 3.4.4. Nonconformance to the VOC limit in 3.4.4 shall constitutes 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 E 97 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 conditions described in 4.3.1 and FED-STD-141, method 4061. Check for compliance with table VII.

4.4.9 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 of this specification and check for compliance with table VII.

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

4.4.11 Infrared reflectance. (Aircraft Green 34031, and Aircraft Gray 36300.) 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 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, 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 and observe for compliance with 3.6.1.2.

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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 D 1849 and then examine the contents. Evaluate the pigment settling as specified in 4.3.12.1 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 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 CO_2 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 manufacturer's recommendations for proper thinning. Material should be sprayed on a clean steel panel to a dry film thickness between 0.0018 and 0.0022 inch. The coating properties of the dry sprayed surface are observed and evaluated in accordance with FED-STD-141, method 4331 for compliance with 3.6.4. A referee test, for use in automatic applications, is conducted in accordance with FED-STD-141, method 2131.

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. 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. Air dry for 168 hours. Bend over a ¼ inch mandrel. Examine the coating for cracks over the area of the bend for compliance with 3.6.6.

4.4.18 Recoatability. 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 inch. 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 inch. 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 inch and air dry for 168 hours. Perform adhesion testing as specified in ASTM D 3359, 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 inch and air dry for 168 hours. Coat all exposed unpainted metal surfaces with wax or suitable protective coating and immerse in water at 25 ± 1^0 C (77 ± 2^0 F) for 168 hours as specified in ASTM D 1308, section 6.4. At the end of the test period, remove and examine for compliance with 3.6.8.

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 ± 1^0 C (77 ± 2^0 F). At the end of the test period, remove and examine for compliance with 3.6.10.

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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 G 154. 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 3.6.11.

4.4.24 DS2 resistance. Spray one 4 by 12 inch steel panel as specified in 4.4.20. Air dry the panel a minimum of 168 hrs. Scribe a 1 inch diameter wax ring using a china marker on the painted surface of the panel. Place approximately 1 mL of DS2 agent on the panel surface. Do not cover: allow to stand 30 minutes then thoroughly wash with water. Examine for compliance with 3.6.12.

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 inch. Air dry 2 hours and spray the coating to be tested to a dry film thickness between 0.0018 and 0.0022 inch. Air dry the panels for 7 days

4.4.25.2 Test conditions. Because the desorption rate of agents from paint is temperature dependent, all agent tests will 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 will be performed in an approved fume hood, and appropriate measures to protect individuals at risk of exposure must 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 to 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 HCS401 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.

4.4.24.4 Test Procedure. Place a 5 cm^2 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 will 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.

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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 1-mL 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-5 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 will 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 solution (micrograms per milliliter read from the standard curve) by the volume of the impinger solution (25 mL).

4.4.26 Weather resistance. Spray 3, 4 by 12 inch steel panels as specified in 4.4.1.1. Air dry for seven days. Place on outdoor exposure for 2 years at an angle of 5 degrees south in the vicinity of northeastern Maryland. At the end of this exposure period examine the panels for compliance with 3.6.14. Determine chalking according to ASTM D 4214. Wash the panels with a warm soap solution using a soft sponge or cloth, rinse, dry and examine for color change.

4.4.27 Freeze-Thaw resistance (Component A). Prepare samples for testing by filling 1-pt (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 in. (25 mm) of air space between adjacent cans and between cans and the chamber walls. Keep the test sample in the chamber for l7 hours and then remove and allow it to stand for 7 hours undisturbed at room temperature, adjacent to the control sample. This will 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, etc. 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 Inspection for quality conformance. All testing and conformance inspections shall be as specified herein and summarized in 4.4.1 and table IX.

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4.5.1 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 that will 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 Polyurethane CARC" product
Name and Date of Product (Sample) Submitted for Qualification Listing)

4.5.2 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.

4.5.3 Batch and lot formation. A batch shall consist of all coating material manufactured during one continuous operation and forming part of one contract or order for delivery. A lot shall consist of all coatings of the same color and type, manufactured at one time from one batch, forming part of one contract, and submitted for acceptance. When required, the manufacturer shall furnish with each batch and/or lot 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.

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

4.5.3.2 Sampling. Sampling for examination shall be in accordance with ASQC Z1.4.

4.5.4 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.

4.5.5 Visual inspection of filled containers. Samples shall be selected at random from each lot in accordance with ASQC-Z1.4, inspection level S-2. 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.

4.5.6 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 4.5.4 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 actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department'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.

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6. NOTES

(This section contains information of a general or explanatory nature which 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. 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, document identifier (number), and date of the specification.
b. Type and color of coating (see 1.2).
c. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2 and 2.3).
d. Kit desired, including the quantity and size of containers (see 4.5.3.1 and 6.2).
e. Test/inspection conformance criteria, special marking and certifications required (4.5.1 and 4.5.2)
f. Retention sample if required and where to send it (see 4.5.4 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.

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: AMSRL-WM-MA, Aberdeen Proving Ground, MD 21005-5069 and information pertaining to qualification of products may be obtained from that activity (see section 4).

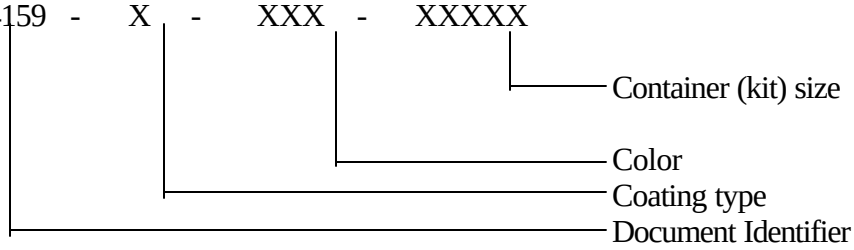
6.5 Product Identification.

6.5.1 Material Safety Data Sheet. Contracting officers will identify those activities 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 FED-STD-313, appendix B.

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6.5.2 Part or Identifying Number (PIN). Part numbers may be coded as follows:

Example: M64159 - X - XXX - XXXXX



6.5.3 Kit size designation codes. The available kit size capacity, designated as XXXXX in the part number example above could be exemplified as follows:

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

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. FED-STD-595 color chips are available from the General Services Administration, Federal Supply Service Specification Section, 470 East L'Enfant Plaza, SW, Suite 8100, Washington, DC 20407. The correct color difference equation, entitled "Hunter's Revised National Bureau of Standards (NBS) Color Difference Equation," can be found in reference source "Color in Business, Science and Industry," (Wiley, NY)."

6.7 Paint shaker. An example of this type of apparatus is a ¼ hp motor powered shaker that operates at a rate of 1350 shakes per minute that is manufactured by Red Devil Tools.

6.8 Test strips. Merckoquant* Lead Test Strips and Merckoquant* Chromate Test Strips are available from EM Science, 2909 Highland Avenue, Cincinnati, Ohio 45212.

6.9 Subject term (key word) listing.

Agent resistant
Coating
Camouflage
CARC
Chemical Agent Resistant Coating
Top coat

CONCLUDING MATERIAL

Custodian:
Army – MR
Air Force – 11
Navy – SH

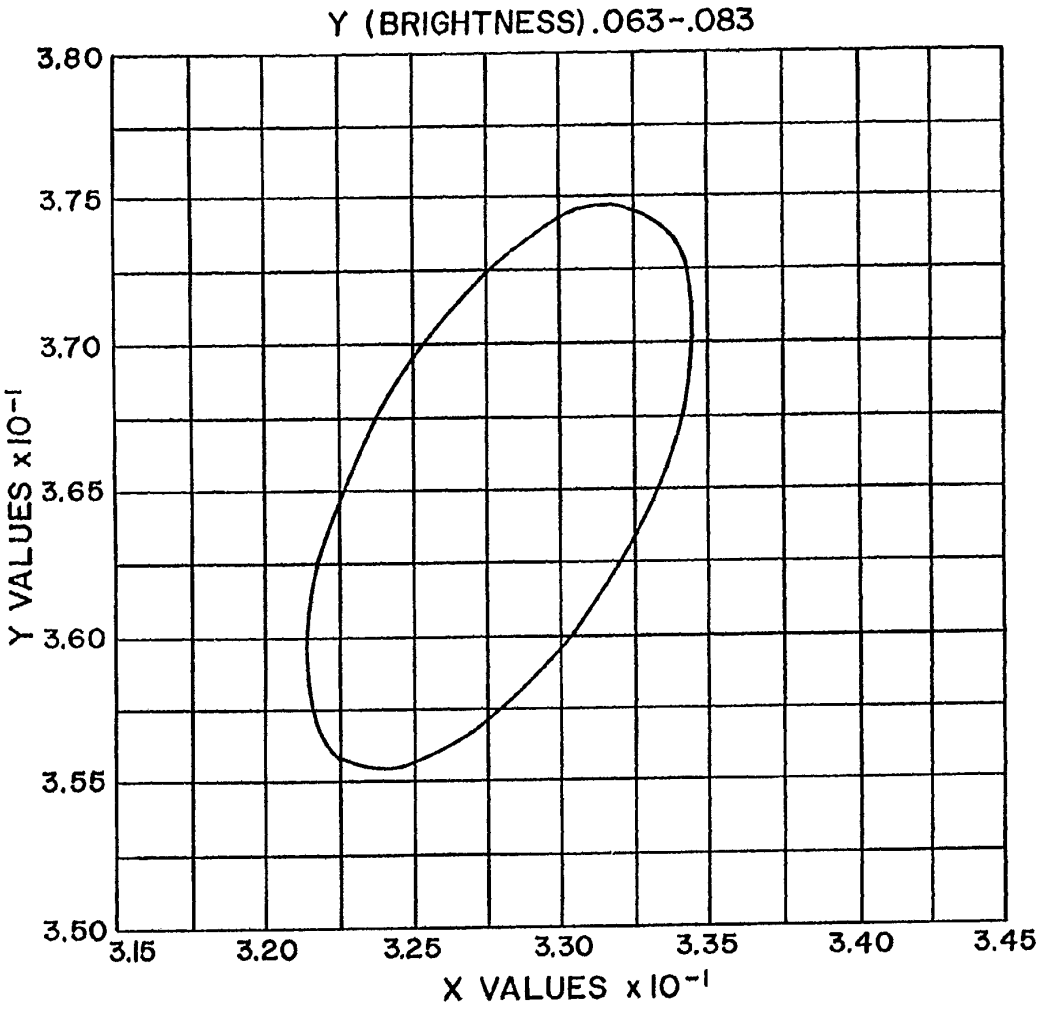
Preparing activity:
Army – MR

Civil Agency Interest:
GSA

Review activities:
Army - AR, AT, AV, EA, MD1, MI
Navy - CG, MC

(Project 8010-0941)

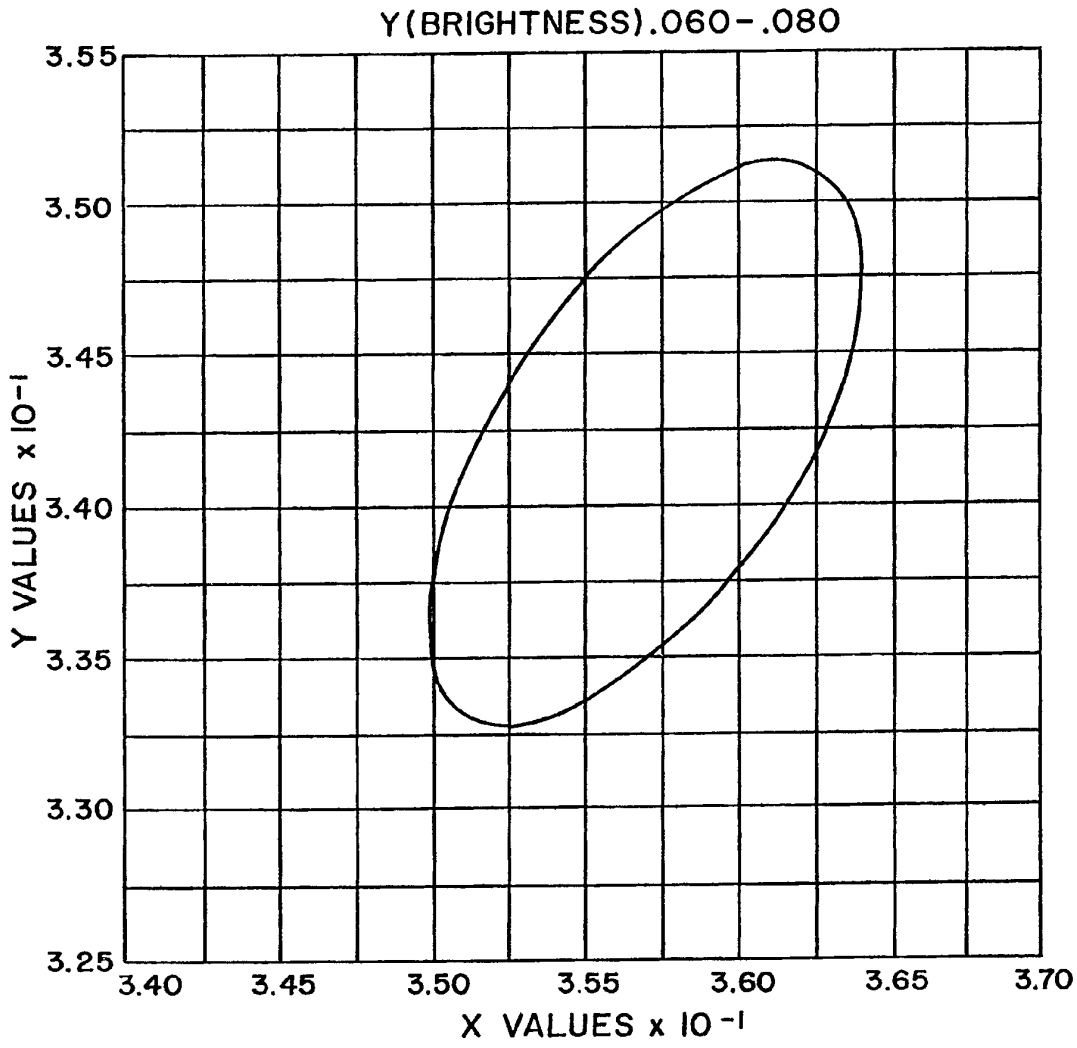
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NOTE – COLOR ELLIPSE IS 2.0 NBS UNITS FROM CENTER VALUE

Fig. 1. Chromaticity diagram for camouflage paint, color – green 383, 34094

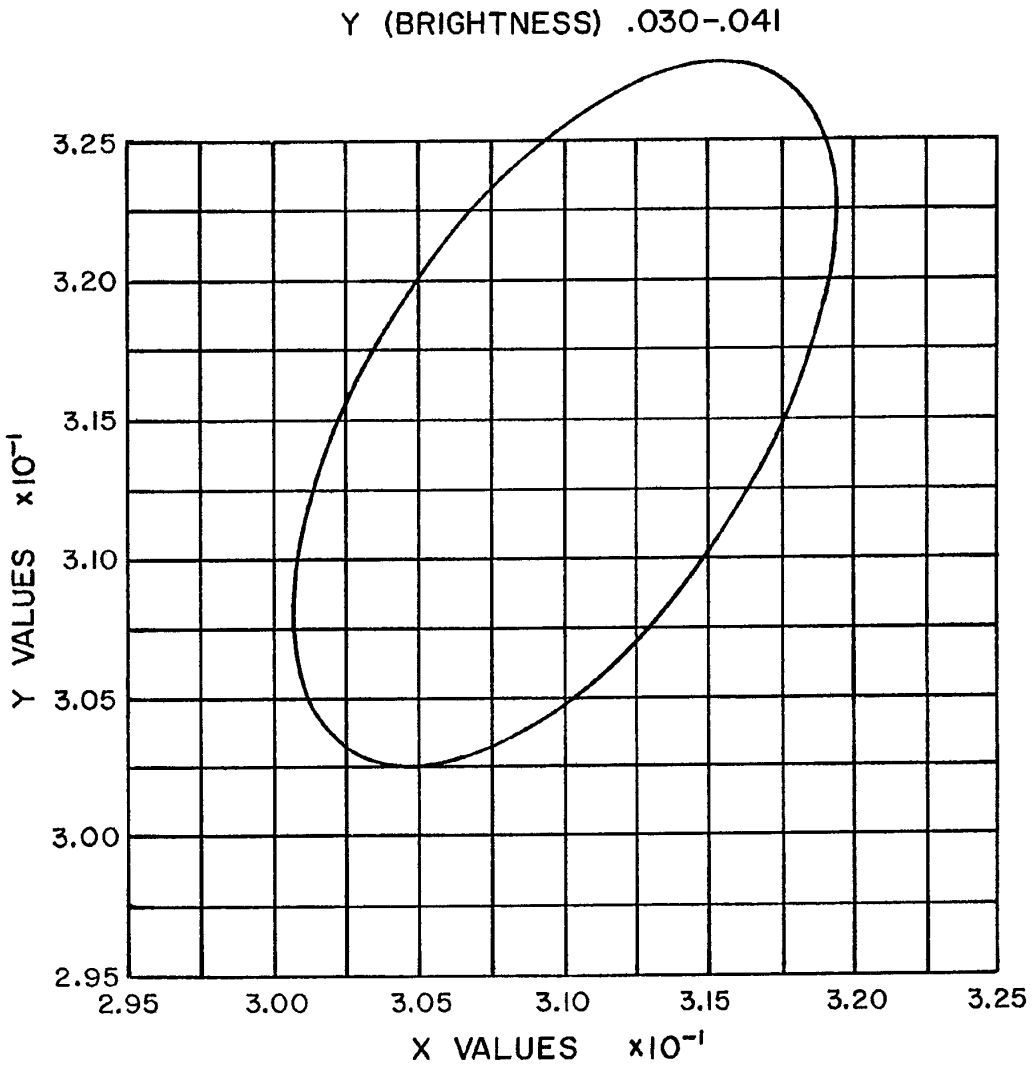
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NOTE – COLOR ELLIPSE IS 2.0 NBS UNITS FROM CENTER VALUE

Fig. 2. Chromaticity diagram for camouflage paint, color – brown 383, 30051

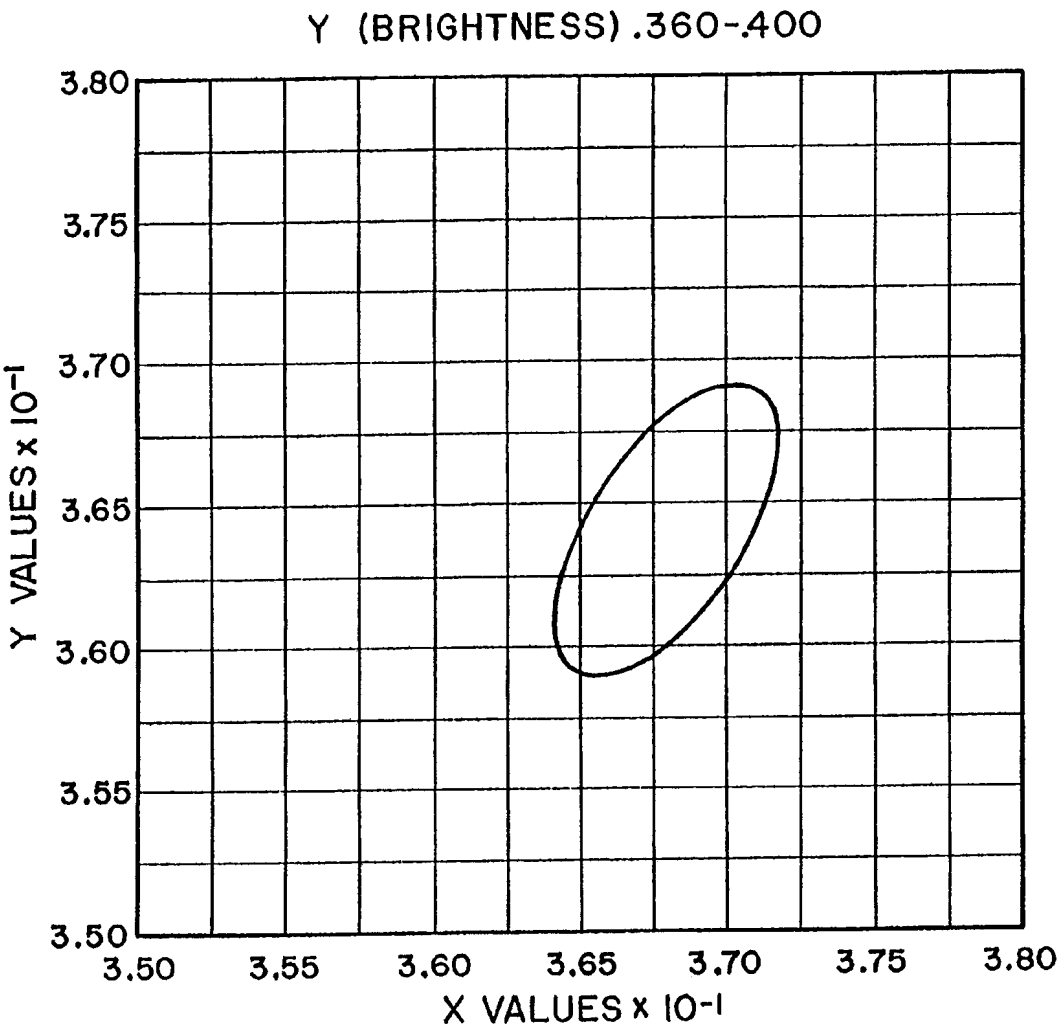
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NOTE – COLOR ELLIPSE IS 2.0 NBS UNITS FROM CENTER VALUE

Fig. 3. Chromaticity diagram for camouflage paint, color – black, 37030

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NOTE – COLOR ELLIPSE IS 2.0 NBS UNITS FROM CENTER VALUE

Fig. 4. Chromaticity diagram for camouflage paint, color – tan 686A, 33446

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7, and send to preparing activity.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-DTL-64159	**2. DOCUMENT DATE (YYYYMMDD)** 20020130

3. DOCUMENT TITLE **COATING, WATER DISPERSIBLE ALIPHATIC POLYURETHANE, CHEMICAL AGENT RESISTANT**

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON *(if applicable)*	**7.DATE SUBMITTED** (YYYYMMDD)

8. PREPARING ACTIVITY

a. NAME US Army Research Laboratory Weapons & Materials Research	b. TELEPHONE *Include Area Code)* (1) Commercial (410) 306-0725 (2) AUTOVON 458-0725
c. ADDRESS *(Include Zip Code)* ARL/WMRD ATTN: AMSRL-WM-MA Aberdeen Proving Ground, MD 21005-5069	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman road, Suite 2533 Ft. Belvoir, VA 22060-2533 Telephone (703) 767-6888 AUTOVON 427-6888