H-09-05
MIL-E-52798A(ME)
21 May 1976
SUPERSEDING
MIL-E-52798(ME)
1 May 1974

MILITARY SPECIFICATION

ENAMEL, ALKYD, CAMOUFLAGE

This specification is approved for use by the Mobility Equipment Research and Development Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers a camouflage alkyd enamel used as a finishing coat on military equipment and is suitable for use under air pollution regulations.

1.2 Classification.

1.2.1 Colors. The enamel shall be of the following colors, as specified (see 6.2):

Light Green	Sand
Forest Green	Earth Brown
Dark Green	Earth Red
Olive Drab	Desert Sand
Field Drab	Black
Earth Yellow	

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this specification to the extent specified herein:

FSC 8010

SPECIFICATIONS

FEDERAL

QQ-A-250/5	- Aluminum Alloy Alclad 2024, Plate and Sheet.
TT-P-346	- Pigment, Chrome-Yellow and Chrome-Orange, Dry.
TT-P-375	- Pigment, Indian Red and Bright Red (Iron Oxide), Dry (for use in Protective Coatings).
TT-P-390	- Pigment, Iron Oxide Black, Synthetic, Dry, Packaging, Packing and Marking of.
TT-P-1757	- Primer Coating, Zinc Chromate, Low Moisture Sensitivity.
TT-R-266	- Resin, Alkyd; Solutions.
TT-S-735	- Standard Test Fluids; Hydrocarbon.
TT-T-291	- Thinner: Paint, Volatile Mineral Spirits (Petroleum Spirits).
CCC-C-458	- Cloth, Cotton, Flannel Canton.
PPP-P-1892	- Paint, Varnish, Lacquer and Related Materials.

MILITARY

MIL-T-704	- Treatment and Painting of Materiel.
MIL-L-2104	- Lubricating Oil, Internal Combustion Engine, Heavy-Duty.
MIL-C-5541	- Chemical Films and Chemical Film Materials for Aluminum and Aluminum Alloys.
MIL-C-81706	- Chemical Conversion Materials for Coating Aluminum and Aluminum Alloy.

STANDARDS

FEDERAL

FED. TEST METHOD STD. No. 141	- Paint, Varnish, Lacquer and Related Materials; Methods of Inspection, Sampling and Testing.

(Copies of specifications and standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 263	-Chrome Oxide Green.
D 476	-Titanium Dioxide Pigments.
D 562	-Consistency of Paints using the Stormer Viscosimeter.
D 768	-Yellow Iron Oxide, Hydrated, Specification for.
D 1014	-Conducting Exterior Exposure Tests of Paints on Steel.
D 1210	-Fineness of Dispersion of Pigment-Vehicle System.
D 1308	-Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
D 1364	-Water in Volatile Solvents (Fischer Reagent Titration Method.)
D 1542	-Qualitative Tests for Rosin in Varnishes.
D 1644	-Standard Methods of Test for Nonvolatile Content of Varnishes.
D 2698	-Determination of the Pigment Content of Solvent-Type Paints by High-Speed Centrifuging.

G 26 -Operating Light-and-Water-Exposure Apparatus (Xenon-Arc Type) for Exposure of Nonmetallic Materials.

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

COUNTY OF LOS ANGELES - AIR POLLUTION CONTROL DISTRICT

Rule 66 - Organic Solvents.

(Application for copies should be addressed to the County of Los Angeles - Air Pollution Control District, 434 S. San Pedro Street, Los Angeles, CA 90013).

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 Qualification. The enamel furnished under this specification shall be a product which is qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.2 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 enamel shall be as specified herein. Material not specified shall be selected by the contractor and shall be subject to all provisions of this specification.

3.3 Color and spectral reflectance. The color compound shall impart to the substrate the required spectral reflectance properties in the visible (380 - 700 nanometers) and near infrared (700 - 900 nanometers) spectrums. The color of this system shall fall within 2 National Bureau of Standards (NBS) units under Standard Illuminant C of those specified in Figures 1 through 11 and all reflectance values shall fall within the limits specified in Table I. In addition, colors light green, forest green, dark green, and olive drab shall meet the spectral reflectance limits specified in Table II or in Figure 12.

Table I. Color and Reflectance Requirements

Color	Visual (Y)	Chromaticity x	Chromaticity y	Infrared (1) Min.	Infrared (1) Max.	Allowable (2) Ratio Min.
Light green	0.098 - .123	0.367	0.413	-	65.0	4.7
Forest green	0.058 - .075	0.333	0.357	-	60.0	5.2
Dark green	0.071 - .091	0.339	0.390	-	60.0	5.2
Olive drab	0.061 - .080	0.357	0.373	-	60.0	5.2
Field drab	0.093 - .117	0.390	0.383	25.0	35.0	-
Earth yellow	0.225 - .266	0.420	0.395	30.0	40.0	-
Sand	0.280 - .327	0.360	0.366	55.0	65.0	-
Earth red	0.087 - .110	0.423	0.377	15.0	25.0	-
Earth brown	0.071 - .091	0.376	0.363	10.0	25.0	-
Desert sand	0.300 - .350	0.360	0.346	35.0	50.0	-
Black	0.030 - .041	0.310	0.315	0.0	15.0	-

(1) See Table IA for wavelength definition.
(2) The ratio is calculated by dividing the value of the infrared by the value of the red spectral range.

TABLE IA. Selected Ordinates for Determining Infrared and Red Reflectance Values from Spectrophotometric Curves Ordinates

Magenta Red Region Nanometers	Infrared Region Nanometers		
620.0	714.0	769.0	816.0
626.0	725.0	773.0	821.0
638.0	730.0	777.0	826.0
645.0	737.0	783.0	831.0
649.0	742.0	787.0	836.0
652.0	747.0	793.0	842.0
653.0	751.0	797.0	848.0
655.0	756.0	802.0	855.0
658.0	760.0	807.0	862.0
663.0	764.0	811.0	873.0

TABLE II. Spectral Reflectance Limits for Light Green, Forest Green, Dark Green, and Olive Drab Colors.

Wavelength Nanometers	% Reflectance Max.	% Reflectance Min.	Wavelength Nanometers	% Reflectance Max.	% Reflectance 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*	9.5	-	820	-	42.0
670*	10.0	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	27.0	890	-	42.0
740	51.8	30.0	900	-	42.0
750	56.0	36.3			

*Values marked with asterisks are for all colors except light green.

For green light, use the following values:

Wavelength Nanometers	% Reflectance Max.	% Reflectance Min.
600	11.6	-
610	11.3	-
620	11.2	-
630	11.2	-
640	11.2	-
650	11.0	-
660	11.0	-
670	11.3	4.0

3.4 Composition.

3.4.1 Pigment. The pigments listed in Table III, or any combination thereof, shall make up the primary hiding pigmentation for the colors specified (see 6.5). Hiding pigments shall be chemically pure and free from extenders. The titanium dioxide shall be rutile chalk resistant type conforming to ASTM D 476, Type III. Small amounts of other tinting pigments may be used when necessary to match the spectral chacterisitics, provided that these additional pigments have good color stability. No other lead-based pigments shall be used other than those specified in Table III. The extender pigments shall be siliceous matter and shall not exceed the amounts specified in Table V.

TABLE III. Pigmentation.

Light green Dark green Forest green Olive drab	-Acid insoluable Green pigment predominately composed of Cobalt, Zinc, and Chromium oxides with other oxides permitted, Chrome yellow, Light stable molybdate orange, Carbazole dioxazine violet, Yellow iron oxide, Red iron oxide.
Field drab Earth yellow Desert sand	-Yellow iron oxide, Red iron oxide, Chromium oxide, Titanium oxide, Carbon Black.
Earth brown Earth red	-Yellow iron oxide, Red iron oxide, Titanium dioxide, Carbon black.
Sand	-Yellow iron oxide, Red iron oxide, Chromium oxide, Titanium dioxide, Carbazole dioxazine violet.
Black	-Carbon black, Black iron oxide

3.4.2 Vehicle.

3.4.2.1 Composition. The vehicle shall be a drying oil phthalic alkyd resin in mineral spirits conforming to the requirements of TT-R-266 and Table IV, together with the necessary additions of driers and volatile solvents. Small amounts of anti-skinning agents, wetting agents, suspensio agents, and stabilizers may be used at the discretion of the contractor.

The vehicle shall give a negative test for rosin and phenolic resin when tested as specified in 4.3, Table VII. The solvents used in manufacturing and thinning prior to application shall conform to the following requirements by volume when tested as specified in 4.4, Table VII.

(a) Aromatic compounds with eight or more carbon atoms except ethylbenzene: 8% maximum.
(b) Ethylbenzene and toluene: 20% maximum.
(c) Solvents with an olefinic or cyclo-olefinic type of unsaturation: Negative Test
(d) Ketones: Negative Test
(e) Total of a & b: 20% maximum

TABLE IV. Characteristics of Alkyd Resin.

Characteristics	Requirements Minimum	Requirements Maximum
Total solids, percent by weight of alkyd resin solution	49	51
Viscosity (Gardner Bubble Viscometer)	U	Z-1
Color (Gardner Color Scale)	-	13 1/
Phthalic anhydride, percent by weight of alkyd resin solids	30	-
Drying oil acids, percent by weight of alkyd resin solids	45	55
Unsaponifiable matter, percent by weight of alkyd resin	-	1.0

1/ Gardner color tube in accordance with Method 4248 of FED. TEST METHOD STD. No. 141.

3.5 Quantitative requirements.

3.5.1 Specific quantitative requirements. Each color shall conform to its specifc requirements in Table V when tested as specified in 4.3. Total solids, pigment solid, and vehicle solids are percent by weight of enamel. Extender pigment is percent by weight of pigment.

TABLE V. Specific Quantitative Requirements.

Color	Total Solids	Pigment Solids		Vehicle Solids	Extender Pigment	Contrast Ratio
	Min.	Min.	Max.	Min.	Max.	Min.
Light green	62	41	45	18	50	0.98
Forest green	62	41	45	18	50	0.98
Dark green	62	41	45	18	50	0.98
Olive drab	62	41	45	18	50	0.98
Field drab	62	41	45	18	65	0.98
Earth yellow	62	41	45	18	65	0.98
Sand	62	41	45	18	65	0.98
Earth red	60	39	43	19	65	0.98
Earth brown	60	39	43	19	65	0.98
Desert sand	62	41	45	18	65	0.98
Black	60	39	43	19	83	0.98

3.5.2 General quantitative requirements. The enamel shall comply with Table VI when tested as specified in 4.3.

TABLE VI. General Quantitative Requirements.

Characteristics	Requirements Minimum	Maximum
Phthalic anhydride, percent by weight of nonvolatile vehicle	30	-
Drying oil acids, percent by weight of nonvolatile vehicle	45	55
Unsaponifiable matter, percent by weight of nonvolatile vehicle	-	1.0
Rosin, on isolated vehicle	Negative	
Phenol, on isolated vehicle	Negative	
Pigment, antimony sulfide	Negative	
Flash point, Pensky - Martens, closed cup, °F	86	-
Water, percent by weight of enamel	-	1.0

TABLE VI. General Quantitative Requirements (Continued).

Characteristics	Requirements Minimum	Requirements Maximum
Coarse particles and skins, percent by weight of pigment	-	1.0
60 degree specular gloss	-	1.0
85 degree specular gloss	-	3.0
Fineness of grind		
Hegman	5.0	-
ASTM (Millimicrons)	-	40.
Consistency; Package, Krebs stormer, shearing rate - 200 R.P.M.		
Grams	125	175
Krebs units	70	80
Drying time:		
Set to touch, hours	-	2
Dry hard, hours	-	8
Full hardness, hours	-	72
Baking:		
Dry through, 250°F or equivalent heat treatment, minutes	-	45

3.6 Qualitative requirements.

3.6.1 Condition in container. Freshly opened, full containers of the enamel shall be free from lumps, skins, grit and coarse particles and shall show no more settling than can be dispersed by 3 minutes of agitation on a Red Devil or equivalent type paint shaker, or by manual stirring, to a smooth homogeneous condition, when tested as specified in 4.3.9.

3.6.2 Storage stability.

3.6.2.1 Partially filled container. A three-quarter filled, closed one-half quart multiple friction top can of enamel, after 48 hours storage at room temperature, shall show no skinning. A three-quarter filled, closed one-half quart multiple friction top can of enamel, after 7 days storage at 140°F, shall show no livering, curdling, hard caking, or gummy sediment, and shall mix to a smooth homogeneous state; any skin formation shall be continuous and easily removed. Tests shall be performed as specified in 4.3.10.1.

3.6.2.2 Full container. When tested as specified in 4.3.10.2, a full, closed multiple friction top can of the enamel, after 1 year storage at room temperature, shall show no skinning, livering, curdling, hard-dry caking or tough gummy sediment; the enamel shall remix to a smooth homogeneous state, and shall have a maximum viscosity of 90 Krebs units. Drying and baking times shall have increased not more than 20 percent over the values specified in Table VI.

3.6.3 Dilution stability. The enamel shall show no evidence of precipitation, curdling or separation and shall remain stable and uniform after reduction with an equal part by volume of thinner conforming to TT-T-291, Type II, Grade A. Any pigment settling after dilution shall be easily redispersed. Tests shall be performed as specified in 4.3.11.

3.6.4 Brushing properties. The enamel shall brush satisfactorily and shall dry to a smooth, uniform film, free from seeds, runs, sags, or streaks when tested as specified in 4.3.12. The dried film shall show no discernible brush marks.

3.6.5 Spraying properties. The enamel shall spray satisfactorily in all respects, and shall show no running, sagging, streaking, or pronounced orange peel. The air dried film shall show no seeding, dusting, floating, fogging, mottling, hazing, or other film defects when tested as specified in 4.3.13.

3.6.6 Flexibility. A film of the enamel shall withstand bending without cracking or flaking when tested in accordance with 4.3.14.

3.6.7 Knife test. When tested as specified in 4.3.15, a film of the enamel shall adhere tightly to and shall not flake or crack from metal. The film shall ribbon or curl from the metal on cutting and the cut shall show beveled edges.

3.6.8 Recoatability. When tested as specified in 4.3.16, recoating of a dried film shall produce no lifting, softening, or other film irregularity.

3.6.9 Water resistance. A film of the enamel tested as specified in 4.3.17 shall show no wrinkling or blistering when examined immediately after removal from distilled water. When examined 2 hours after removal, there shall be no excessive softening, whitening, or dulling. After 24 hours air 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 degrees spectral gloss.

3.6.10 Hydrocarbon resistance. A film of the enamel tested as specified in 4.3.18 shall show no blistering or wrinkling when examined immediately after removal from the hydrocarbon test fluid. When examined 2 hours after removal, there shall be no excessive softening, whitening, or dulling. After 24 hours drying, the portion of the panel 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 specular gloss.

3.6.11 Acid resistance. For light green, forest green, dark green, and olive drab enamels: A film of enamel tested as specified in 4.3.19 shall have no blistering and show no change from the original color.

3.6.12 Polish resistance. A film of enamel tested as specified in 4.3.20 shall have a maximum 85 degree specular gloss of 10.

3.6.13 Accelerated weathering. Samples of the enamel tested as specified in 4.3.21 for 300 hours 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, the color after accelerated weathering shall remain within 2.5 NBS Units of the values specified in Table I. The infrared reflectance and allowable ratio shall remain within those limits originally specified.

3.6.14 Weather resistance. A film of the enamel prepared and exposed as in 4.3.22 shall show no checking, cracking, or appreciable film deterioration. Colors containing titanium dioxide shall have no more than moderate chalking and all other colors no more than light chalking (Nos. 4 and 6, Method 6411 of FED. TEST METHOD STD. No. 141). The film 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.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.1.1 Sampling and inspection. Sampling and inspection shall be performed in accordance with Section 1000 of FED. TEST METHOD STD. No. 141.

4.2 Classification of tests. Testing under this specification shall be for the following:

(a) Qualification (see 3.1 and 6.4).
(b) Acceptance of individual lots.
(c) Acceptance for use as component on end item.
(d) Validation of spectral reflectance characteristics.

4.2.1 Qualification tests. Qualification testing shall consist of tests for all requirements specified in Section 3 (see 6.4).

4.2.2 Acceptance tests. Acceptance testing of individual lots shall consist of tests for all requirements specified in Section 3 with the exception of storage stability (see 3.6.2.2) and weather resistance (see 3.6.14).

4.2.3 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:

Phthalic Anhydride	Flexibility
Drying Oil Acids	Knife Test
Color - Spectral Reflectance	Water Resistance
Fineness of Grind	Hydrocarbon Fluid Resistance
60 Degree Gloss	Acid Resistance
85 Degree Gloss	

4.2.4 Validation. The contracting officer shall require that at least a quart sample from each production lot be forwarded to the Organic & Chemical Coatings Research Group, Lab 9000, DRXFB-VO, MERADCOM, Fort Belvoir, Virginia 22060 for validation of spectral reflectance characteristics.

4.3 Test methods.

4.3.1 Test conditions. The routine and referee testing conditions shall be in accordance with Section 7 of FED. TEST METHOD STD. No. 141 except as otherwise specified herein. Failure of any test result to fall within the ranges specified in 3.2, 3.3, 3.4, 3.5, or 3.6, as applicable, shall constitute failure of the applicable test.

4.3.1.1 Test panels. Except as otherwise specified, all panels for test purposes shall be aluminum clad aluminum alloy conforming to QQ-A-250/5 and given a chemical film treatment with materials conforming to Form I or II, Method C (Immersion), Class 1A of MIL-C-81706 to produce coatings meeting the requirements of MIL-C-5541. When primed panels are specified, application of the enamel shall be over control formula zinc chromate primer conforming to TT-P-1757 with a dry film thickness between 0.3 and 0.5 mil and air dried 18 hours. When tin plated panels are specified, they shall be prepared in accordance with Method 2012 of FED. TEST METHOD STD. No. 141 using the aliphatic naphtha-ethylene glycol monoethyl ether mixture.

4.3.1.2 Test procedures. The following tests (see Table VII) shall be conducted in accordance with FED. TEST METHOD STD. No. 141 and as specified herein. The right is reserved to make any additional tests deemed necessary to determine that the enamel meets the requirements of this specification.

TABLE VII. Index.

Item	Test Method: Application Method in FED. TEST METHOD STD. No. 141	Test Method: Applicable ASTM Test Method	Para. of this Specification Giving further references	Para. of this Specification giving requirements
Color and spectral reflectance	4251, 6241	-	4.3.2	3.3, TABLE I
Total solids	4041	D 1644	-	TABLE V
Pigment content	4022	D 2698	-	TABLE V
Vehicle solids	4052	D 2698	-	TABLE V
Pigment analysis	-	-	4.3.3	TABLE III, V
Unsaponifiable	7014	-	-	TABLE VI
Drying oil acids	7014	-	-	TABLE VI
Phthalic anhydride	7014	-	-	TABLE VI
Aromatic compounds	7355, 7356	-	-	3.4.2.1
Olefinic and cyclo-olefinic	7355, 7356	-	-	3.4.2.1
Ketones	7355, 7356	-	-	3.4.2.1
Hiding power (contrast ratio)	4122	-	4.3.4	TABLE V
Rosin	5031	D 1542 Sec. 4 A	-	TABLE VI
Phenol	5141	-	-	TABLE VI
Antimony sulfide	-	-	4.3.5	TABLE VI
Flash point	4293	-	-	TABLE VI
Water	4082	D 1364	-	TABLE VI
Coarse particles and skins	4092	-	-	TABLE VI
60° specular gloss	6101	-	4.3.6	TABLE VI
85° specular gloss	6103	-	4.3.7	TABLE VI
Fineness of grind	4411	D 1210	-	TABLE VI
Consistency	4281	D 562	-	TABLE VI
Drying time	4061	-	4.3.8	TABLE VI
Condition in container	3011	-	4.3.9	3.6.1
Storage stability	-	-	4.3.10	3.6.2
Partially full container	3021	-	4.3.10.1	3.6.2.1
Full container	3022	-	4.3.10.2	3.6.2.2

TABLE VII. Index (Continued)

Item	Test Method: Application Method in FED. TEST METHOD STD. No. 141	Test Method: Applicable ASTM Test Method	Para. of this Specification Giving further references	Para. of this Specification giving references
Dilution stability	4203	-	4.3.11	3.6.3
Brushing properties	4321, 2141	-	4.3.12	3.6.4
Spraying	4331, 2131	-	4.3.13	3.6.5
Flexability	6221	-	4.3.14	3.6.6
Knife test	6304	-	4.3.15	3.6.7
Recoatability	-	-	4.3.16	3.6.8
Water resistance	6011	D 1308 Sec. 5.4	4.3.17	3.6.9
Hydrocarbon resistance	6011	D 1308 Sec. 5.4	4.3.18	3.6.10
Acid resistance	-	-	4.3.19	3.6.11
Polish resistance	-	-	4.3.20	3.6.12
Accelerated weathering	6122	-	4.3.21	3.6.13
Weather resistance	6160	D 1014	4.3.22	3.6.14

4.3.2 Color and spectral reflectance. Draw down the enamel on a black and white Morest card using a 0.0040-inch (0,0080-inch gap clearance) film applicator. Dry for 48 hours at a temperature of 23° ± 1.1°C (73.4 ± 2°F), a relative humidity of 50 ± 4 percent, and under dust-free conditions. Determine the color from the spectral reflectance curves of six samples using the Diano Hardy recording spectrophotometer method in accordance with FED. TEST METHOD STD. No. 141, Method 4251. Determine infrared reflectance in accordance with Method 6241 of FED. TEST METHOD STD. No. 141. Check for compliance with 3.3 Tables I and II, and Figure No. 12. A deviation of more than 2 NBS units in color space or noncompliance with the spectral units or allowable ratio shall constitute failure of this test. Measurements shall be made over the black portion of the Morest card.

4.3.3 Pigment analysis. Extract the pigment as in Method 4021 of FED. TEST METHOD STD. No. 141 using Extraction Mixture C. Make appropriate qualitative and quantitative tests on the extracted pigment to determine

if only permissible pigments were used in formulating the different colors. Examination of the acid insoluable portion of the pigment by X-ray diffraction for colors light green, forest green, dark green, and olive drab, shall show the presence of the acid insoluable green pigment and silica. Nonconformance to the applicable requirements in Tables III and V shall constitute failure of this test.

4.3.4 Hiding power (contrast ratio). Determine the contrast ratio in accordance with Method 4122 of FED. TEST METHOD STD. No. 141, using a film applicator that will deposit a 3-inch-wide film with a dry film thickness of 0.0010 inch maximum. Air dry for 72 hours. Determine the reflectance, verify the film thickness in the area in which the reflectance was measured, and calculate the contrast ratio. Nonconformance to Table V shall constitute failure of this test.

4.3.5 Antimony sulfide. Add 25 ml of 50 percent ammonium hydroxide to about 2 grams of pigment in a 50 ml erlenmeyer flask. With agitation, saturate the mixture with hydrogen sulfide for about 1 minute. Filter through course paper into a 100 ml beaker. Do not wash residue. Slowly and with stirring, add 6 N HCL to the filtrate until it is acidic. Formation of a yellow-brown precipitate indicates that antimony was in the original pigment mixture. A milky white precipitate of sulfur will form in the absence of Sb_2S_3. Nonconformance to Table VI shall constitute failure of this test.

4.3.6 60 degree specular gloss. Draw down the enamel using a 0.0020-inch (0.0040-inch gap clearance) film applicator and test as specified in Method 6101 of FED. TEST METHOD STD. No. 141. Nonconformance to Table VI shall constitute failure of this test.

4.3.7 85 degree specular gloss. Draw down the enamel using a 0.0020-inch (0.0040-inch gap clearance) film applicator and test as in Method 6103 of FED. TEST METHOD STD. No. 141. Nonconformance to Table VI shall constitute failure of this test.

4.3.8 Drying time. Determine drying time in accordance with Method 4061 of FED. TEST METHOD STD. No. 141 under referee conditions using a 0.0020-inch (0.0040-inch gap clearance) applicator. Nonconformance to Table VI shall constitute failure of this test.

4.3.8.1 Full hardness. Determine full hardness by drawing down a film of enamel using a 0.0020-inch (0.0040-inch gap clearance) film applicator on an unprimed aluminum panel prepared as specified in 4.3.1.1.

The film shall be considered to have reached full hardness when it is very difficult to remove with a knife blade. Nonconformance to Table VI shall constitute failure of this test.

4.3.9 Condition in container. Determine package conditions for acceptance testing in accordance with Method 3011 of FED. TEST METHOD STD. No. 141 and observe for compliance with 3.6.1. For qualification testing, evaluate pigment settling or caking by proceeding as in Method 3011 but do not stir. Reseal the can and then agitate for 3 minutes on a paint shaker.[1/] On re-examination of the contents, the presence of any gel particles or undispersed pigment indicates unsatisfactory settling properties. Nonconformance to 3.6.1 shall constitute failure of this test.

4.3.10 Storage stability.

4..310.1 Partially full container. Determine skinning after 48 hours in accordance with Method 3021 of FED. TEST METHOD STD. No. 141. Reseal and age for 7 days at 60°C. Nonconformance to 3.6.2.1 shall constitute failure of this test.

4.3.10.2 Full container. In accordance with Method 3022 of FED. TEST METHOD STD. No. 141 allow a full standard quart can of the enamel to stand undisturbed for 1 year and then examine the contents. Evaluate pigment settling or caking as specified in 4.3.9, except agitate the can for 5 minutes on the paint shaker prior to re-examination. Determine viscosity and make other applicable tests. Nonconformance to 3.6.2.2 shall constitute failure of this test.

4.3.11 Dilution stability. Reduce one part by volume of the enamel with one part by volume of thinner conforming to TT-T-291, Type II, Grade A. Test according to Method 4203 of FED. TEST METHOD STD. No. 141. Nonconformance to 3.6.3 shall constitute failure of this test.

1/ An apparatus of this type, powered by a 1/4 hp motor, operates at a rate of 1350 shakes per minute and is manufactured by Red Devil Tools, Irvington, New Jersey.

4.3.12 Brushing properties. Apply the enamel as packaged or reduced not more than five parts by volume of thinner conforming to TT-T-291, Type II, Grade A, to 95 parts by volume of enamel. Use a 2-1/2-inch brush in accordance with Method 4321 of FED. TEST METHOD STD. No. 141. Nonconformance to 3.6.4 shall constitute failure of this test.

4.3.13 Spraying properties. Reduce four parts of enamel with one part by volume with thinner conforming to TT-P-291, Type 2, Grade A. Spray on an aluminum panel to give a dry film thickness between 0.0009 - 0.0011 inch and observe for spraying properties in accordance with Method 4330 of FED. TEST METHOD STD. No. 141. For referee test, use automatic application per Method 2131 of FED. TEST METHOD STD. No. 141. Nonconformance to 3.6.5 shall constitute failure of this test.

4.3.14 Flexibility. Determine flexibility in accordance with Method 6221 of FED. TEST METHOD STD. No. 141. Apply the enamel with a 0.0020-inch (0.0040-inch gap clearance) film applicator on a flat tin plate panel. Air dry 18 hours then bake the panel at 105° ± 2°C (221° ± 4°F) for 96 hours. Condition at 23° ± 1°C for 1/2 hour and bend over a 1/4 inch mandrel. Nonconformance to 3.6.6 shall constitute failure of this test.

4.3.15 Knife test. Perform the knife test in accordance with Method 6304 of FED. TEST METHOD STD. No. 141. Mask one-half of an unprimed aluminum panel and spray the uncovered half to a dry film thickness between 0.0003 and 0.0005 inch with a primer conforming to TT-P-1757. Air dry 18 hours, remove the masking paper, and spray the entire panel with a coat of the enamel to a top coat dry film thickness between 0.0009 and 0.0011 inch. Air dry the enamel 72 hours and then examine for compliance with 3.6.7. Repeat the test as above except bake the primer 45 minutes at 121°C (250°F). Allow 15 minutes to return to room temperature before applying the top coat. Bake 45 minutes at 121°C (250°F) and condition 24 hours at room temperature before testing. Nonconformance to 3.6.7 shall constitute failure of this test.

4.3.16 Recoating. Prepare two unprimed 4 x 12 inch aluminum panels as in 4.3.1.1 and spray with enamel to a dry film thickness of 0.0009 to 0.0011 inch. Apply a second coat of enamel to one panel after 2 hours air drying and a second coat to the other after 24 hours air drying. Air dry both panels 24 hours. Examine for lifting, softening, and evidence of other film irregularity. Nonconformance to 3.6.8 shall constitute failure of this test.

4.3.17 Water resistance. Draw down a film of the enamel with a 0.0020-inch (0.0040-inch gap clearance) film applicator on two unprimed aluminum panels prepared as specified in 4.3.1.1. Air dry the enamel for 72 hours and immerse in distilled water at 23° ± 1°C for 18 hours in accordance with Method 6011 of FED. TEST METHOD STD. No. 141 or ASTM Method D 1308. At the end of the test period, remove and examine the panels. Nonconformance to 3.6.9 shall constitute failure of this test.

4.3.18 Hydrocarbon resistance. Prepare a film of the enamel as in 4.3.17. Air dry the panels for 72 hours and then immerse one of the panels for 4 hours at 23° ± 1°C in a hydrocarbon fluid conforming to TT-S-735, Type III in accordance with Method 6011 of FED. TEST METHOD STD. No. 141 or ASTM Method D 1308. At the end of the test period, remove and examine the panels. Nonconformance to 3.6.10 shall constitute failure of this test.

4.3.19 Acid resistance. Prepare a film of the enamel as in 4.3.17. Air dry the panels for 72 hours and then place a 3 to 5 ml spot of a 10 percent volume acetic acid solution on the surface of the enamel. Cover with an appropriate size watchglass and allow to stand for 1 hour. Rinse with water thoroughly, allow to dry, and examine for blistering and color change. Nonconformance to 3.6.11 shall constitute failure of this test.

4.3.20 Polish resistance.

4.3.20.1 Test apparatus. The apparatus[2/] shall consist of an electrically operated straight line, reciprocating washability and abrasion machine with an abrasion boat attachment. The abrasion boat shall be approximately 3-1/2 by 2-1/8 inches at the base and shall weigh 4-1/2 pounds including added weights. The abrasion boat shall have a spindle located at each end to retain the roll or polishing cloth and a vertical pin by which it is attached to the driving cord. A roll of 5.0 ounce flannel cloth, 1-3/4 inches wide, conforming to CCC-C-458, Type I, shall be attached to the spindles for this test. The length of the stroke shall be approximately 13 inches. The speed shall be approximately 37 cycles (74 strokes) per minute.

2/ An apparatus of this type is powered by a 1/3 hp explosion-proof motor, and is manufactured by the Gardner Laboratory, Inc., Bethesda, MD 20014.

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

50 parts Synthetic yellow iron oxide (ASTM D 768).
100 parts SAE-10 Engine oil conforming to MIL-L-2104.

4.3.20.3 Test procedure.

4.3.20.3.1 Test procedure (a). Draw down a 2-inch-wide film of enamel with a 0.0020-inch (0.0040-inch gap clearance) doctor blade on a 6 by 17 inch glass panel prepared and cleaned in accordance with Method 2021 of FED. TEST METHOD STD. No. 141. Air dry the specimen for 72 hours and then apply a 0.0020-inch film of the polishing medium over the enamel area of the test specimen.

4.3.20.3.2 Test procedure (b). Condition the flannel cloth by drawing down a 2-inch-wide film of the polishing medium with a 0.0020-inch (0.0040-inch gap clearance) doctor blade on a 6 by 17 inch glass panel. Clamp the glass panel on the abrasion apparatus so the film is centered with the polishing stroke, and run the apparatus for 10 cycles (20 strokes. Use a new flannel cloth for each test.

4.3.20.3.3 Test procedure (c). Remove the glass panel used to condition the flannel cloth and replace with the specimen test panel from 4.3.20.3.1. Run the apparatus for 30 cycles (60 strokes). Remove the panel, rinse with enamel thinner conforming to TT-T-291, and wash with a soft sponge or cloth using yellow laundry soap and water. Dry thoroughl and determine the sheen of the area in the center of the panel by Method 6103 of FED. TEST METHOD STD. No. 141.

4.3.21 Accelerated weathering. Prepare a 0.0020-inch dry film of the enamel as specified in 4.3.14 and air-dry for 72 hours. Determine the color and infrared reflectance as in 4.3.2 and measure the 60 and 85 degree gloss. Expose the panel for 300 hours to accelerated weathering in accordance with ASTM Method G 26, Type BH. 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 cheesecloth. Nonconformance to 3.6.13 shall constitute failure of this test.

4.3.22 Weather resistance. Spray two 4 by 12 inch primed aluminum panels with the enamel to be tested to a uniform dry film thickness between 0.0018 and 0.0022 inch. Air dry for 96 hours and place on outdoor exposure for 18 months at an angle of 45 degrees South in the vicinity of Washington, DC. At the end of this exposure period, examine for compliance with 3.6.14. Nonconformance to 3.6.14 shall constitute failure of this test.

4.4 Inspection of packaging. The enamel shall be inspected for compliance with the packaging, packing, and marking requirements of Section 5.

5. PACKAGING

5.1 Packaging, packing, and marking. The enamel shall be packaged, packed, and marked in accordance with PPP-P-1892. Packaging shall be Level A or Commercial and packing shall be Level A, B, or Commercial as specified (see 6.2). The enamel shall be furnished in the size of container specified (see 6.2).

6. NOTES

6.1 Intended use. The enamel is a high grade air drying medium oil alkyd type intended to be used as a camouflage coating for use over new or previously painted surfaces. Unless otherwise specified, the treatment and painting of bare metal shall be in accordance with MIL-T-704. The enamel is a lusterless coating in 11 different camouflage colors which exhibit excellent weather resistance, color retention, flexibility, and resistance to water and hydrocarbons. For adequate camouflage properties, it is necessary to apply the enamel to a dry film thickness of 0.0018 to 0.0022 inch.

6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number, and date of this specification.
(b) Color of enamel required (see 1.2.1).
(c) Level of packaging and level of packing required (see 5.1).
(d) Size of container required (see 5.1).

6.3 Basis of purchase. The enamel covered by this specification should be purchased by volume, the unit being 1 U.S. gallon of 231 cubic inches at 68°F.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for opening of bids, been tested and approved for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the contractors is called to this requirement, and manufacturers are urged to arrange to have the product that they propose to offer to the Federal Government, tested for qualification, in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Organic and Chemical Coatings Research Group, Laboratory 9000, DRXFB-VO, USA Mobility Equipment Research and Development Command, Fort Belvoir, VA 22060. Color chips and information pertaining to qualification of products may be obtained from that activity.

6.5 Sample pigment formulas. The enamel procured under this specification is contemplated to be comparable in performance for the various color and spectral requirements to the following suggested pigment compositions. However, the Government assumes no responsibility for the acceptance of a product to be manufactured under an identical formulation.

TABLE VIII. Percent by Weight.

Ingredient	Light Green	Forest Green	Dark Green	Olive Drab	Field Drab	Earth Yellow	Sand	Earth Brown	Earth Red	Desert Sand	Black
Acid Insoluble Green Pigment	53.95	72.15	64.75	63.45							
Chromium Oxide ASTM D 263					60.20	8.75	26.50				
Chrome Yellow TT-P-346, Type III	42.85	22.10	32.70	25.80							
Light Stable Molybdate Orange	2.50	3.20	0.90	8.30							
Yellow Iron Oxide ASTM D 768					26.00	49.80	16.00	77.40	80.90	12.30	
Red Iron Oxide TT-P-375, Type II					11.50	2.75	2.50	15.60	17.10	3.05	
Carbazole Dioxazine Violet	0.70	2.55	1.65	2.45							
Black Iron Oxide TT-P-390											96.00
Carbon Black					0.30	0.20		7.00	2.00	0.65	4.00
Titanium Dioxide ASTM D 476, Type II					2.00	38.50	55.00			84.00	

Custodian:

Army - ME

Review activities:

Army - EL, GL, MD, MR, MI

User activity:

Army - AT

Preparing activity:

Army - ME

Project 8010-A110

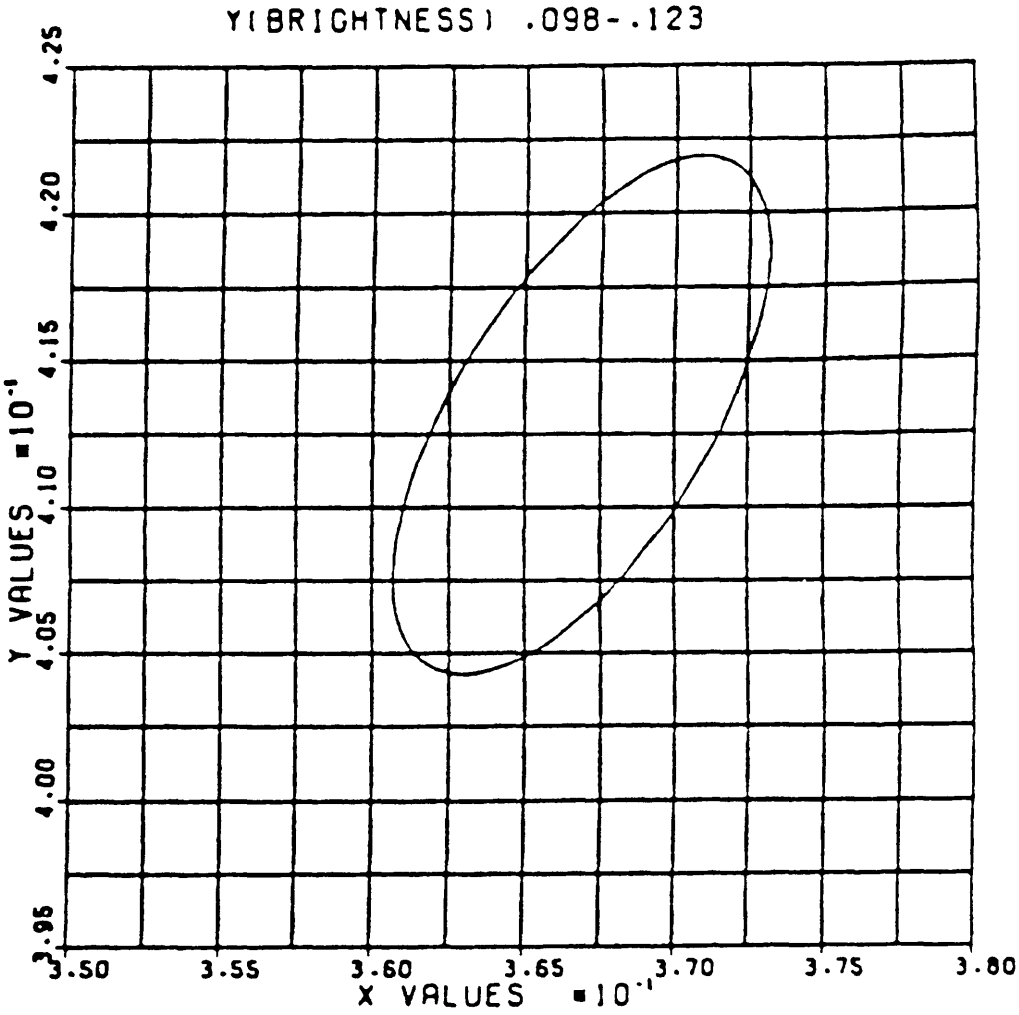

FIGURE 1

CHROMATICITY DIAGRAM FOR CAMOUFLAGE PAINT

COLOR- LIGHT GREEN

NOTE-COLOR ELLIPSE IS 2. NBS UNITS FROM CENTER VALUES.

X-2794

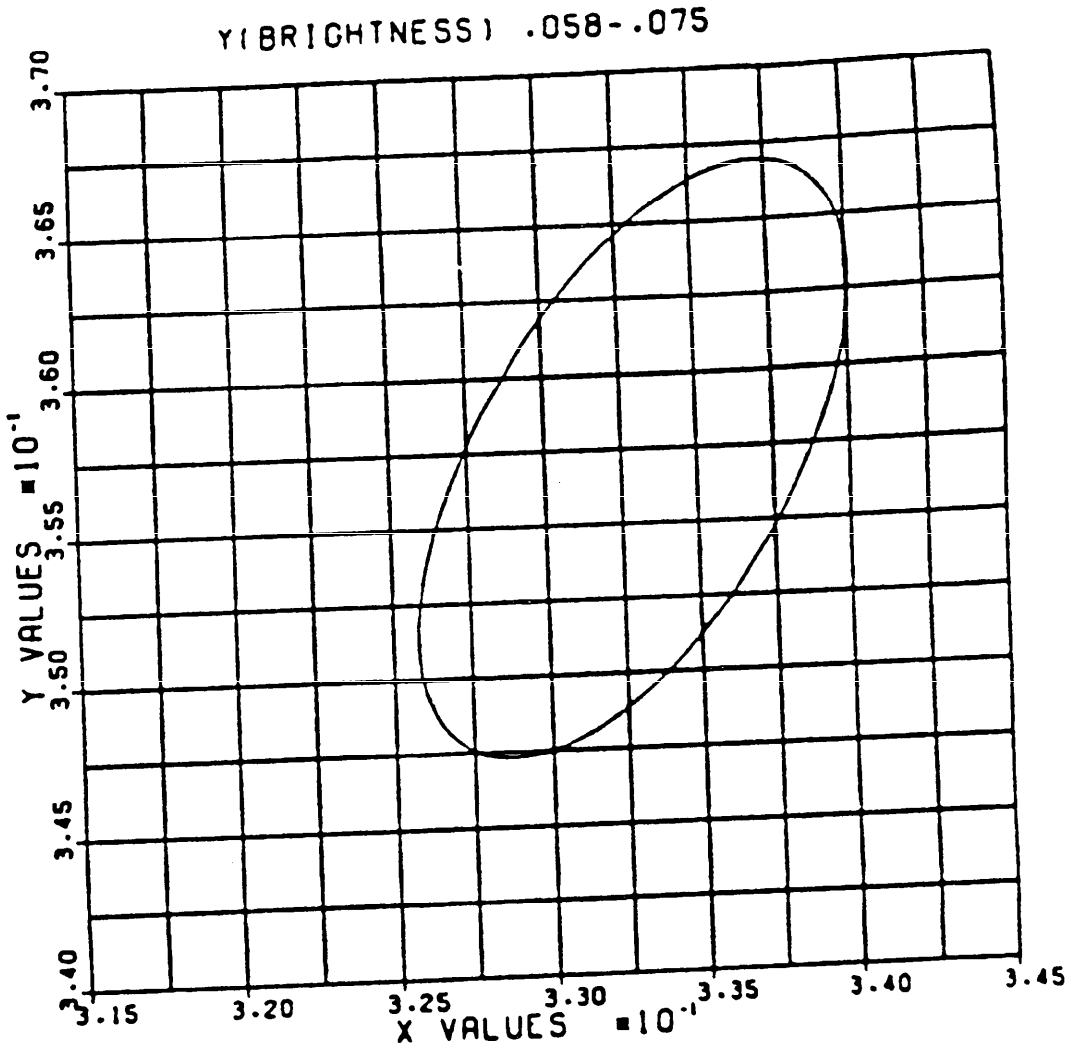

FIGURE 2
CHROMATICITY DIAGRAM FOR CAMOUFLAGE PAINT
COLOR- FOREST GREEN
NOTE-COLOR ELLIPSE IS 2. NBS
UNITS FROM CENTER VALUES.

X-2795

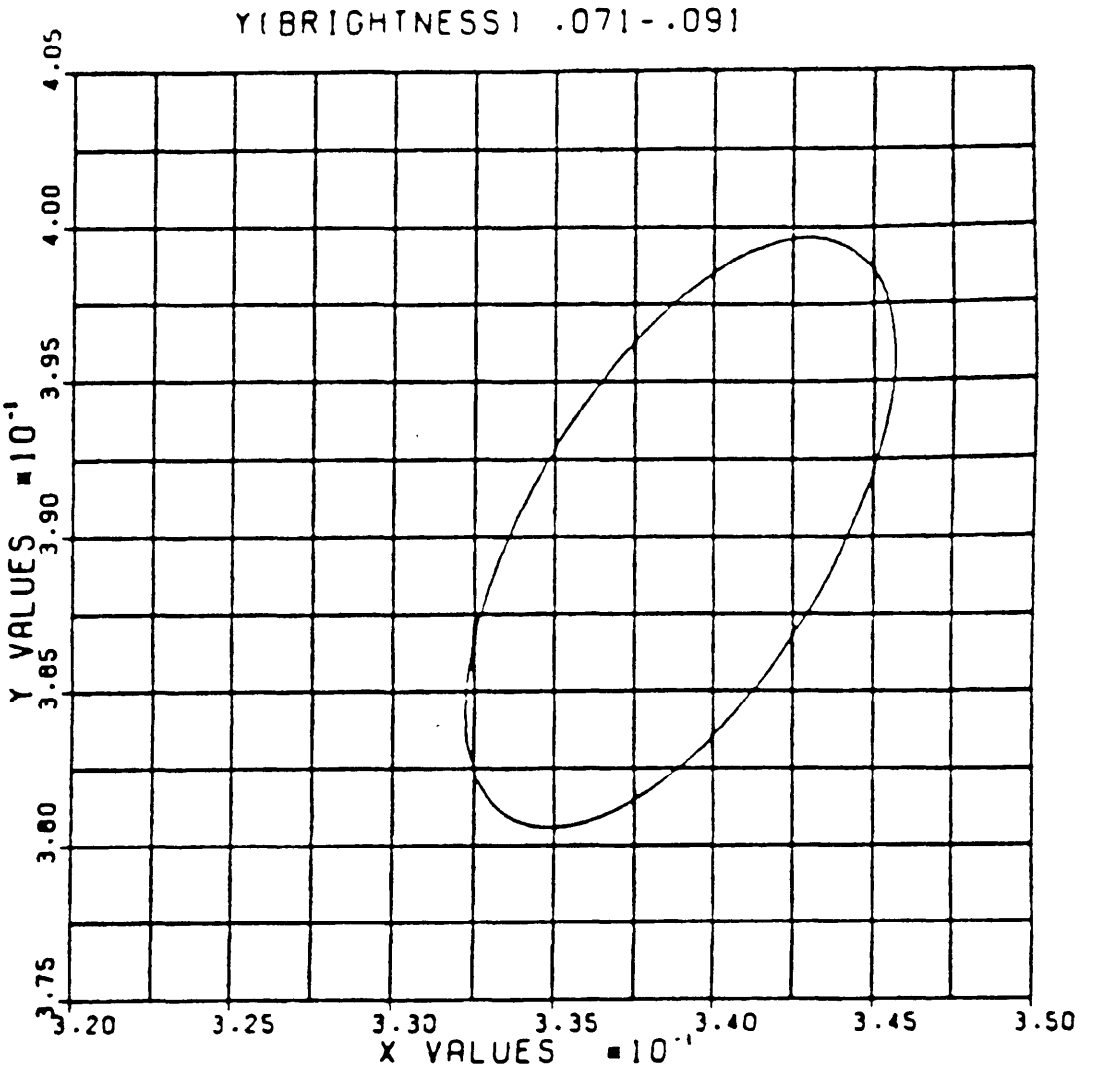

FIGURE 3

CHROMATICITY DIAGRAM FOR CAMOUFLAGE PAINT

COLOR- DARK GREEN

NOTE-COLOR ELLIPSE IS 2. NBS UNITS FROM CENTER VALUES.

X-2796

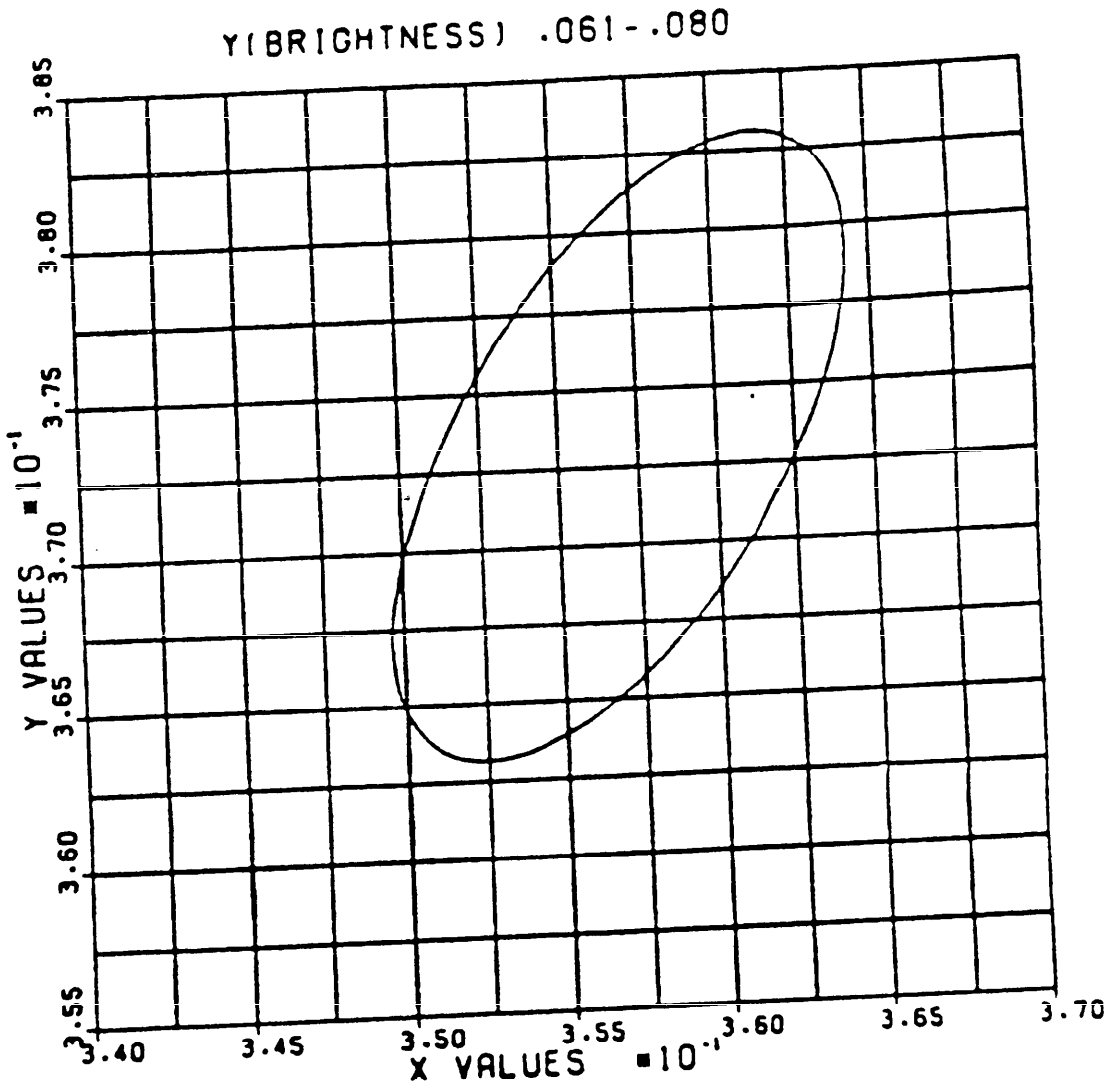

FIGURE 4

CHROMATICITY DIAGRAM FOR CAMOUFLAGE PAINT

COLOR- OLIVE DRAB

NOTE-COLOR ELLIPSE IS 2. NBS UNITS FROM CENTER VALUES.

X-2797

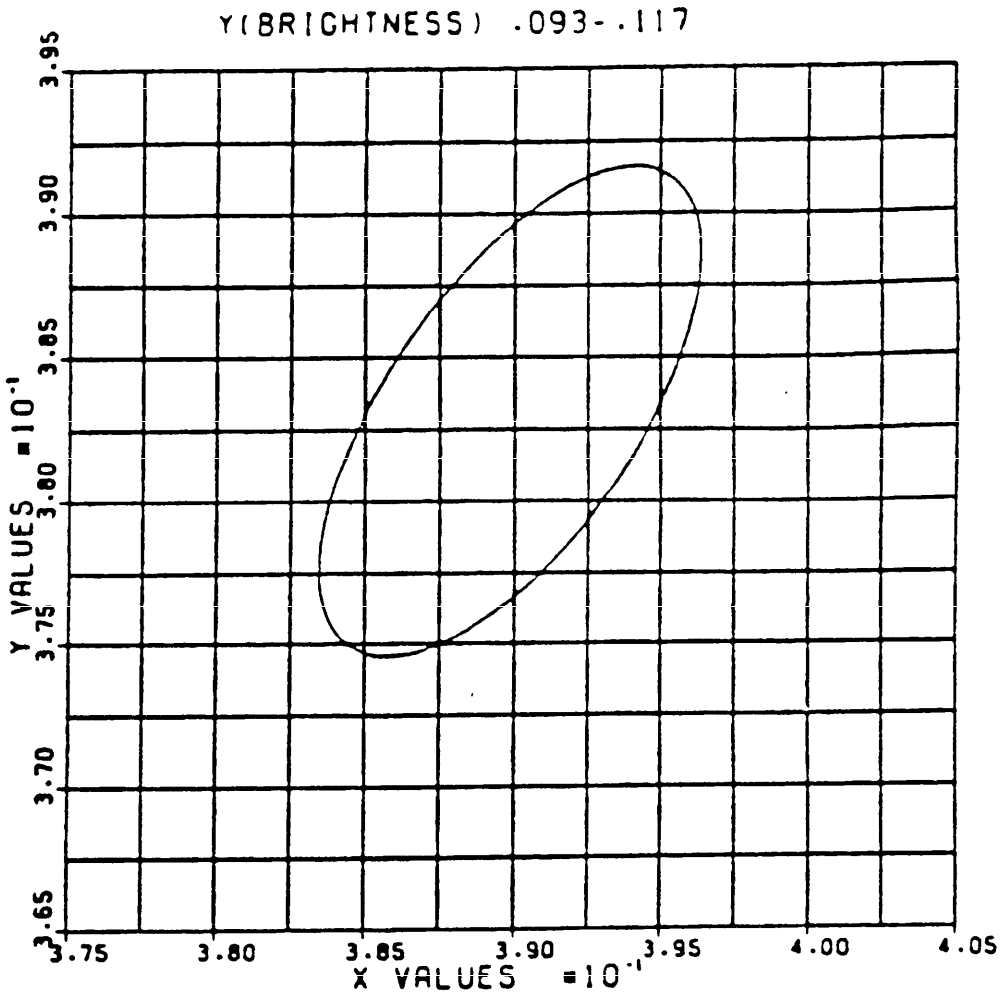

FIGURE 5

CHROMATICITY DIAGRAM FOR CAMOUFLAGE PAINT

COLOR- FIELD DRAB

NOTE-COLOR ELLIPSE IS 2. NBS UNITS FROM CENTER VALUES.

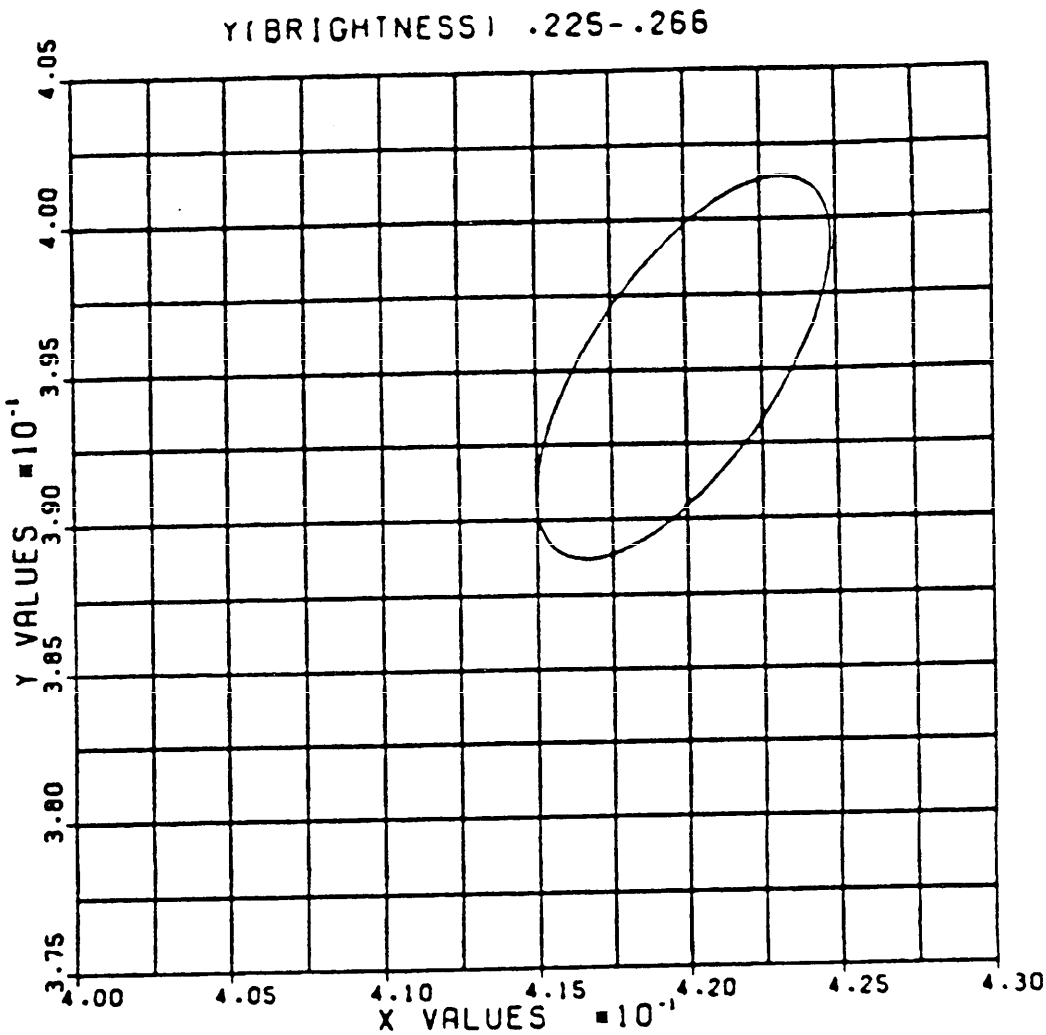

FIGURE 6
CHROMATICITY DIAGRAM FOR CAMOUFLAGE PAINT
COLOR- EARTH YELLOW
NOTE-COLOR ELLIPSE IS 2. NBS
UNITS FROM CENTER VALUES.

X-2799

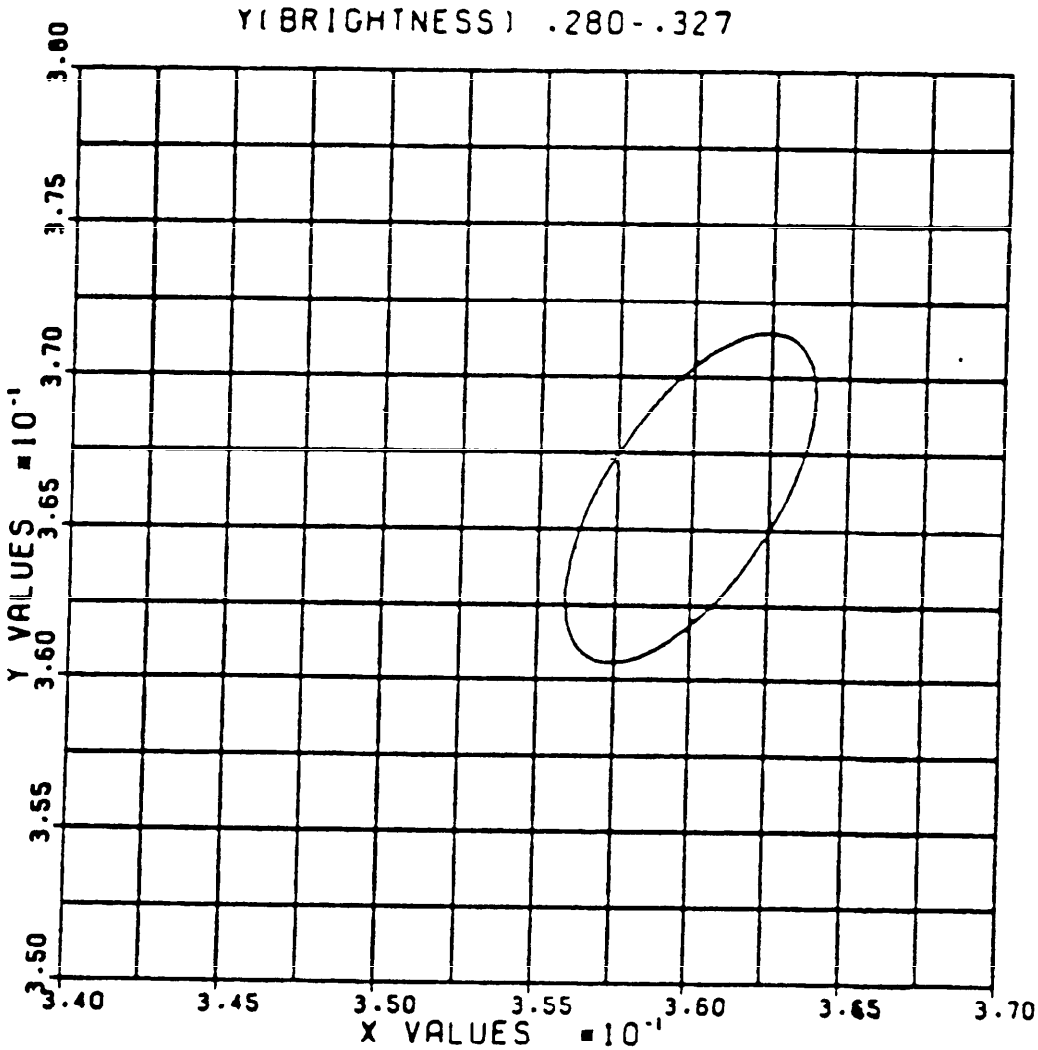

FIGURE 7

CHROMATICITY DIAGRAM FOR CAMOUFLAGE PAINT COLOR- SAND

NOTE-COLOR ELLIPSE IS 2. NBS UNITS FROM CENTER VALUES.

X-2800

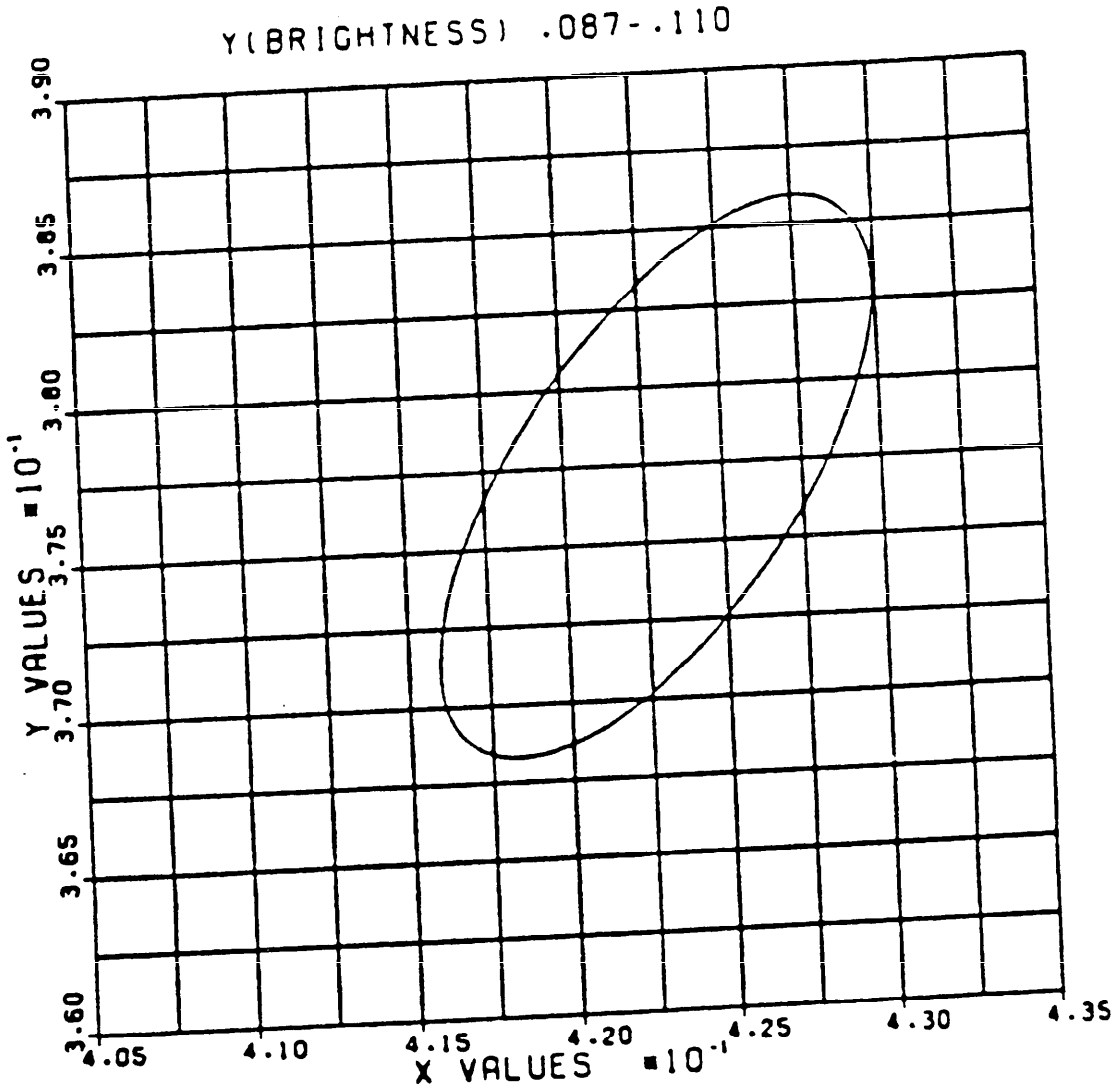

FIGURE 8

CHROMATICITY DIAGRAM FOR CAMOUFLAGE PAINT

COLOR- EARTH RED

NOTE-COLOR ELLIPSE IS 2. NBS UNITS FROM CENTER VALUES.

X-2801

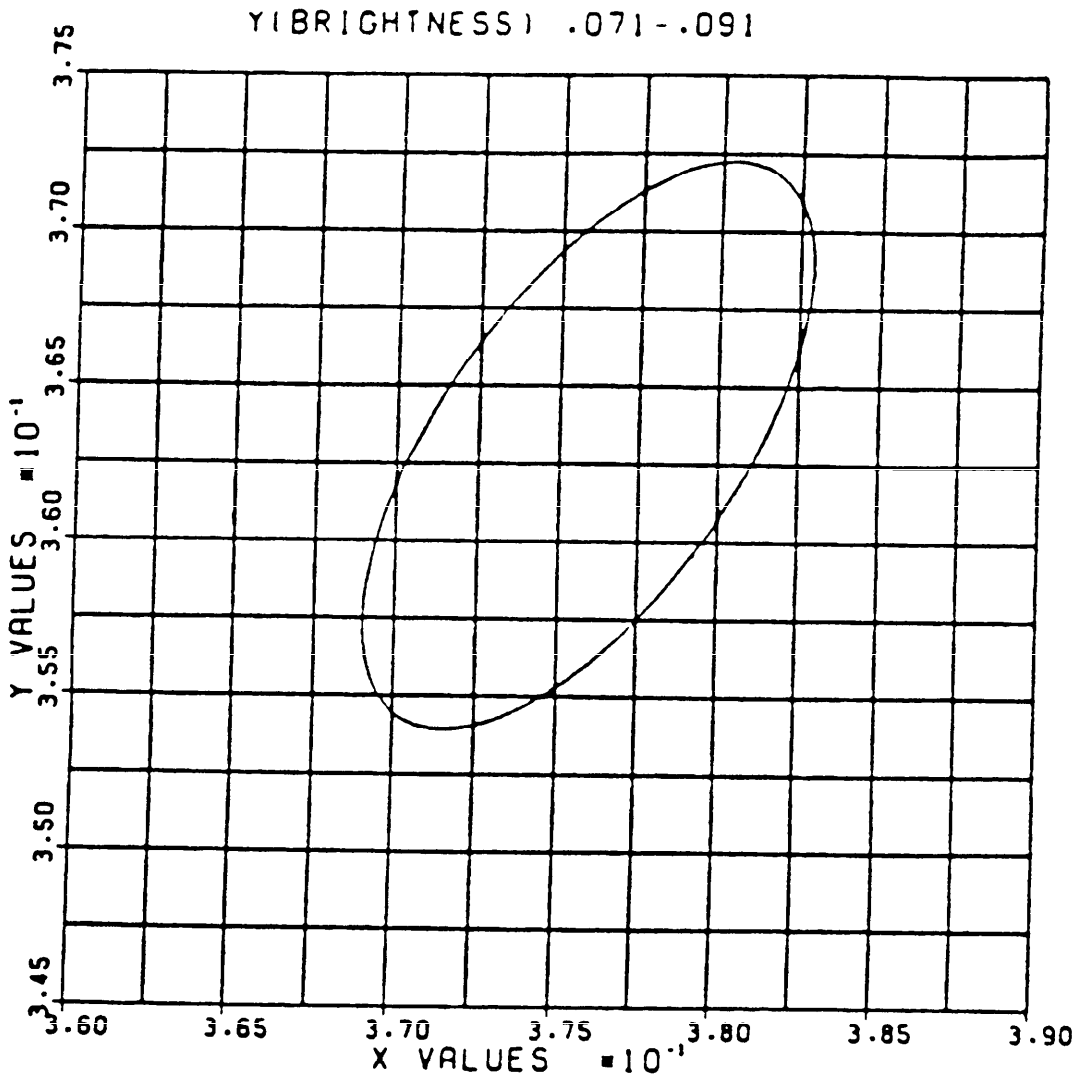

FIGURE 9
CHROMATICITY DIAGRAM FOR CAMOUFLAGE PAINT
COLOR- EARTH BROWN

NOTE-COLOR ELLIPSE IS 2. NBS UNITS FROM CENTER VALUES.

X-2802

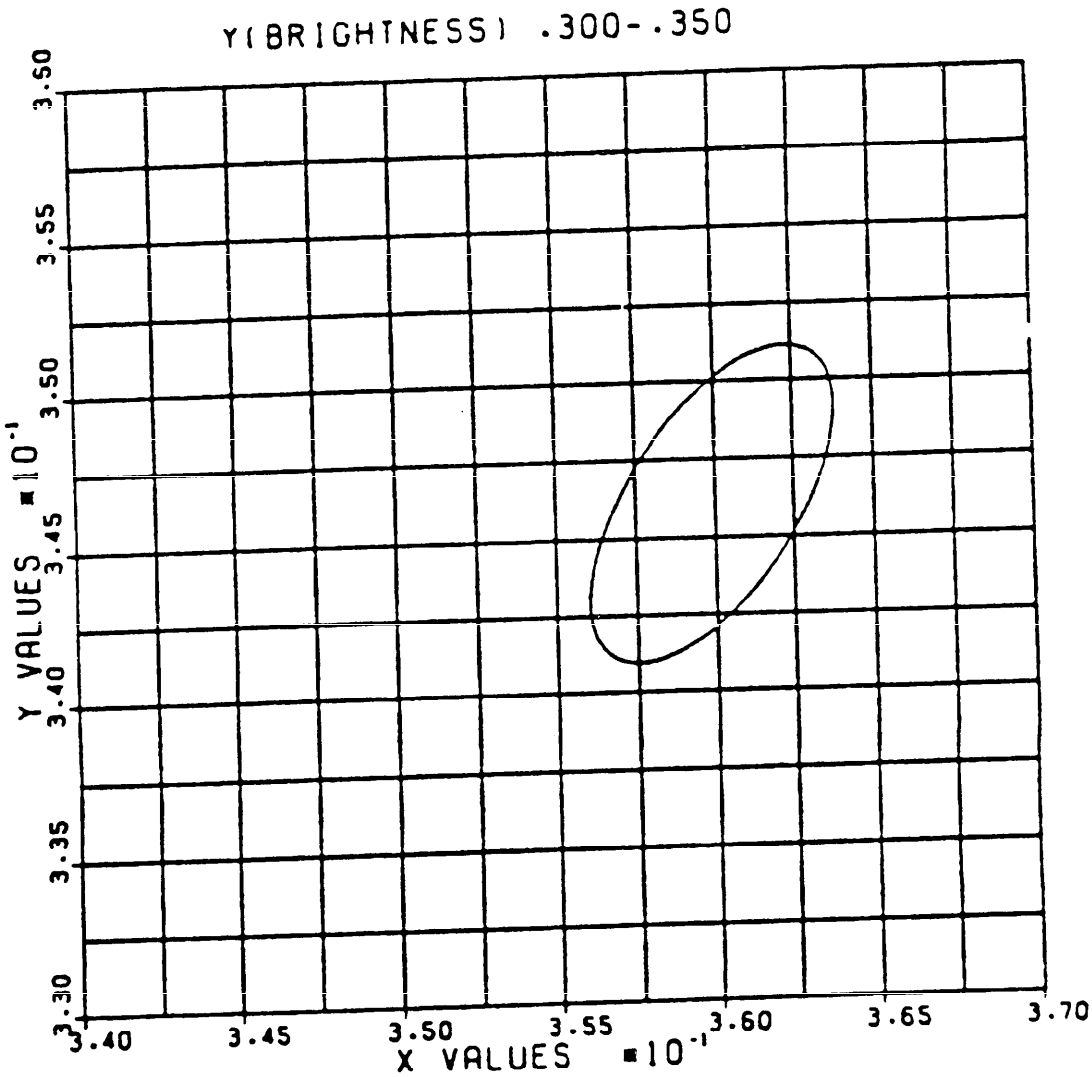

FIGURE 10
CHROMATICITY DIAGRAM FOR CAMOUFLAGE PAINT
COLOR- DESERT SAND
NOTE-COLOR ELLIPSE IS 2. NBS
UNITS FROM CENTER VALUES.

X-2803

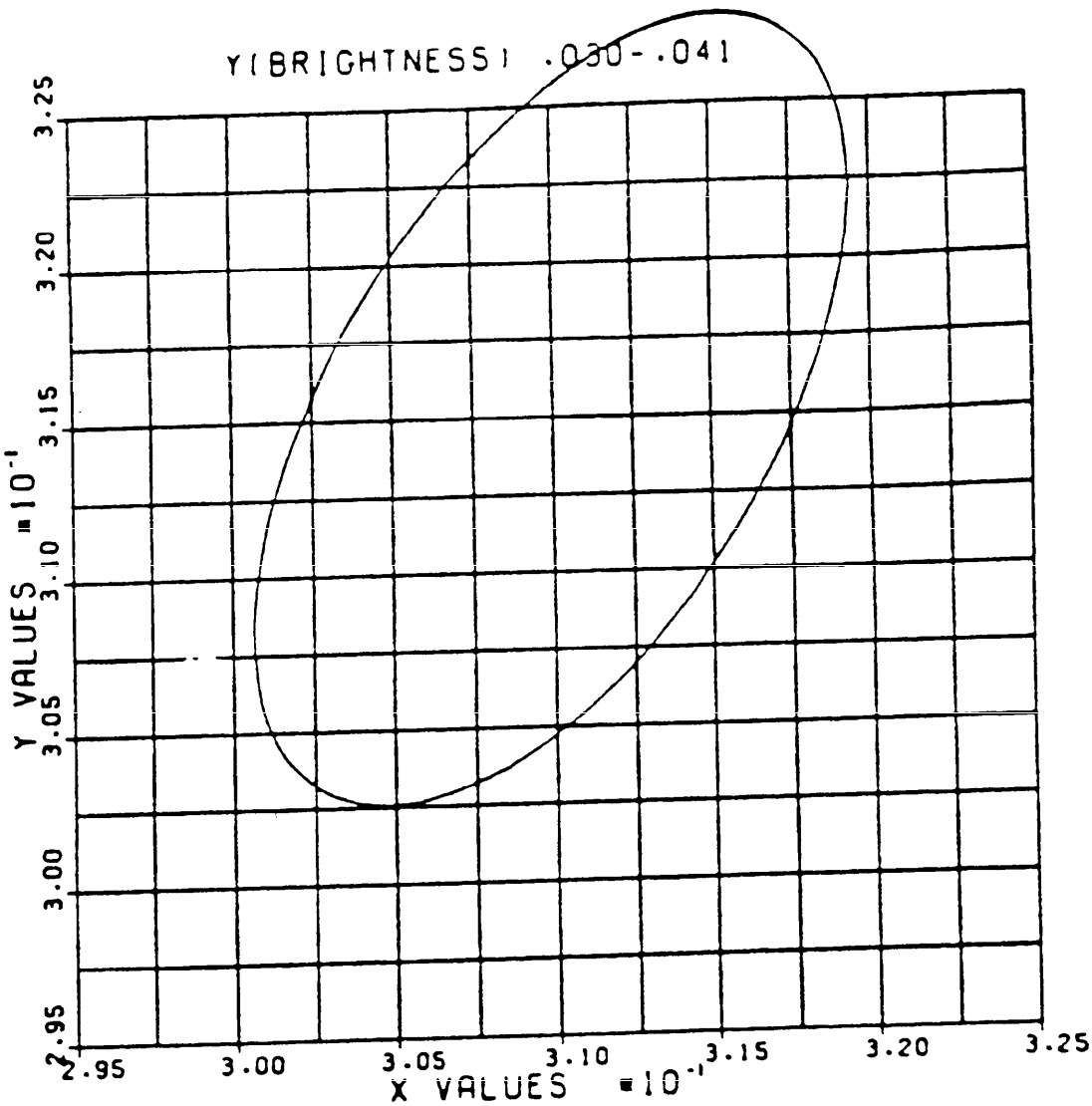

FIGURE 11
CHROMATICITY DIAGRAM FOR CAMOUFLAGE PAINT
COLOR- BLACK
NOTE-COLOR ELLIPSE IS 2. NBS
UNITS FROM CENTER VALUES.

X-2804

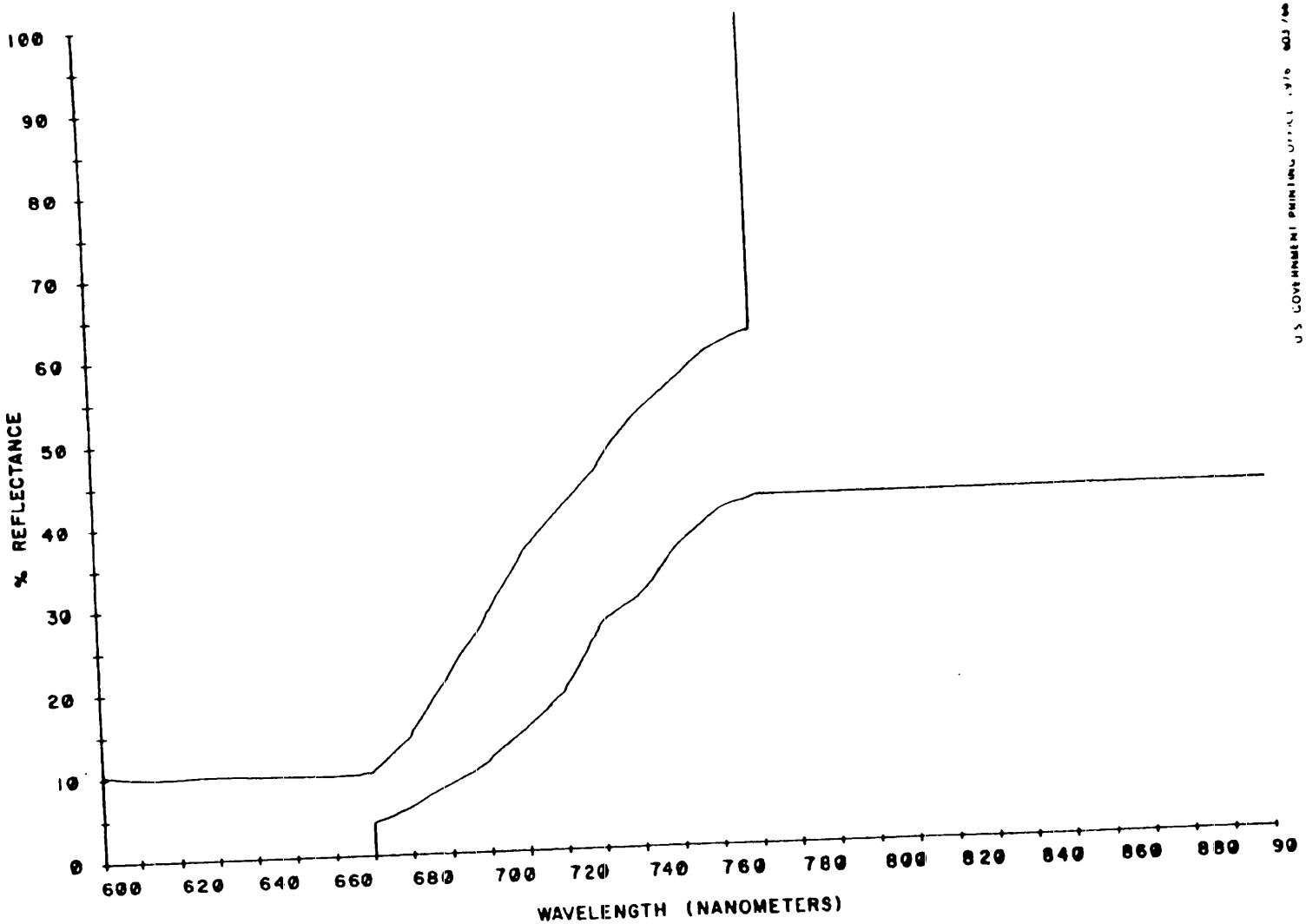

FIGURE 12. SPECTRAL REFLECTANCE LIMITS

X-3013A