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SUPERSEDING
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28 March 1984

MILITARY SPECIFICATION

COATING, ALIPHATIC POLYURETHANE, CHEMICAL AGENT RESISTANT

This specification is approved for use within the USA Belvoir Research, Development, and Engineering Center, 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 both camouflage and noncamouflage, chemical agent resistant, aliphatic polyurethane coating for use as a finish coat on military combat equipment. It can be used in areas covered by air pollution regulations (see 1.2.2).

1.2 Classification.

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

Aircraft Black 37038
Aircraft Gray 36300
Aircraft Green 34031
Aircraft Insignia Blue 35044
Aircraft Red 31136
Aircraft White 37875
Aircraft Yellow 33538
Black 37030
Brown 383, 30051
Dark Green 34082
Dark Sandstone 33510
Earth Yellow 33245
Field Drab 33105
Green 383, 34094
Interior Aircraft Black 37031
Interior Aircraft Gray 36231
Olive Drab 34088
Sand 33303
Tan 686, 33440

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: USA Belvoir Research, Development, and Engineering Center, ATTN: STRBE-TSE, Fort Belvoir, VA 22060-5606 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 8010

1.2.2 Types. The coating shall be furnished in the following types as specified (see 6.2):

Type I - Deleted (see 6.6).
Type II - Lead and chromate (hexavalent) free formulation to meet Rule 102, South Coast Air Quality Management District (see 3.4.3).
Type III - Lead and chromate (hexavalent) free formulations using 1,1,1-trichloroethane[1/] to meet a volatile organic compound content of 420 gm/liter (3.5 lb/gallon) maximum as packaged (see 3.4.4).
Type IV - High solids lead and chromate (hexavalent) free formulation to meet a volatile organic compound content of 420 gm/liter (3.5 lb/gallon) maximum as packaged (see 3.4.4).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

FEDERAL

TT-B-1325	- Beads (Glass Spheres); Retro-Reflective.
TT-C-490	- Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings.
TT-S-735	- Standard Test Fluids, Hydrocarbon.
TT-T-291	- Thinner: Paint, Volatile Mineral Spirits (Petroleum Spirits).
PPP-B-601	- Boxes, Wood, Cleated Plywood.
PPP-B-621	- Box, Wood, Nailed and Lock-Corner.
PPP-B-636	- Box, Shipping, Fiberboard.
PPP-C-96	- Can, Metal, 28 Gage and Lighter.
PPP-D-729	- Drums, Shipping and Storage, Steel, 55 Gallon (208 Liters).
PPP-D-732	Drum, Metal, 55 Gallon Reconditioned (for Shipment of Noncorrosive Material).
PPP-P-704	- Pail, Metal (Shipping, Steel, 1 through 12 Gallons).
PPP-P-1892	- Paint, Varnish, Lacquer and Related Materials: Packaging, Packing & Marking of.

1/ Chlorothene® SM by Dow Chemical Co., 2020 Dow Center, Midland, MI 48640 or equivalent.

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MIL-L-2104	- Lubricating Oil, Internal Combustion Engine, Heavy-Duty.
MIL-P-52192	- Primer Coating, Epoxy.
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-T-81772	- Thinner, Aliphatic Polyurethane Coating.

STANDARDS

FEDERAL

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

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

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

2.1.2 Other Government documents. The following other Government documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

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

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

2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the non-Government documents which is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 476 - Titanium Dioxide Pigments, Specification for.
D 523 - Specular Gloss, Standard Test Method for.
D 562 - Consistency of Paints Using the Stormer Viscosimeter, Method of Test for.
D 659 - Resistance to Chalking of Exterior Paints, Evaluating Degree of.
D 768 - Yellow Iron Oxide, Hydrated, Specification for.
D 1014 - Conducting Exterior Exposure Test of Paints on Steel, Standard Method of.
D 1210 - Fineness of Dispersion of Pigment-Vehicle System.
D 1306 - Phthalic Anhydride Content of Alkyd Resins and Esters Containing Other Dibasic Acids (Gravimetric).
D 1308 - Effect of Household Chemical on Clear and Pigmented Organic Finishes, Standard Method of Test for.
D 1364 - Water in Volatile Solvents (Fischer Reagent Titration Method), Method of Test for.
D 1475 - Density of Paint, Varnish, Lacquer, and Related Products, Test Method for.
D 1545 - Viscosity of Transparent Liquids by Bubble Time Method, Standard Test Method for.
D 1639 - Acid Value of Organic Coating Materials, Standard Test Method for.
D 1849 - Package Stability of Paint, Standard Test Method for.
D 2369 - Volatile Content of Paints, Standard Method of Test for.
D 2455 - Identification of Carboxylic Acids in Alkyd Resins, Method for.
D 2805 - Hiding Power of Paints, Standard Test Method for.
D 2998 - Polyhydric Alcohols in Alkyd Resins, Method of Test for.
D 3272 - Vacuum Distillation of Solvents from Solvent-Base Paints for Analysis.
D 3335 - Test for Low Concentration of Lead, Cadmium and Cobalt in Paint by Atomic Absorption Spectroscopy.
D 3951 - Standard Practices for Commercial Packaging.
E 97 - Directional Reflectance Factor, 45-degree, 0-deg, of Opaque Specimens by Broad-Band Filter Reflectometry.
E 167 - Goniophotometry of Reflecting Objects and Materials.
E 308 - Spectrophotometry and Description of Color in CIE 1931 System, Standard Recommended Practice for.
G 26 - Operating Light- and Water-Exposure Apparatus (Xenon-Arc type) for Exposure of Nonmetallic Materials, Recommended Practice for.

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

NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, INC., AGENT

National Motor Freight Classification (NMFC)

(Application for copies should be addressed to ATA, Tariff Order Section, 1616 P Street, N.W. Washington, D.C. 20036.)

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

Rule 102 - Photochemically Reactive Solvents.
Rule 1107 - Manufactured Metal Parts and Products Coatings.

(Application for copies should be addressed to the South Coast Air Quality Management District, 9150 E. Flair Drive, El Monte, CA 91731.)

UNIFORM CLASSIFICATION COMMITTEE, AGENT

Uniform Freight Classification (UFC)

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

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

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence. Nothing in this specification, however, shall supersede 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 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 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 given 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. Figures 4 through 11 may be used as approximate guidelines for the appropriate color. The colors Dark Green 34082 and Green 383, 34094 shall meet the spectral reflectance limits specified in table II and in figure 12. Aircraft Gray 36300, Aircraft Green 34031, Interior Aircraft Black 37031, and Dark Sandstone 33510 shall match color chips furnished by USA Belvoir Research, Development, and Engineering Center, ATTN: STRBE-VO, Fort Belvoir, VA 22060-5606 and these colors must meet the infrared reflectance requirements of table I when tested as in 4.3.11. Interior Aircraft Black 37031 shall also meet the specular reflectance limits of table III. All other colors shall match the appropriate color chips from FED-STD-595.

TABLE I. Color reflectance and requirements.

Color	Visual (Y)	Chromaticity x	Chromaticity y	Infrared 1/ Min.	Infrared 1/ Max.	Allowable 2/ Ratio Min.
Dark Green 34082	0.071- .091	0.339	0.390	-	60.0	5.2
Green 383, 34094	0.063- .083	0.328	0.365	-	60.0	5.2
Field Drab 33105	0.093- .117	0.390	0.389	25.0	35.0	-
Earth Yellow 33245	0.228- .263	0.420	0.395	30.0	40.0	-
Sand 33303	0.284- .323	0.360	0.366	55.0	65.0	-
Brown 383, 30051	0.060- .080	0.357	0.342	8.0	20.0	-
Tan 686, 33440	0.360- .400	0.368	0.364	40.0	50.0	-
Black 37030	0.030- .041	0.310	0.315	0.0	15.0	-
Aircraft Green 34031	-	-		-	7.0	-
Interior Aircraft black 37031	-	-	-	-	7.0	-
Aircraft gray 36300	-	-	-	-	15.0	-
Dark Sandstone 33510	-	-	-	-	45.0	-

1/ For wavelength definition, see table II or 4.3.11 as applicable.
2/ The ratio is calculated by dividing the value of the infrared by the value of the red spectral range.

TABLE II. Selected ordinates for determining infrared and red reflectance values from spectrophotometric 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 III. Specular reflectance for Interior Aircraft Black 37031.

Incident angle Degrees	Viewing Angle Degrees	Reflectance Maximum
20	45	2.60
10	45	2.70
0	45	2.95
-10	45	3.20
-20	45	3.60
-30	45	4.20
-40	45	5.25
-45	45	5.80
-50	45	6.50
-55	45	7.30
-60	45	8.25
-70	45	10.50

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

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

TABLE IV. Spectral reflectance limits for Dark Green 34082 and Green 383, 34094. (Cont'd)

Wavelength	% Reflectance		Wavelength	% Reflectance	
Nanometers	Max.	Min.	Nanometers	Max.	Min.
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 phthalic-trimethylol propane polyesters combined with prime and extender pigments and volatile solvents; component B shall consist of an aliphatic isocyanate prepolymer combined with volatile solvents. The catalyzed NCO^{-}/OH ratio shall not fall below 1.1/1.0 when mixed 4 parts A to 1 part B by volume and produce a product which will meet the requirements of this specification.

3.4.1 Pigment. The pigments listed in table V, 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 occuring. The titanium dioxide shall be rutile chalk resistant type conforming to ASTM D 476, type III. If other tinting pigments are used to match the spectral characteristics, these additional pigments must have good color stability. No lead or chromate (hexavalent) pigments shall be used and antimony sulfide shall be absent. The extender pigments shall be siliceous matter and shall not exceed the amounts specified in table IX. Glass beads for Interior Aircraft Black 37031 shall conform to TT-B-1325, type I, grade B and shall conform to the amount specified in table IX.

TABLE V. Pigmentation.

Dark Green 34082 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.
Field drab 33105	-	Chromium oxide, titanium dioxide, carbon black, carbazole dioxazine violet, iron oxides, zinc/magnesium ferrite or or other mixed metal oxides.

TABLE V. Pigmentation. (Cont'd)

Earth yellow 33245 Brown 383, 30051 Sand 33303 Tan 686, 33440 Dark Sandstone 33510		
Aircraft green 34031 Olive Drab 34088	-	Carbon black, iron oxides, zinc/magnesium ferrites or other mixed metal oxides
Black 37030 Aircraft Black 37038 Interior Aircraft Black 37031	-	Carbon black, iron oxides
Aircraft White 37875	-	Titanium dioxide
Aircraft Red 31136	-	Titanium dioxide, light stable organic red
Aircraft Gray 36300 Interior Aircraft Gray 36231	-	Titanium dioxide, carbon black
Aircraft Insignia Blue 35044	-	Copper phthalocyanine blue, carbon or lampblack, black iron oxide, titanium dioxide

3.4.1.1 Lead content. The lead content shall not exceed 0.06 percent by weight of total nonvolatile content upon analysis per 4.3.4.1.

3.4.2 Nonvolatile vehicle.

3.4.2.1 Component A.

3.4.2.1.1 Dicarboxylic acids. When tested as specified in 4.3.5.2 the dicarboxylic acids shall be phthalic with only trace amounts of other acids.

3.4.2.1.2 Polyols. When tested as specified in 4.3.5.4 the polyols shall be trimethylol propane with only trace amounts of other polyols.

3.4.2.2 Component B. When tested as specified in 4.3.6.3 the nonvolatile vehicle in component B shall be an aliphatic isocyanate prepolymer. It shall contain no toluene diisocyanate and no aromatic isocyanates.

3.4.3 Volatile content for type II. The volatile content of components A and B admixed shall consist of a nonphotochemically reactive solvent blend and shall conform to the following requirements by volume when tested as specified in 4.3.7 as defined in Rule 102, South Coast Air Quality Management District.

a. Aromatic compounds with eight or more carbon atoms except ethyl benzene: 8 percent maximum.
b. Ethyl benzene, toluene, and ketones having branched hydrocarbon structures: 20 percent maximum.
c. Solvents with olefinic or cycloolefinic type of unsaturation: negative.
d. Total of a + b: 20 percent maximum.

3.4.4 Volatile organic compound content for types III and IV. The volatile organic compound content shall not exceed 420 gm/liter (3.5 lbs/gallon) when tested as specified in 4.3.7.1 as defined in Rule 1107, South Coast Air Quality Management District.

3.5 Quantitative requirements.

3.5.1 Component A (polyester). Component A shall conform to the quantitative requirements of table VI when tested as specified in 4.3.5.

TABLE VI. Component A (polyester) requirements.

Characteristic	Min.	Max.
Phthalic anhydride, percent by weight of nonvolatile vehicle, types II and III	42	-
Phthalic anhydride, percent by weight of nonvolatile vehicle, type IV	28	-
Acid number, based on nonvolatile vehicle	-	6
Water, percent by weight of component A	-	0.5
Coarse particles and skin (retained on No. 325 mesh sieve), percent by weight of pigment		1.0
Viscosity, Types II and IV, Krebs stormer shearing rate-200 rpm grams	150	200
Equivalent K.U.	70	85
Type III, Krebs stormer shearing rate - 200 rpm grams	200	300
Equivalent K.U.	-	95

TABLE VI. Component A (polyester) requirements. (Con't)

Characteristic	Min.	Max.
Fineness of grind (all camouflage colors plus Dark Sandstone 33510)		
Hegman	3	-
ASTM Microns	-	60
Interior Aircraft Black 37031		
Hegman		0
ASTM Microns	100	
Aircraft Green 34031		
Hegman	0	2
ASTM Microns	75	100
Other Aircraft colors, and Olive Drab 34088		
Hegman	5	-
ASTM Microns	-	40

3.5.2 Component B (isocyanate). Component B shall conform to the quantitative requirements of table VII when tested as specified in 4.3.6.

TABLE VII. Component B (isocyante) requirements.

Characteristics	Min.	Max.
Nonvolatile, percent by weight of component B	73	-
Viscosity, Gardner tubes, biuret.	-	N
Viscosity, Gardner tubes, trimer.	-	Z_2
Isocyanate content, percent by weight of component B.	14.5	-

3.5.3 Mixed coating. When mixed 4 parts component A to 1 part component B by volume the coating shall conform to the quantitative requirements of table VIII when tested as specified in 4.3.1.1.

TABLE VIII. Mixed coating requirements.

Characteristics	Min.	Max.
Hiding power (contrast ratio)		
Aircraft Red 31136	.94	-
Aircraft White 37875, Aircraft Yellow 33538	.92	-
Other colors	.98	-
Drying time		
Set to touch, minutes	-	30
Dry hard, hours	-	3
Dry through, hours	-	4

TABLE VIII. Mixed coating requirements. (Cont'd)

Characteristics	Min.	Max.
Specular gloss (for camouflage colors and Dark Sandstone 33510)		
60 degree	-	1.0
85 degree	-	3.5
Aircraft Green 34031 and Interior Aircraft Black 37031		
60 degree	-	0.5
85 degree	-	1.0
Other aircraft colors and Olive Drab 34088		
60 degree	-	3.0
85 degree	-	8.0
Specular reflectance for Interior Aircraft Black 37031	See table III	

3.5.4 Specific quantitative requirements.

3.5.4.1 Specific quantitative requirements. Each color shall conform to its specific requirement in table IX when tested as specified in 4.3.1.1. Total solids, pigment solids, and vehicle solids are percent by weight of component A. Extender pigment is percent by weight of pigment.

TABLE IX. Specific quantitative requirements.

Color	Total Solids Min. Type II, III	Total Solids Min. Type IV	Pigment Solids Min. Type II, III	Pigment Solids Min. Type IV	Vehicle Solids Min. Type II, III	Vehicle Solids Min. Type IV	Extender Pigment Max.
Green 383, 34094	60	65	44	48	14	13	65
Dark Green 34082	60	65	44	48	14	13	65
Field Drab 33105	58	62	44	44	13	13	65
Earth Yellow 33245	58	62	44	44	13	13	65
Sand 33303	58	61	44	44	13	13	65
Tan 686, 33440	58	61	44	44	13	13	65
Brown 383, 30051	56	68	42	50	13	13	65
Black 37030	56	68	42	48	13	15	83
Aircraft green 34031	61	65	42	46	14	13	65

TABLE IX. Specific quantitative requirements. (cont'd)

Color	Total Solids Min. Type II, III	Total Solids Min. Type IV	Pigment Solids Min. Type II, III	Pigment Solids Min. Type IV	Vehicle Solids Min. Type II, III	Vehicle Solids Min. Type IV	Extender Pigment Max.
Interior aircraft black 37031	58	62	41	41	16	16	78 (19-20% glass beads)
Olive Drab 34088	58	62	44	44	13	13	65
Aircraft White 37875	62	68	48	49	13	13	50
Aircraft Red 31136	58	62	43	43	14	15	75
Aircraft Black 37038	58	62	43	43	14	15	85
Aircraft Gray 36300	60	68	46	50	13	13	60
Interior Aircraft Gray 36231	60	68	46	50	13	13	60
Aircraft Insignia Blue 35044	48	52	30	34	15	15	88
Dark Sandstone 33510	58	62	44	44	13	13	60

3.6 Qualitative requirements.

3.6.1 Condition in container.

3.6.1.1 Component A. When tested as specified in 4.3.12.1, component A shall be free from grit, seeds, skins, abnormal thickening or livering in a freshly opened container 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 4.3.12.2, component B shall be clear and free from sediment and suspended matter when examined by transmitted light. It shall show no livering, curdling, gelling or skinning in a freshly opened full container.

3.6.2 Storage stability.

3.6.2.1 Component A. A full quart can of component A shall show no skinning, livering, curdling, hard dry caking nor tough gummy sediment when tested as specified in 4.3.13.1. It shall remix readily to a smooth homogeneous state,

shall have a maximum viscosity of 85 K.U. for type II and IV and a maximum viscosity of 95 K.U. for type III and shall meet all other requirements of this specification.

3.6.2.2 Component B. When tested as specified in 4.3.13.2, a full 8 ounce can of the component B shall be clear and free from sediment and suspended matter when examined by transmitted light. It shall show no livering, curdling, gelling or skinning in a freshly opened container, and shall meet all other requirements of the specification.

3.6.3 Mixing properties. When tested as specified in 4.3.14, a smooth homogeneous mixture shall result. The coating shall be free from grit, seeds, skins, or lumps. After aging as specified in 4.3.14, the coating shall show no signs of gelation.

3.6.4 Spraying properties. When tested as in 4.3.15, 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 and shall present a smooth lustreless finish free from seediness (except Aircraft Green 34031 and Interior Aircraft Black 37031).

3.6.5 Brushing properties. The coating shall brush satisfactorily and shall dry to a smooth, uniform film, free from seeds, runs, sags, or streaks when tested as specified in 4.3.16. The dried film shall show no discernible brush marks.

3.6.6 Flexibility. A film of the coating tested as specified in 4.3.17 shall withstand bending without cracking or flaking.

3.6.7 Recoatability. When tested as specified in 4.3.18 recoating of a dried film shall produce no lifting, softening, or other film irregularity.

3.6.8 Water resistance. A film of the coating tested as specified in 4.3.19 shall show no blistering or wrinkling and no more than a slight whitening or softening immediately upon removal from the water. After 2 hours air drying the portions of the panel that was immersed shall be almost indistinguishable with regard to adhesion, hardness, color and gloss from the portion that was not immersed.

3.6.9 Hydrocarbon resistance. A film of the coating tested as specified in 4.3.20 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.

3.6.10 Acid resistance. For Green 383, 34094, and Dark Green 34082, a film of the coating tested as specified in 4.3.21 shall have no blistering and show no change from the original color.

3.6.11 Polish resistance (except Interior Aircraft Black 37031). A film of the coating tested as in 4.3.22 shall have a maximum 85 degree specular gloss of 12 for all colors except Aircraft Green 34031. Aircraft Green 34031 shall have a maximum 85 degree gloss of 5.

3.6.12 Accelerated weathering. Samples of aircraft colors, Dark Sandstone 33510 and Olive Drab 34088 tested as specified in 4.3.23 for 300 hours shall show no cracking, chalking, loss of adhesion and shall meet the color, infrared reflectance if applicable, 60 degrees and 85 degrees gloss requirements of the specification. Camouflage colors tested as specified in 4.3.23 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 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. The infrared reflectance and allowable ratio shall remain within those limits originally specified.

3.6.13 DS2 resistance. A film of the coating when tested as specified in 4.3.24 shall show no blistering, wrinkling, or film softening when examined immediately after washing with water. After drying, there shall be a maximum color change of 2.5 N.B.S. units when comparing a portion of the untested panel to that of the tested area.

3.6.14 Chemical agent resistance. A film of the coating tested as specified in 4.3.25 shall desorb a maximum of 40 micrograms of agent GD and 180 micrograms of agent HD (see appendix A, 10.1).

3.6.15 Weather resistance. Films of the coating tested as specified in 4.3.26 shall show no checking, cracking or appreciable film deterioration. There shall be no more than light chalking (see ASTM D 659). 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 Exclusion of toxic solvents. The product shall contain no benzol (benzene), chlorinated compounds (except Chlorothene® SM or equivalent in type III), hydrolyzable chlorine derivatives, or ethylene based gylcol ethers and their acetates.

3.7 Material safety data sheet. A material safety data sheet shall be prepared in accordance with FED-STD-313 for the aliphatic polyurethane coating. The contractor will overpack a copy of the Material Safety Data Sheet with each shipment of material (see 6.5).

3.8 User instruction marking. In addition to the markings specified in 5.3.1 and 5.3.2, all containers shall be legibly marked or labeled with the following:

CAUTION:
The Surgeon General requires airline respirators to be used unless air sampling shows exposure to be below standards, then either chemical cartridge respirators or airline respirators are required.
Avoid contact with skin and eyes.
Use with adequate ventilation.
For other safety recommendations refer to the Material Safety Data Sheet.
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 4 parts by volume of component A and mix well.
Material should be used within 8 hours after mixing.

4. QUALITY ASSURANCE PROVISONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for performance of all inspection requirements as specified herein. The contractor shall verify that his test, measurement and diagnostic equipment (TMDE) is calibrated in accordance with MIL-STD-45662. Except as otherwise specified in the contract, the contractor may utilize his own or any other facilities suitable for the performance of 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 the prescribed requirements.

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

4.1.2 Material safety data sheet. Material safety data sheets must address components A and B and be in compliance with the requirements of FED-STD-313 (see 3.7).

4.2 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.
c. Acceptance for use as component on end item (conformance tests).
d. Validation of spectral reflectance characteristics (see 4.2.4).
e. Inspection of packaging (see 4.4).

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

4.2.2 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.

4.2.3 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:

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

4.2.4 Validation except aircraft colors Red 31136, Blue 35044, Gray 36231, Black 37038, White 37875, Yellow 33538, and Olive Drab 34088. The contracting officer shall require that at least a quart sample from each production lot be forwarded to the USA Belvoir Research, Development, and Engineering Center, ATTN: STRBE-VO, Fort Belvoir, VA 22060-5606, for validation of spectral reflectance characteristics.

4.3 Test methods.

4.3.1 Test conditions. The routine testing conditions for qualification testing and the referee testing for validation testing shall be in accordance with section 9 of FED-STD-141 or in accordance with the appropriate ASTM method 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 and 3.6 as applicable, shall constitute failure of the applicable test.

4.3.1.1 Test procedures. The following tests (see table X) shall be conducted in accordance with FED-STD-141 or ASTM as specified herein. 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.

TABLE X. Index.

Item	Application method in FED-STD-141	Applicable ASTM test method	Test paragraph	Requirement paragraph
Color and spectral reflectance	6241	E 308	4.3.2	3.3
Total nonvolatile	-		4.3.3	Tables VII & IX
Pigment analysis	4021	-	4.3.4	Tables V, IX and 3.4.1
Lead content	-	-	4.3.4.1	3.4.1.1
Chromium, hexavalent			4.3.4.2	3.4.1
Antimony sulfide	-	-	4.3.4.3	3.4.1
Nonvolatile vehicle		-	4.3.5.1	Table IX
Dicarboxylic acids	-	D 2455	4.3.5.2	3.4.2.1.1
Phthalic anhydride	-	D 1306	4.3.5.3	Table VI
Polyols	-	D 2998	4.3.5.4	3.4.2.1.2
Acid number		D 1639	-	Table VI
Water content	-	D 1364	-	Table VI
Coarse particles and skins	4092	-	-	Table VI
Isocyanate content	-	-	4.3.6.2	Table VII
Aliphatic isocyanate	-	-	4.3.6.3	3.4.2.2
Solvent analysis	7360	D 3272	4.3.7	3.4.3
Volatile organic compounds	-	-	4.3.7.1	3.4.3, 3.4.4
Viscosity				
Krebs Stormer	-	D 562	-	Table VI
Gardner Tubes	-	D 1545	-	Table VII
Hiding power (contrast ratio)		D 2805	4.3.8	Table VIII
Fineness of grind		D 1210	-	Table VI
Drying time	4061	-	4.3.9	Table VIII
Specular gloss		D 523	4.3.10	Table VIII
Specular reflectance	-	E 167	4.3.10.1	Table III
Infrared reflectance				
Camouflage colors	6241	-	4.3.2	Table I
Noncamouflage colors	6242	-	4.3.11	Table II
Condition in container	-	-		
Component A	3011	-	4.3.12.1	3.6.1.1
Component B	4261	-	4.3.12.2	3.6.1.2
Storage stability				
Component A	-	D 1849	4.3.13.1	3.6.2.1
Component B	4261	-	4.3.13.2	3.6.2.2

TABLE X. Index. (cont'd)

Item	Application method in FED-STD-141	Applicable ASTM test method	Test paragraph	Req pa
Mixing properties	-	-	4.3.14	3.6.
Spraying properties	4331/2131	-	4.3.15	3.6.
Brushing properties	4321	-	4.3.16	3.6.
Flexibility	6221	-	4.3.17	3.6.
Recoatability	-	-	4.3.18	3.6.
Water resistance	-	D 1308, Sec. 6.4	4.3.19	3.6.
Hydrocarbon resistance	-	D 1308, Sec. 6.4	4.3.20	3.6.
Acid resistance	-	-	4.3.21	3.6.
Polish resistance	2021	-	4.3.22	3.6.
Accelerated weathering	-	G 26	4.3.23	3.6.
DS2 resistance	-	-	4.3.24	3.6.
Chemical agent resistance	-	-	4.3.25	3.6.
Weather resistance	-	D 1014	4.3.26	3.6.
Toxic solvents	-	-	-	3.6.

4.3.2 Color and spectral reflectance. Prepare four drawdowns of the e on black and white Morest cards to a dry film thickness of 0.002 ±0.0002 inches. Dry for 48 hours according to the test conditions in 4.3.1. Det the color from the spectral reflectance curves using the recording spectr photometer method in accordance with ASTM E 308. Determine infrared reflectance in accordance with method 6241 of FED-STD-141. Measurements be made over the black portion of the Morest card. For aircraft colors, Drab 34088 and Dark Sandstone 33510 compare color as specified in 3.3. Nonconformance to 3.3 shall constitute failure of this test.

4.3.3 Nonvolatile. Place a portion of the thoroughly mixed sample in dropping bottle and weigh to the nearest one-tenth mg. Weigh a 60 mm alu dish with fourth decimal accuracy. Transfer a small sample that does not 0.3 g to the dish, determine its exact weight by loss of weight of the bo Dissolve the sample in 2 mL of A.C.S. reagent grade acetone and dry in a convection oven at 105 °C for 30 minutes. Upon cooling, re-weigh the dis to the nearest one-tenth mg. From the weight of the residue in the dish weight of the sample taken, calculate the percent nonvolatile or volatile required. Check for compliance with tables VII and IX.

4.3.4 Pigment analysis. Extract the pigment as in method 4021 of FED- using extraction mixture C. Calculate the percent pigment (TP) and using value for total solids (TS) obtained in 4.3.3, calculate the vehicle soli

content of Part A as TS-TP. Check for compliance with table IX. Run the acid insoluble by method 5271 of FED-STD-141. In the case of the camouflage green colors, examination of the pigment by X-ray diffraction shall show the presence of the insoluble green pigment and silica. Check for compliance with table V and IX and 3.4.1.

4.3.4.1 Lead content.

4.3.4.1.1 Determination of lead by atomic absorption spectroscopy. Determine percent of lead in accordance with ASTM D 3335 on the catalyzed paint. Nonconformance to 3.4.1.1 shall constitute failure of this test.

4.3.4.1.2 Determination of lead by X-ray emission spectrometric analysis (alternate method).

4.3.4.1.2.1 Test panel preparation. Using 100 grams of a known lead free type II enamel, prepare standard aliquots containing 0.00, 0.03, 0.06, and 0.09 percent lead metal, based on total nonvolatile paint, by adding calculated amounts of lead napthenate of a known lead content. Thoroughly mix the aliquots to incorporate the lead and draw down the standards and enamel to be tested on duplicate black and white Morest cards using a 0.0020 inch (0.004 inch gap clearance) film applicator. Dry for 48 hours at a temperature of 23 $\pm$1.1 °C (73.4 $\pm$2 °F), a relative humidity of 50 $\pm$4 percent, and under dust free conditions. Cut the drawdowns into a suitable size and shape to fit the sample holder of the X-ray fluorescence spectrometer.

4.3.4.1.2.2 X-ray analytical procedure. Lead content shall be determined using an X-ray fluorescence spectrometer capable of determining lead content at a minimum level of 0.03 percent by weight of the total nonvolatile paint. The parameters of angle, crystal, pulse height selection, counting time, collimator, X-ray tube, voltage and amperage, shall be established for a wave length dispersive fluorescence spectrometer according to conventional X-ray analytical procedures. The analytical line Pb L-Alpha or Pb L-Beta shall be used. To calibrate, place the known standards in the X-ray unit and measure the count rates of lead, lead background and the Compton scattered background from the X-ray tube. The ratio R, of net lead intensity and Compton scattered background is calculated as follows:

$$R = \frac{I_{Pb} - (I_{Pb}\ \text{Background I} + I_{Pb}\ \text{Background II})}{\frac{2}{I_{\text{Compton Line}}}}$$

White I = Gross Intensity
and the background is taken on each side of the Pb line.

Establish a lead calibration curve using these results. Determine the lead content of the test paint using the above procedure and calibration curve. When using an energy dispersive fluorescence spectrometer, it shall be set up in accordance with the manufacturer's manual.

4.3.4.1.2.3 Failure criteria. Nonconformance to 3.4.1.1 shall constitute failure of this test.

4.3.4.2 Hexavalent chromium (Cr^{6+} must be absent).

a. Reagents:
1. 25 percent aqueous KOH

b. Procedure:
1. Add 5 ml of 25 percent aq. KOH to 1/2 g of the extracted pigment contained in a 15 ml centrifuge tube.
2. Agitate by shaking the tube for a few minutes then centrifuge.
3. The supernatant liquid should be colorless. A yellow color indicates presence of chromate. Nonconformance to the requirement in 3.4.1 shall constitute failure of this test.

4.3.4.3 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 coarse 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 3.4.1 shall constitute failure of this test.

4.3.5 Analysis of component A vehicle.

4.3.5.1 Nonvolatile vehicle. The nonvolatile vehicle of component A shall be obtained according to the method in 4.3.3. Check for compliance with table VI.

4.3.5.2 Dicarboxylic acids. Determine the dicarboxylic acids in the vehicle of component A using ASTM D 2455 and check for compliance with 3.4.2.1.1.

4.3.5.3 Phthalic anhydride. Determine phthalic anhydride using ASTM D 1306. Check for compliance with table VI.

4.3.5.4 Polyols. Determine the polyols in the vehicle of component A in accordance with ASTM D 2998, used qualitatively and check for compliance with 3.4.2.1.2.

4.3.6 Analysis of component B.

4.3.6.1 Nonvolatile. Determine nonvolatile content according to ASTM D 2369. Check for compliance with table VII.

4.3.6.2 Isocyanate content.

4.3.6.2.1 Reagent. Dissolve 32 grams of anhydrous dibutylamine in anhydrous chlorobenzene and dilute to 250 mL volume with chlorobenzene. Store in a brown bottle. If high purity reagent materials are not available, the dibutylamine should be freshly distilled and the chlorobenzene dried over calcium chloride and redistilled.

4.3.6.2.2 Procedure. Weigh accurately from a dropping bottle, a sample of component B that does not exceed 2 grams, into a 250 mL Erlenmeyer flask. Add from a pipet 10 mL of the dibutylamine reagent solution and swirl until clear but not less than 2 minutes. Pipet another 10 mL of the dibutylamine reagent into a separate flask to be titrated as a blank. Add 2 to 3 drops of a 1 percent alcoholic solution of bromophenol blue indicator. Add 100 mL of absolute methanol slowly with swirling of the sample. Titrate the excess dibutylamine with aqueous 1 N hydrochloric acid using a 10 mL buret with 0.05 divisions, to a color change from blue to yellow.

4.3.6.2.3 Calculation.

$$\%NCO = \frac{(\text{mL HCl for blank} - \text{mL HCl for sample}) \times \text{normality} \times 4.2}{\text{Weight of sample in grams}}$$

Check for compliance with table VII.

4.3.6.3 Isocyanate type. Vacuum dry a film of the vehicle on a salt plate and scan the infrared spectrum from 2 to 15 um. The scan will closely resembl the spectra shown in figure 1. That is, it will show the presence of an aliphatic isocyanate and the absence of aromatic bands.

4.3.7 Solvent analysis. Vacuum distill the solvents from parts A and B usi ASTM D 3272. Analyze a mixture of 8 mL A and 1 mL B using method 7356 of FED-STD-141. Determine compliance with 3.4.3.

4.3.7.1 Volatile organic compound (VOC) determination. The VOC is calculat using the following equation for part A and part B:

$$VOC = \frac{D_c(100 - X_c - X_e)}{100 - X_e \cdot \frac{D_c}{D_e}}$$

where D_c = density of a coating as determined in accordance with ASTM D 1475.
X_c = weight percent solids as determined in 4.3.3.
X_e = weight percent exempt solvent as determined below (type III).
D_e = density of exempt solvent (type III).

Determine the weight of exempt solvent (type III) by the following gas chromatographic method:

Apparatus

Pre-column - An insert fitting into the gas chromatograph. The pre-colu should be 101.6 mm long by 3.2 mm outside diameter stainless steel, packed wi glass wool. Placed on the entrance end of the column, it will retain any nonvolatile materials and minimize sludge build-up in the column.

Column - The column should be 1.22 m long by 3.2-mm outside diameter stainless steel, packed with 80/100 mesh porapak R®.

Procedure - Into a 25 mL vial, accurately weigh 16.0 g of dimethylformamide, 5.0 g of the paint, and 2 g of 1-propanol (internal standard). Shake the vial and then centrifuge at 1000 rpm for 5 minutes.

Inject 1 microliter of the supernatant onto the chromatographic column and develop the chromatogram under the following conditions:

Sample Inlet	200 °C
Detector, TCD	250 °C
Column	
Initial	100 °C
Final	230 °C (for 8 min)
Program Rate	8 °C/min
Carrier Gas	helium
Flow Rate	30 mL/min

Identify the chlorinated compounds from the approximate retension time of 9.5 minutes for 1,1,1-trichloroethane.

Calculate the exempt solvent, chlorinated hydrocarbon as follows:

$$X_e = \frac{F_{CH} \times A_{CH} \times IS}{F_{IS} \times A_{IS} \times W} \times 100$$

Where:

X_e = Chlorinated hydrocarbon, percent

F_{CH} = Response factor for the chlorinated hydrocarbon

A_{CH} = Area of the chlorinated hydrocarbon peak

IS = Weight of internal standard added to the sample in grams

F_{IS} = Response factor for the internal standard in the standard solution

A_{IS} = Area of the internal standard peak

W_{Sample} = Weight of the sample in grams

Determine the VOC for the coating as mixed with the equation:

$$\frac{4(\text{VOC of part A}) + (\text{VOC of part B})}{5} = \text{VOC per gallon of mixed coating}$$

Determine compliance with 3.4.4.

4.3.8 Hiding power (contrast ratio). Prepare a drawdown as in 4.3.2 except the final dry film thickness should be 0.001 ±0.0001 inch. Verify the dry film thickness in the area in which the reflectance is measured. 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 and R_W respectively. Calculate the hiding power by R_B/R_W and check for compliance with table VIII.

4.3.9 Drying time. Draw down the mixed coating to a dry film thickness of 0.001 ±0.0001 inches and determine the drying under conditions described in 4.3.1 and FED-STD-141, method 4061. Check for compliance with table VIII.

4.3.10 Specular gloss. Draw down the mixed coating to a dry film thickness of 0.001 ±0.0001 inches. Test for 60-degree gloss and 85-degree gloss (sheen) as specified in table X of this specification and check for compliance with table VIII.

4.3.10.1 Specular reflectance for Interior Aircraft Black 37031. Prepare two 4 by 12 inch steel panels as in 4.3.19 except the coating shall be sprayed to a dry film thickness minimum of 0.0018 inch, and allow to air dry 72 hours. Determine the goniophotometric reflectance in accordance with ASTM E 167 except 7.3.1 and 8.1 shall be changed as follows:

"7.3.1 For nonrecording instruments take readings using the green filter at each 10-degree interval from +20 to -70 degrees and also the -45 and -55 degree incident angles."

"8.1 Calculate the average sample reading (Ri) for each specimen at each incident angle. Calculate a factor (Fs) by dividing the 0-45 degree reflectance standard value in percent by the value the goniophotometer was adjusted to read for the reference standard. The goniphotometric data (Gd) for each incident angle is calculated by multiplying the average sample reading (Ri) by the reference standard factor (Fs)."

Check the values for compliance with table III.

4.3.11 Infrared reflectance. (Aircraft Green 34031, Interior Aircraft Black 37031, Dark Sandstone 33510 and Aircraft Gray 36300.) Determine the infrared reflectance on the black portion of the drawdown made in 4.3.2. For Aircraft Green 34031 and Interior Aircraft Black 37031 determine the infrared reflectance using a Wratten 87 filter as described in method 6242 of FED-STD-141. Determine the infrared reflectance for Aircraft Gray 36300 and Dark Sandstone 33510 at 1500 nanometers using a spectrophotometer which is capable of measuring the total diffuse reflectance. Nonconformance with table I shall constitute failure of this test.

4.3.12 Condition in container.

4.3.12.1 Component A. Determine package condition of component A in accordance with method 3011 of FED-STD-141 and observe for compliance with 3.6.1.1. On qualification testing determine pigment settling by proceeding as in method 3011 of FED-STD-141 but do not stir. Reseal and then agitate the can for 3 minutes on a paint shaker[2/]. 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.

4.3.12.2 Component B. Determine package condition of component B in accordance with method 4261 of FED-STD-141 and observe for compliance with 3.6.1.2.

4.3.13 Storage stability.

4.3.13.1 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.

4.3.13.2 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 method 4261 of FED-STD-141 for compliance with 3.6.2.2.

4.3.14 Mixing properties. Thoroughly mix 4 parts by volume of component A with 1 part by volume of component B, reduce as specified in 4.3.15, and examine for compliance with 3.6.3. Place 3 ounces of the material in a 4 ounce glass jar and do not agitate or disturb for 8 hours for type II and III and 4 hours for type IV. At the end of this period examine for compliance with 3.6.3.

4.3.15 Spraying properties. If necessary for application, reduce 4 parts by volume of the mixed coating with 1 part by volume of applicable solvent. The applicable solvent for type II is MIL-T-81772 and the solvent for type III is Chlorothene SM® or equivalent. The solvent for type IV is MIL-T-81772 or follow manufacturer's recommendations not to exceed a 3.5 lb/gallon VOC level. Spray the coating on a solvent cleaned steel panel to a dry film thickness between 0.0009 and 0.0011 inch and observe for spraying properties in accordance with method 4331 of FED-STD-141 for compliance with 3.6.4. For referee test use automatic application per method 2131 of FED-STD-141.

4.3.16 Brushing properties. Apply the coating after mixing 4 parts by volume of component A with 1 part by volume of component B. Thin as in 4.3.15 if necessary. Use a 2-1/2 inch brush in accordance with method 4321 of FED-STD-141. Check for compliance with 3.6.5.

2/ 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, NJ.

4.3.17 Flexibility. Determine flexibility in accordance with method 6221 of FED-STD-141. Spray the coating to a dry film thickness of 0.0009 to 0.0011 inch on a No. 31 gage (0.0107 in.) cold rolled, luster finish steel panel prepared as in procedure B, phosphoric acid etched, method 2011 of FED-STD-141. Age the film in a horizontal position for 72 hours then bake for 96 hours at 105 °C ±4 °C (221 ±4 °F). Condition the panel for 1/2 hour under referee conditions. Bend over a 1/4 inch mandrel. Examine the coating for cracks over the area of the bend for compliance with 3.6.6.

4.3.18 Recoating. Prepare two solvent cleaned 12 inch steel panels and spray with coating to a dry film thickness of 0.0009 to 0.0011 inch. Apply a second coat of paint to one panel after 2 hours air drying and a second coat to the other after 24 hours air drying. Air dry both panels 24 hours. Examine for lifting, softening, and evidence of other film irregularity, for compliance with 3.6.7.

4.3.19 Water resistance. Prepare a steel panel pretreated as specified in 4.3.1.1 and mix the coating as specified in 4.3.15. Spray the coating to a dry film thickness of 0.0009 to 0.0011 inch and air dry for 168 hours. Coat all exposed unpainted metal surfaces with wax or suitable protective coating and immerse in water at 23 C ±1 °C (77 °F ±1 °F) for 168 hours as in ASTM D 1308, section 6.4. At the end of the test period remove and examine for compliance with 3.6.8.

4.3.20 Hydrocarbon resistance. Prepare a film of the coating as in 4.3.19. Air dry the specimen for 168 hours and then immerse for 168 hours (at 23 ±1 °C) in a hydrocarbon fluid conforming to TT-S-735, type III as in ASTM D 1308, section 6.4. At the end of the test period remove and examine for compliance with 3.6.9.

4.3.21 Acid resistance. Using the film prepared in 4.3.10, place a 3 to 5 mL spot of a 10 percent by volume acetic acid solution on the surface of the coating. Cover with an appropriate size watch glass and allow to stand for 1 hour. Rinse with water thoroughly, allow to dry, and examine for blistering and color change for compliance with 3.6.10.

4.3.22 Polish resistance (except Interior Aircraft Black 37031).

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

3/ An apparatus of this type powered by a 1/3 hp explosion-proof motor, is manufactured by the Gardner Laboratores, Inc., Bethesda, Maryland.

4.3.22.2 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.

4.3.22.3 Test procedure.

4.3.22.3.1 Test procedure (a). Draw down a 2-inch-wide film of the coating with a 0.002 inch (0.004 inch gap clearance) doctor blade on a 6 by 17 inch glass panel prepared and cleaned as in method 2021 of FED-STD-141. Air dry the specimen for 168 hours and then apply a 0.002 inch film of the polishing medium over the coating areas of the test specimen.

4.3.22.3.2 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.

4.3.22.3.3 Test procedure (c). Remove the glass panel used to condition the flannel cloth and replace with the specimen test panel from 4.3.22.3.1. Run the apparatus for 100 cycles (200 strokes). Remove the panel, rinse with thinner conforming to TT-T-291, grade 1 and wash with a soft sponge or cloth using yellow laundry soap and water. Dry thoroughly, determine gloss and sheen of the area in the center of the panel as in 4.3.10, and check for compliance with 3.6.11.

4.3.23 Accelerated weathering. Prepare four panels to 0.0020 ±0.0002 inch dry film thickness of the coating on a flat tin panel and air-dry for 72 hours. Three panels are to be tested and one retained as control. Determine the color and infrared reflectance as in 4.3.2 and measure the 60 and 85 degree gloss. Expose three panels for 300 hours to accelerated weathering in accordance with ASTM G 26, method A, apparatus 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 cheese cloth. Check for compliance with 3.6.12.

4.3.24 DS2 resistance. Prepare one 4 by 12 inch steel panel as in 4.3.19, except spray the coating to a dry film thickness of 0.0018 inch minimum. Air dry the panel 1 day, then bake for 1 day at 105 °C ±2 °C (221 °F ±2 °F). Allow the panel to return to room temperature and place 2 spots approximately 1/2 mL each of DS2 agent on the panel surface. Do not cover, allow to stand 30 minutes then thoroughly wash with water. Examine for compliance with 3.6.13.

4.3.25 Chemical agent resistance.

4.3.25.1 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-52192, 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 four days, then bake for three days at 105 °C ±2 °C (221 °F ±2 °F).

4.3.25.2 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 is a known carcinogen. All work will be performed in an approved fume hood and appropriate measures to protect individuals at risk of exposure must be taken.

4.3.25.3 Test apparatus. In the fume hood, use a short length of tubing to attach an apparatus similar to that shown in figure 2 to a sampling bubbler, (figure 3) filled with 5 milliliters of diethyl phthalate. Connect the outlet of the bubbler to the vacuum line in the hood with a 1 liter per minute critical orifice inserted between the bubbler and the vacuum line. A charcoal trap or canister will be inserted directly before the vacuum line.

4.3.25.4 Test procedure. Mark a circular 5 square centimeter area in the center of the test panel and place the panel in the fume hood. Completely contaminate the area drop-wise from a microsyringe, spreading the agent with the flat portion of the needle and being careful not to damage the paint. Keep the area wet for 30 minutes by adding more agent as required. After 30 minutes, pick up the panel with tongs, hold it over a toxic waste container, and direct a stream of isopropyl alcohol (reagent grade) onto the surface of the panel to remove any liquid agent remaining. Use about five such rinses from a wash bottle and after the final rinse, continuously monitor the panel until the alcohol has evaporated. Place the stainless steel permeation cell over the contaminated area, seal with duct seal and start sampling. Draw air into the inlet of the test apparatus, over the contaminated film and through the bubbler and critical orifice. Any agent vapors emitted are picked up by the air stream and absorbed in the diethyl phthalate in the bubbler. After sampling continuously for 24 hours, analyze the diethyl phthalate for the presence of agent using the methods in the Appendix A, or by an appropriate gas chromatographic method. Determine the agent recovered in micrograms for compliance with 3.6.14.

4.3.26 Weather resistance. Spray two 4 by 12 inch steel panels as in 4.3.25.1. Air dry for seven days. Place on outdoor exposure for 2 years at an angle of 45 degrees south in the vicinity of Washington, D.C. At the end of this exposure period examine the panels for compliance with 3.6.15. Determine chalking according to ASTM D 659. Wash the panels with a warm soap solution using a soft sponge or cloth, rinse, dry and examine for color change.

4.4 Inspection of packaging.

4.4.1 Quality conformance inspection of pack.

4.4.1.1 Unit of product. For the purpose of inspection, a completed pack prepared for shipment shall be considered a unit of product.

4.4.1.2 Sampling. Sampling for examination shall be in accordance with MIL-STD-105.

4.4.1.3 Examination. Samples selected in accordance with 4.4.1.2 shall be examined for the following defects. The acceptable quality level (AQL) shall be 1.0 percent defective.

No.	Defect	A	B	Comm.
101.	Primary containers not of the types specified.	5.1.1.3		5.1.1.4
102.	Primary containers not coated as specified.	5.1.1.3		
103.	Closure of primary containers not as specified.	5.1.1.3		5.1.1.4
104.	Primary containers not placed in unit containers as specified.	5.1.2		5.1.2.2
105.	Unit containers not as specified.	5.1.2.1		5.1.2.2
106.	Unit containers not placed in intermediate containers as specified.	5.1.3		5.1.3.2
107.	Intermediate containers not as specified.	5.1.3.1		5.1.3.2
108.	Unlike kits packed in same shipping container.	5.2.1	5.2.2	5.2.3
109.	Shipping containers not as specified.	5.2.1	5.2.2	5.2.3
110.	Palletization not as specified when required.	5.2.4	5.2.4	5.2.4
111.	Standard marking not as specified.	5.3.1	5.3.1	5.3.2
112.	Additional marking not as specified.	5.3.3	5.3.3	5.3.3

5. PACKAGING.

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

5.1.1 Primary containers.

5.1.1.1 Component A (polyester). The primary containers for component A shall, as specified (see 6.2), be 1 quart or 1 gallon multiple friction plug containers, each filled to its rated capacity with component A, 5 gallon lug cover steel pails filled with but 4 gallons of component A, 55 gallon steel drums filled with but 40 gallons of component A, or 55 gallon steel drums filled to their rated capacity with component A.

5.1.1.2 Component B (catalyst). The primary containers for component B shall, as specified (see 6.2), be 1/2 pint, 1 quart or 1 gallon multiple friction plug containers, 10-gallon lug cover steel pails or 55 gallon steel drums. All primary containers for component B shall be filled to their rated capacities.

5.1.1.3 Level A. Primary containers, of the types and sizes specified in 5.1.1 (see 6.2), shall comply with the following requirements:

a. Multiple friction plug containers shall be in accordance with PPP-C-96, type V, class 2. Interior coatings, as applicable, shall be as specified therein. Exterior coatings, including side seam stripping, shall be as specified therein for plan B. Wire handles as specified therein shall be provided for the 1 gallon container. Closure of the filled and properly sealed cans shall be as specified in appendix thereto.
b. Lug cover steel pails shall be in accordance with PPP-P-704, type II or III, class as applicable. Interior coatings and exterior coatings shall be as specified therein. Closure of filled and properly sealed pails shall be as specified in appendix thereto.
c. Steel drums shall conform to PPP-D-729. Alternatively, when specified (see 6.2), the 55 gallon drums shall conform to PPP-D-732. Drum types shall be as applicable and classes shall be optional.
d. The containers shall comply with the requirements of the Uniform Freight Classification (UFC) or the National Motor Freight Classification (NMFC) and the applicable requirements of the Code of Federal Regulations 49 CFR, Department of Transportation (DOT).

5.1.1.4 Commercial. Primary containers of the types and sizes specified in 5.1.1 (see 6.2), shall be those containers normally used for products of this nature providing there will be no interaction chemically or physically with the contents so as to damage the container or alter the strength, quality or purity of the contents. The containers shall comply with the requirements of the UFC or the NMFC and the requirements of 49 CFR.

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

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

5.1.2.1 Level A. Unit containers, required of the component combinations in 5.1.2, shall be in accordance with PPP-B-636, type CF, grade V3c, W5c or W6c, as applicable, style optional. The primary containers shall be arranged within the unit container to provide the smallest practical cubage yet permit the applica-

tion of cushioning and functional filler devices. Such cushioning and fillers shall completely fill the container. Container closure shall be in accordance with method IV of the appendix to PPP-B-636. Container shall comply to UFC or NMFC, and 49 CFR requirements.

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

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

a. Eight unit containers, each with one, 1 quart primary container of component A and one, 1/2 pint primary container of component B shall be placed in an intermediate container.
b. Four unit containers, each with one, 1 gallon primary container of component A and one 1 quart primary container of component B shall be placed in an intermediate container.
c. Intermediate containers shall not be required for the 4 gallon to 1 gallon combination, the 40 gallon to 10 gallon combination or the completely filled 55 gallon drums.

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

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

5.2 Packing. Packing shall be level A, level B or commercial as specified (see 6.2).

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

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

5.2.3 Commercial. The coating, in intermediate containers and unit containers as specified in 5.1.3, shall be packed in multiples of like kits in accordance with UFC or NMFC, and 49 CFR requirements.

5.2.4 Palletization. When specified (see 6.2), the primary containers for the 40 gallon/10 gallon combination and the completely filled 55 gallon drums shall be palletized in accordance with the requirements of MIL-STD-147. Only one size primary container for a single component shall be placed on a pallet.

5.3 Marking.

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

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

5.3.3 Additional marking. In addition to any special or identification marking which may be required by the contract or purchase order (see 6.2), and by 3.8, 5.3.1, and 5.3.2, each primary container shall be marked "Component A (polyester)", or "Component B (catalyst)" as applicable.

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

6. NOTES

6.1 Intended use. This coating is intended for use to provide surfaces easily and effectively decontaminated after exposure to liquid chemical agents. It may be used in areas where Air Pollution Regulations are in force. It is applied over epoxy primers MIL-P-52192, MIL-P-23377, MIL-P-53022 or MIL-P-53030 depending on the substrate or regulatory requirements. For adequate camouflage properties, it is necessary to apply the coatings to a minimum dry film thickness of 0.0018 inches.

6.2 Ordering data. Procurement documents should specify the following:

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

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

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable qualified products list whether or not such products have actually been so listed by that date. The attention of contractors is called to this requirement and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the USA Belvoir Research, Development, and Engineering Center, ATTN: STRBE-VO, Fort Belvoir, VA 22060-5606, and information pertaining to qualification of products may be obtained from the activity (see section 4).

6.4.1 Qualification extension. Qualification testing shall be performed on the colors listed in the left column of table XI. Colors approved for qualification will extend to their respective colors listed in the right column after a satisfactory extension test program. The extension test program will test for color, infrared reflectance, accelerated weathering (Aircraft Yellow 33538 and Red 31136 only) 60 and 85 degree gloss, DS2 resistance, chemical agent resistance and acid resistance. Colors in the right column will be listed on the qualified products list if they satisfy the requirements of the extension test program. A quart sample and necessary paperwork is required for this testing.

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

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

6.6 Classification change. Type I formulation has been discontinued.

6.7 Subject term (key word) listing.

Agent resistant
Coating
Camouflage
CARC
Chemical Agent Resistant Coating
Top coat

6.8 Changes from previous issue. Asterisks (or vertical lines) are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

TABLE XI. Qualification and Extension Colors.

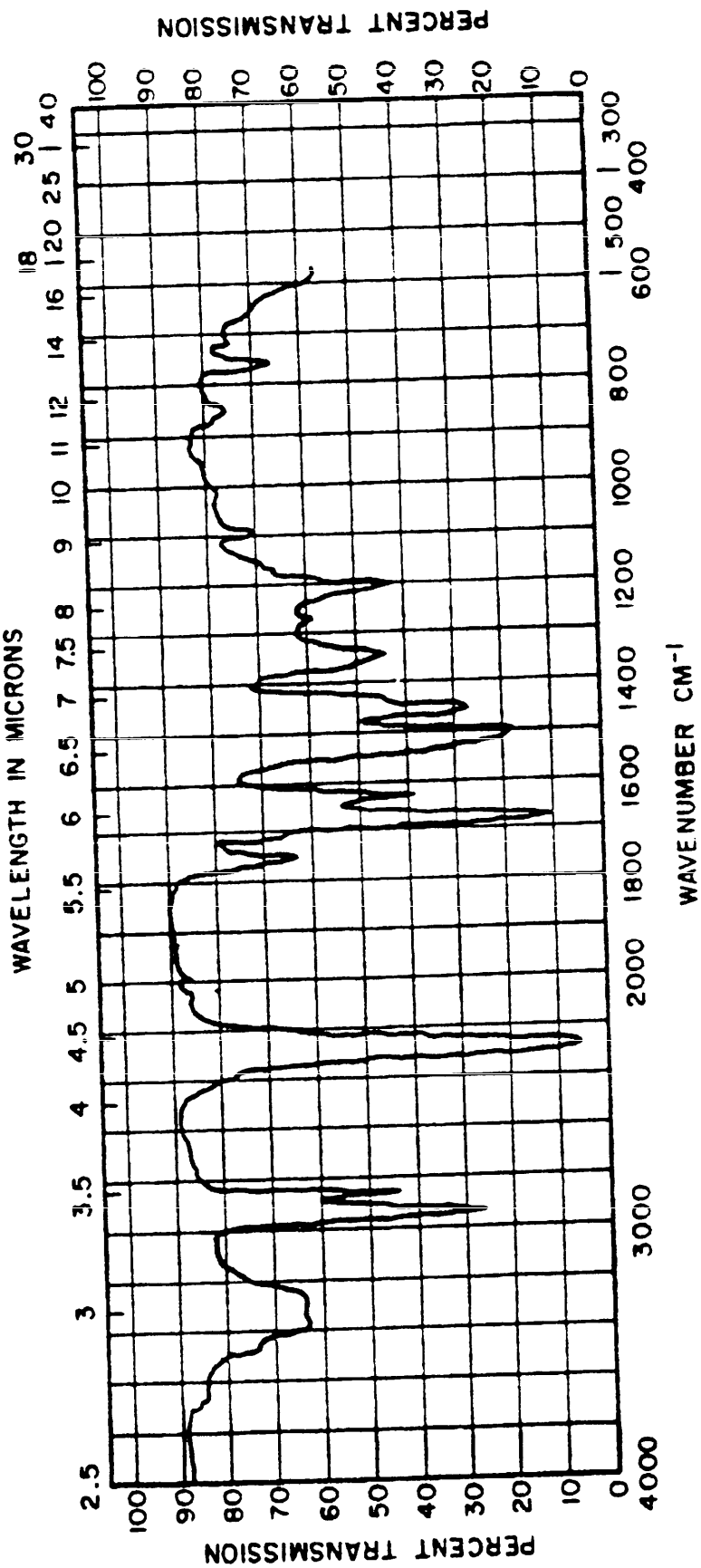
Color qualified	Additional colors to which approval is extended
Green 383, 34094	Dark Green 34082
Field Drab 33105	Earth Yellow 33245, Dark Sandstone 33510
Sand 33303	Tan 686, 33440
Brown 383, 30051	- - -
Black 37030	- - -
Olive Drab 34088	Aircraft Green 34031
Aircraft Gray 36300	Interior Aircraft Gray 36231
Interior Aircraft Black 37031	- - -
Aircraft White 37875	Aircraft Red 31136, Aircraft Insignia Blue 35044 Aircraft Yellow 33538
Aircraft Black 37038	- - -

Custodian:
Army - ME

Review activities:
Army - AR, AT, AV, EA, ER, MD, MI

Preparing activity:
Army - ME

Project 8010-A303



X-4698

FIGURE 1. Nonvolatile from component B. Spectrum should show the presence of an aliphatic isocyanate and the absence of aromatics (Biuret form).

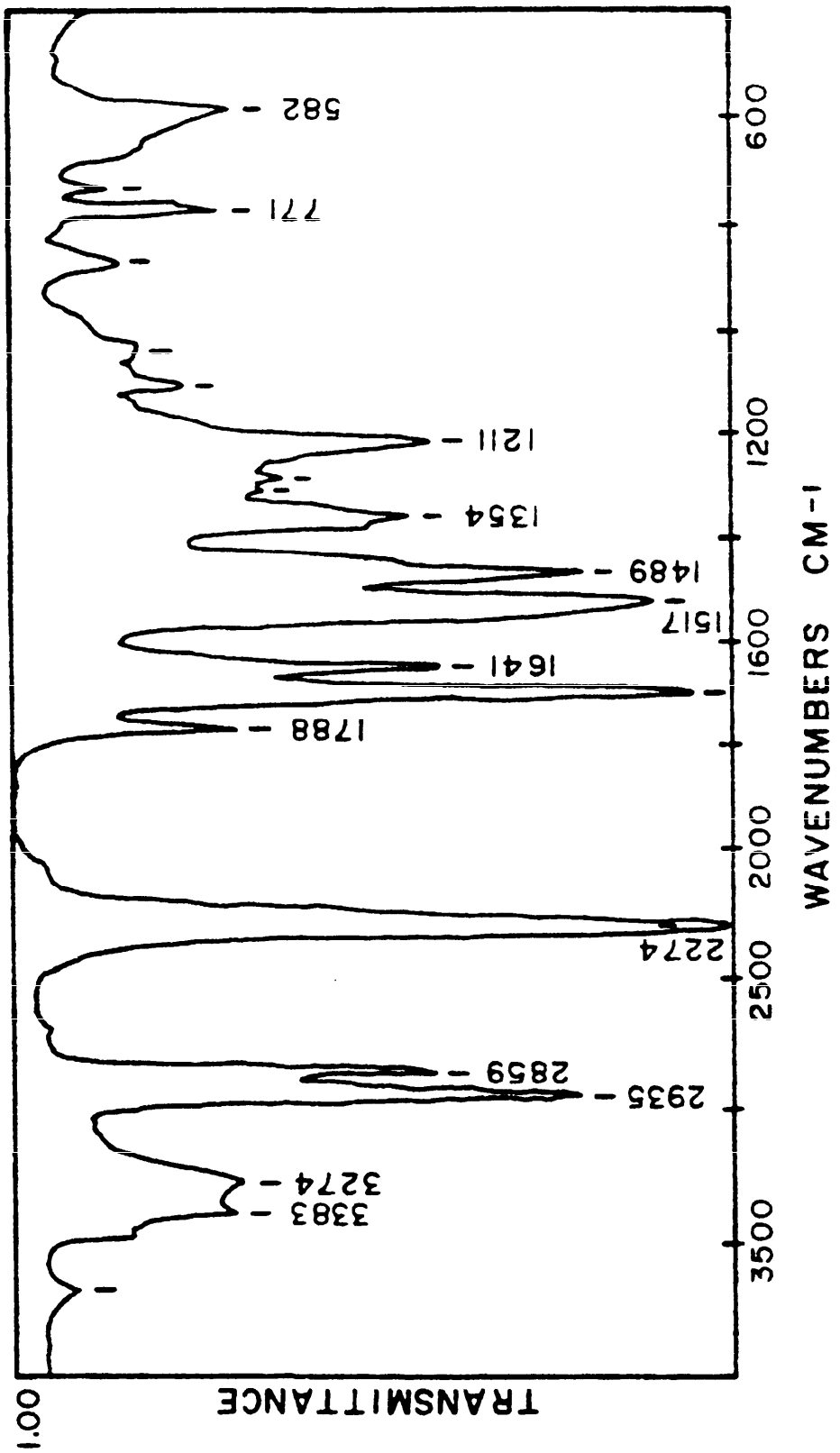


FIGURE 1. a. Nonvolatile from component B. Spectrum should show the presence of an aliphatic isocyanate and the absence of aromatics (Biuret form).

X-4699

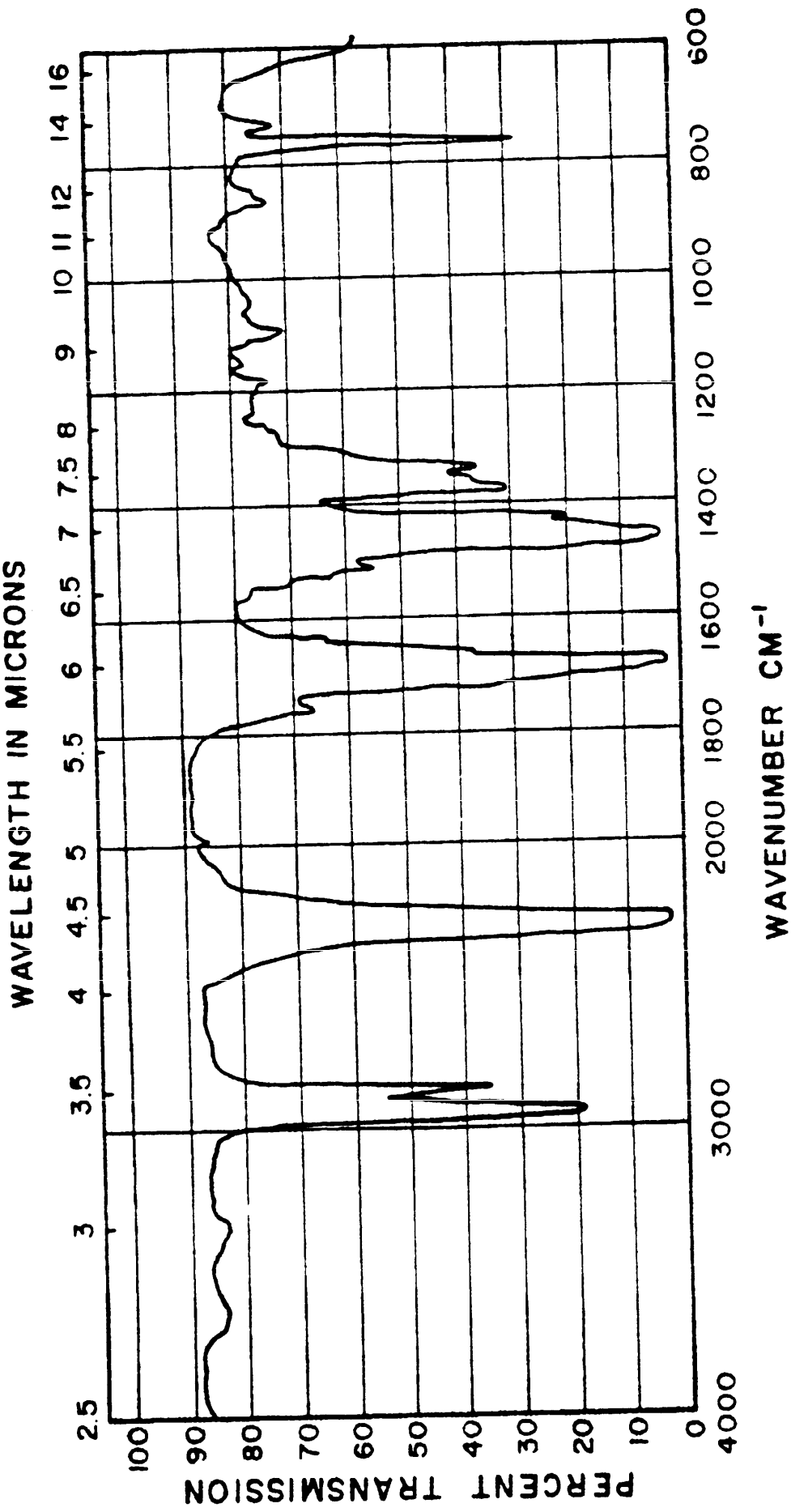


FIGURE I.b. Nonvolatile from component B. Spectrum should show the presence of an aliphatic isocyanate and the absence of aromatics (trimer form).

X-4700

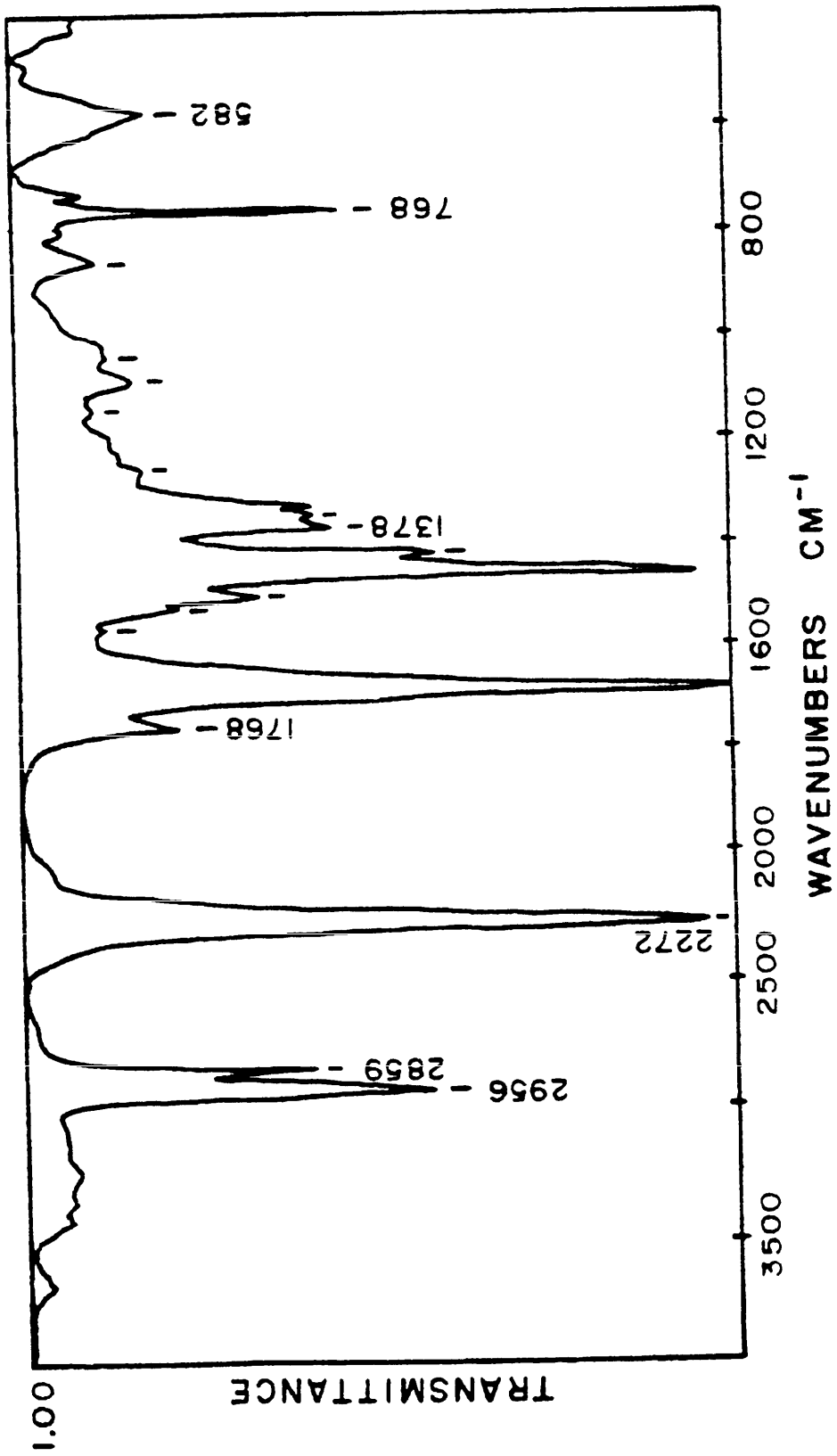
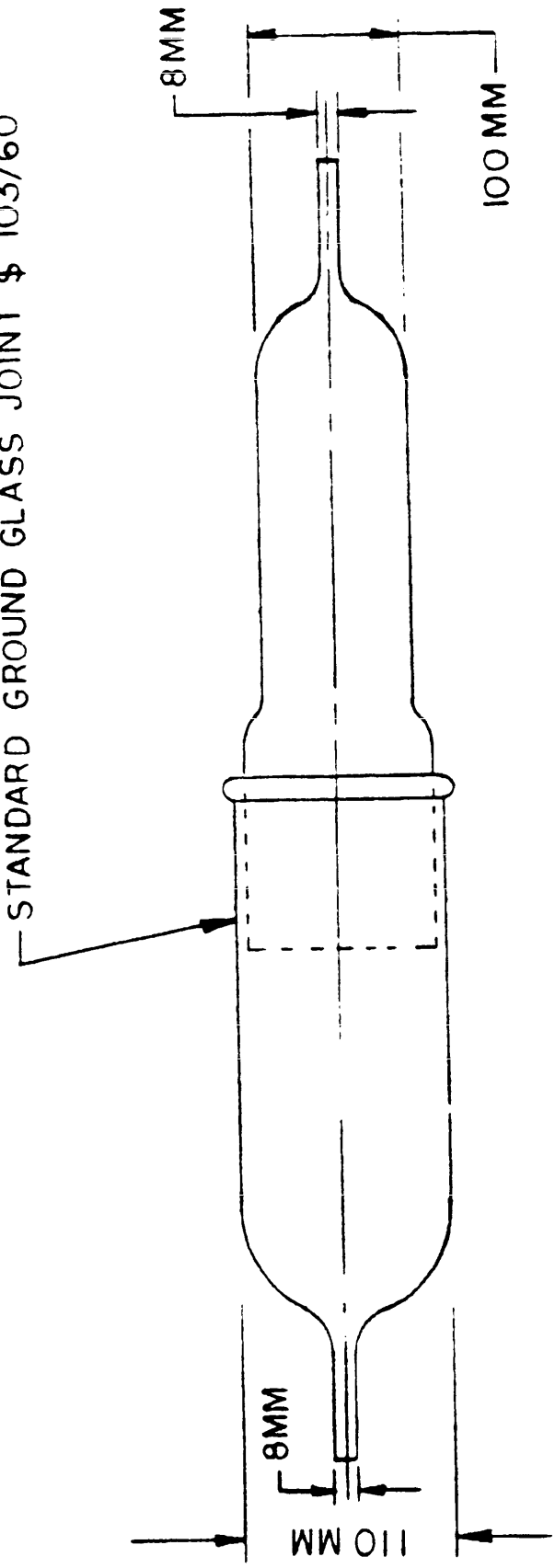


FIGURE 1. c. Nonvolatile from component B. Spectrum should show the presence of an aliphatic isocyanate and the absence of aromatics (trimer form).

X-4701



X-3684

FIGURE 2. Test apparatus.

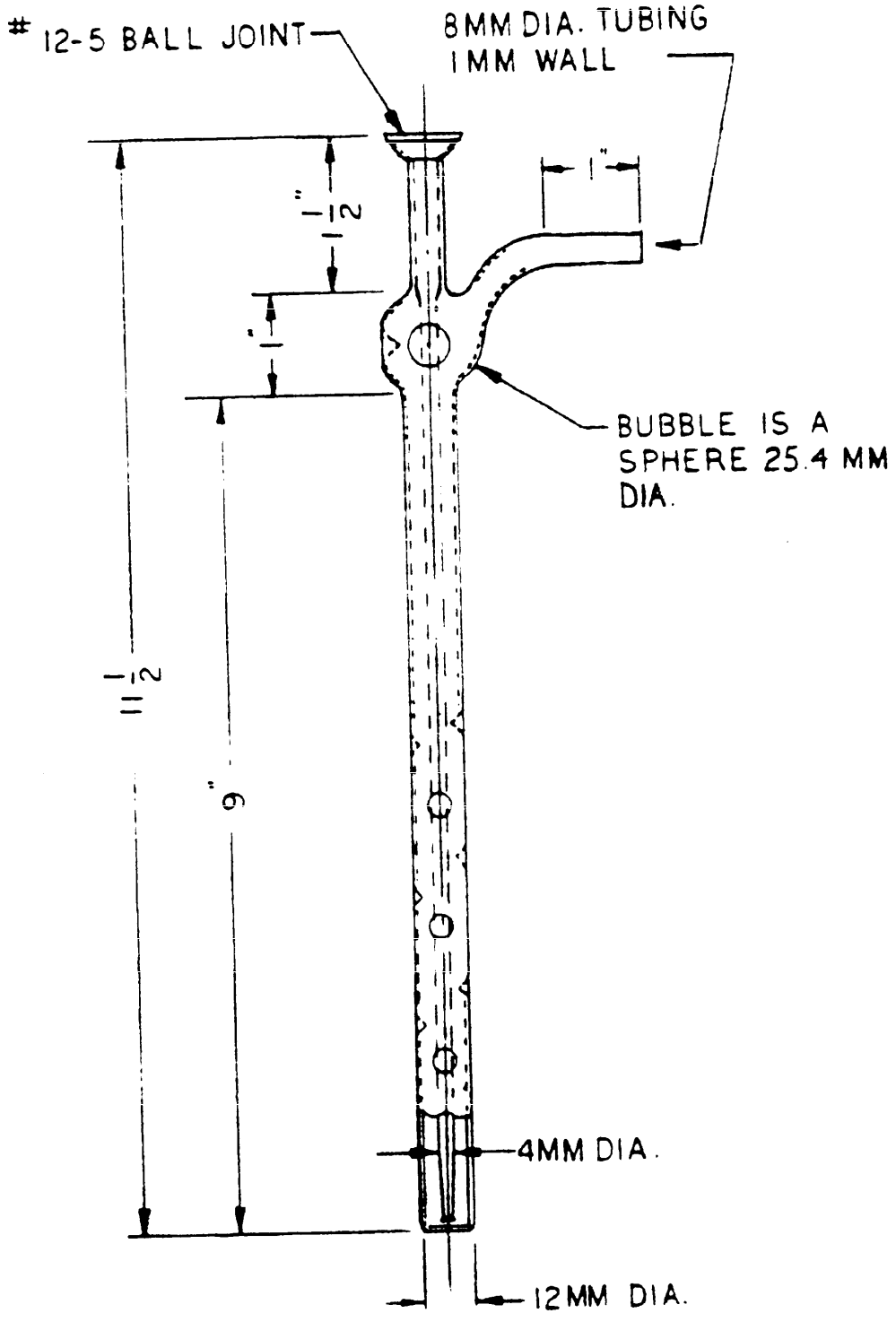
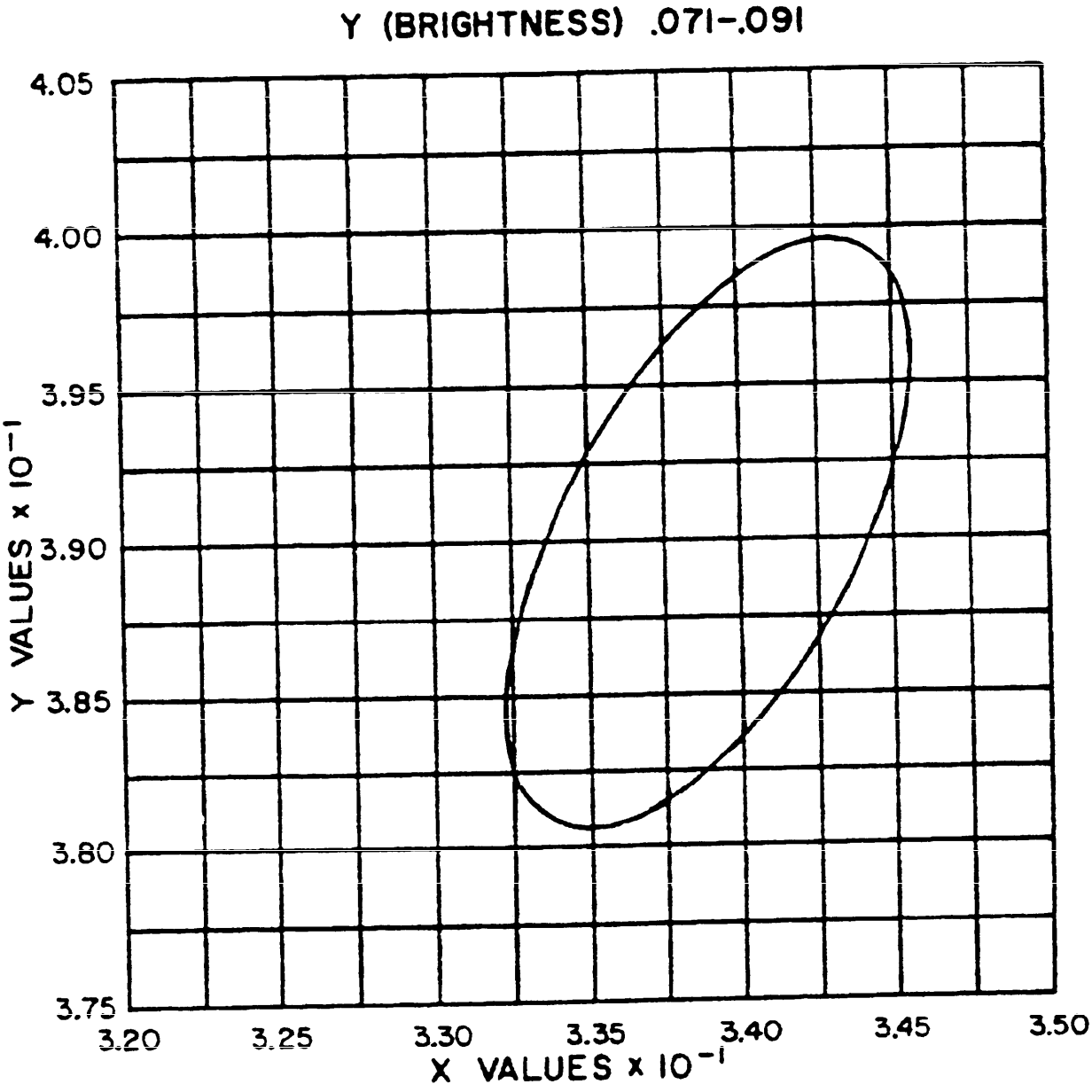


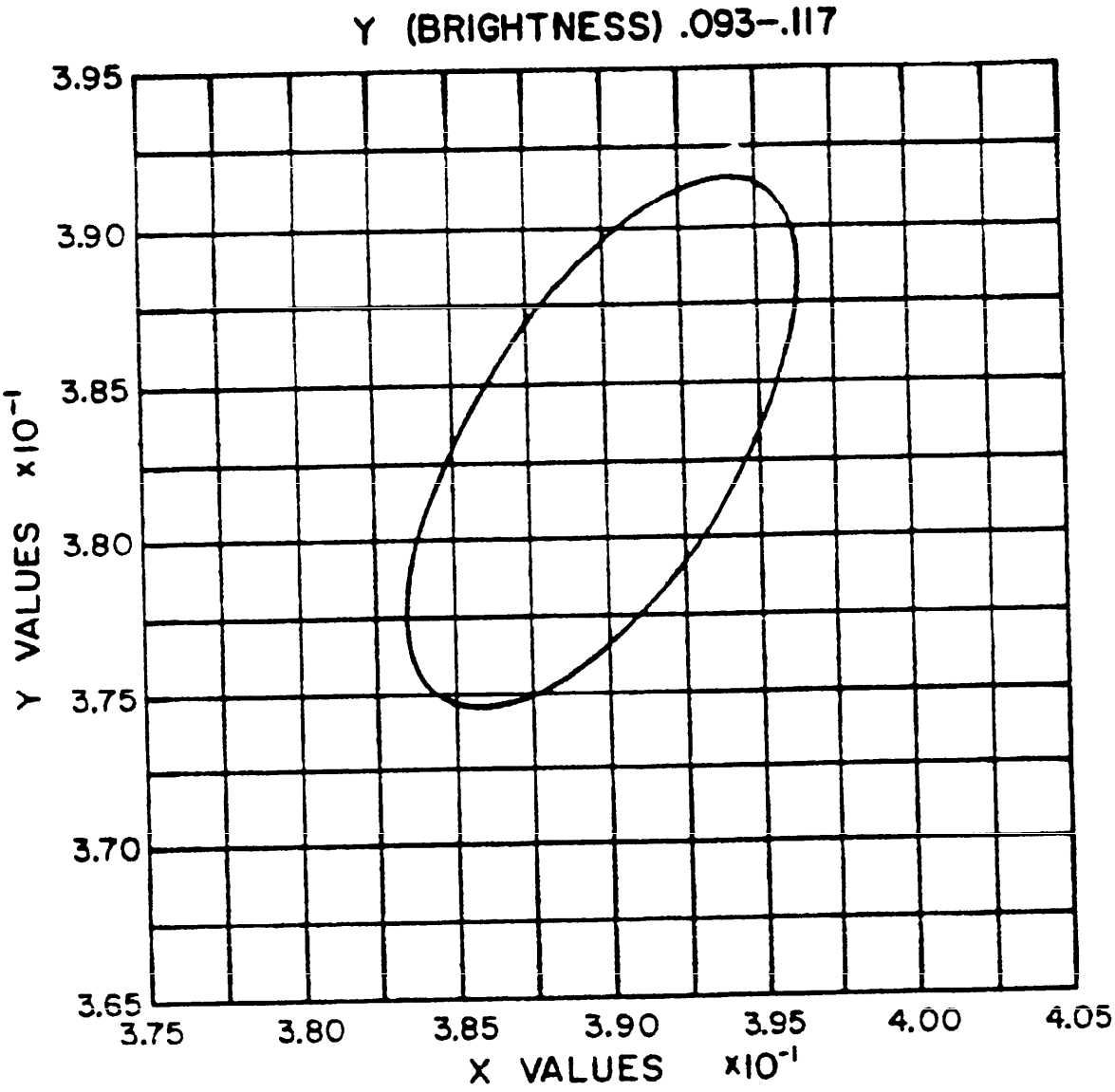
FIGURE 3. Sampling bubbler. X-3685A



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

FIGURE 4. Chromaticity diagram for camouflage paint, color-dark green 34082.

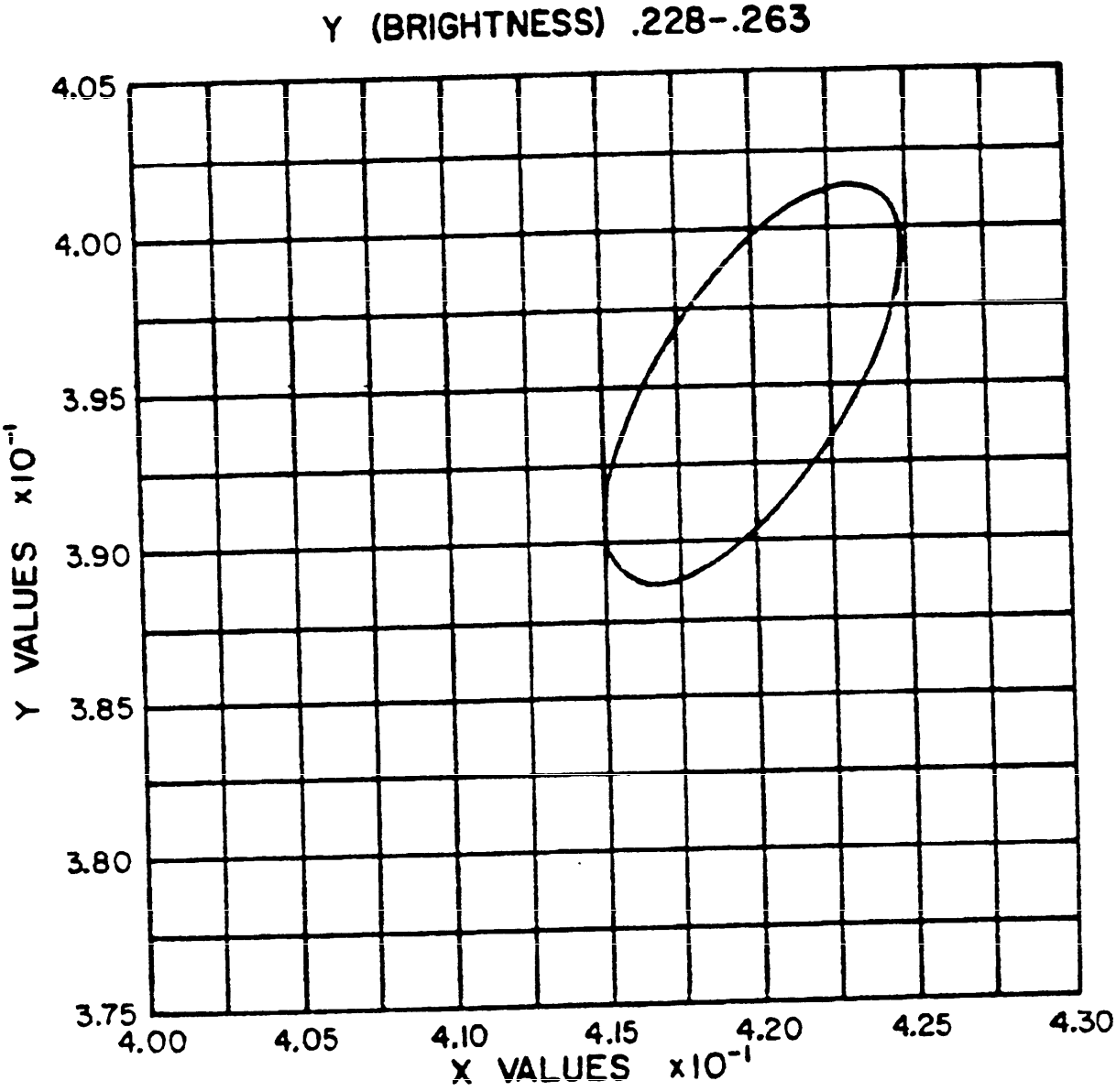
X-2796A



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

FIGURE 5. Chromaticity diagram for camouflage paint, color-field drab 33105.

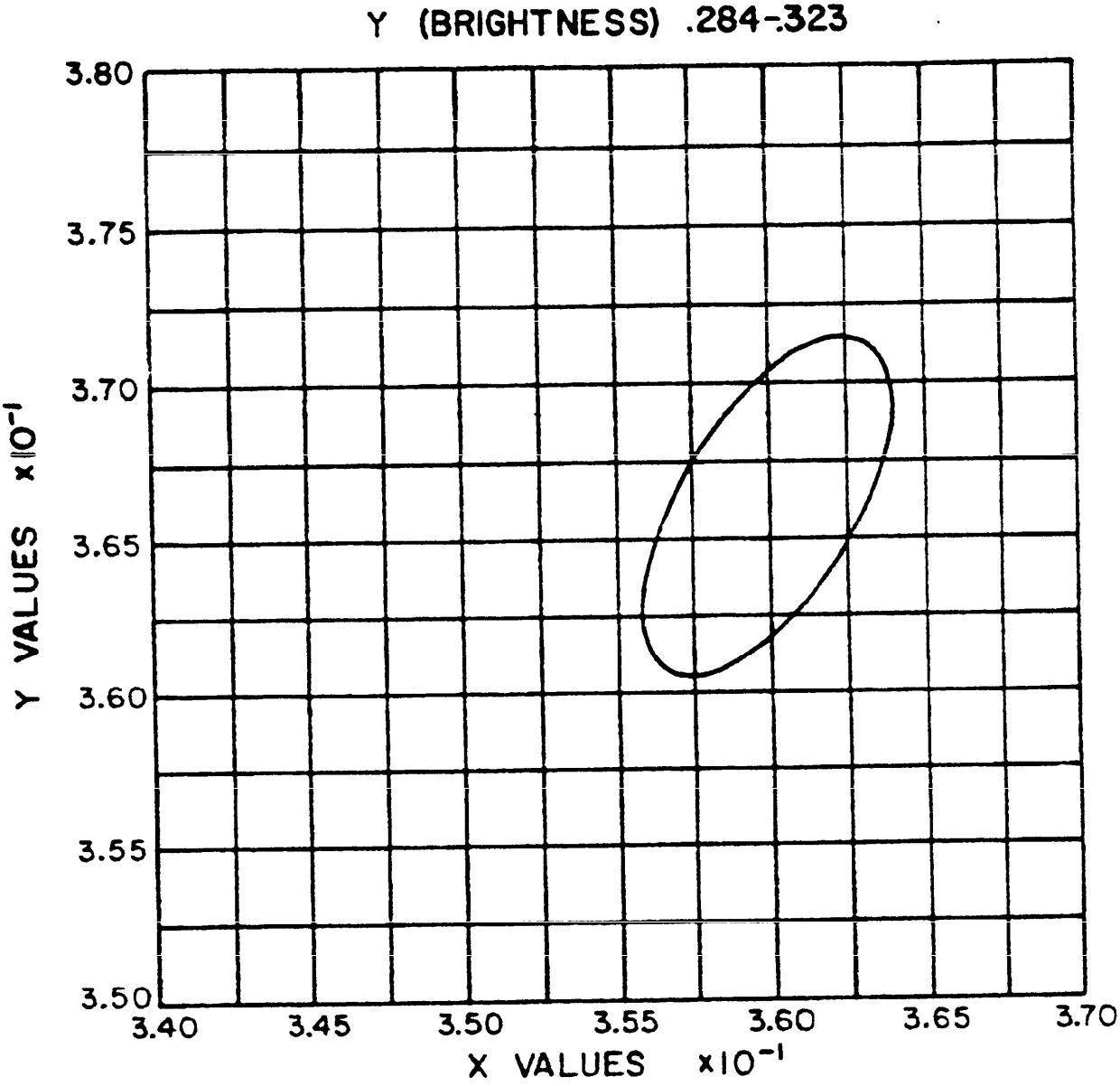
X-2798A



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

FIGURE 6. Chromaticity diagram for camouflage paint, color-earth yellow 33245

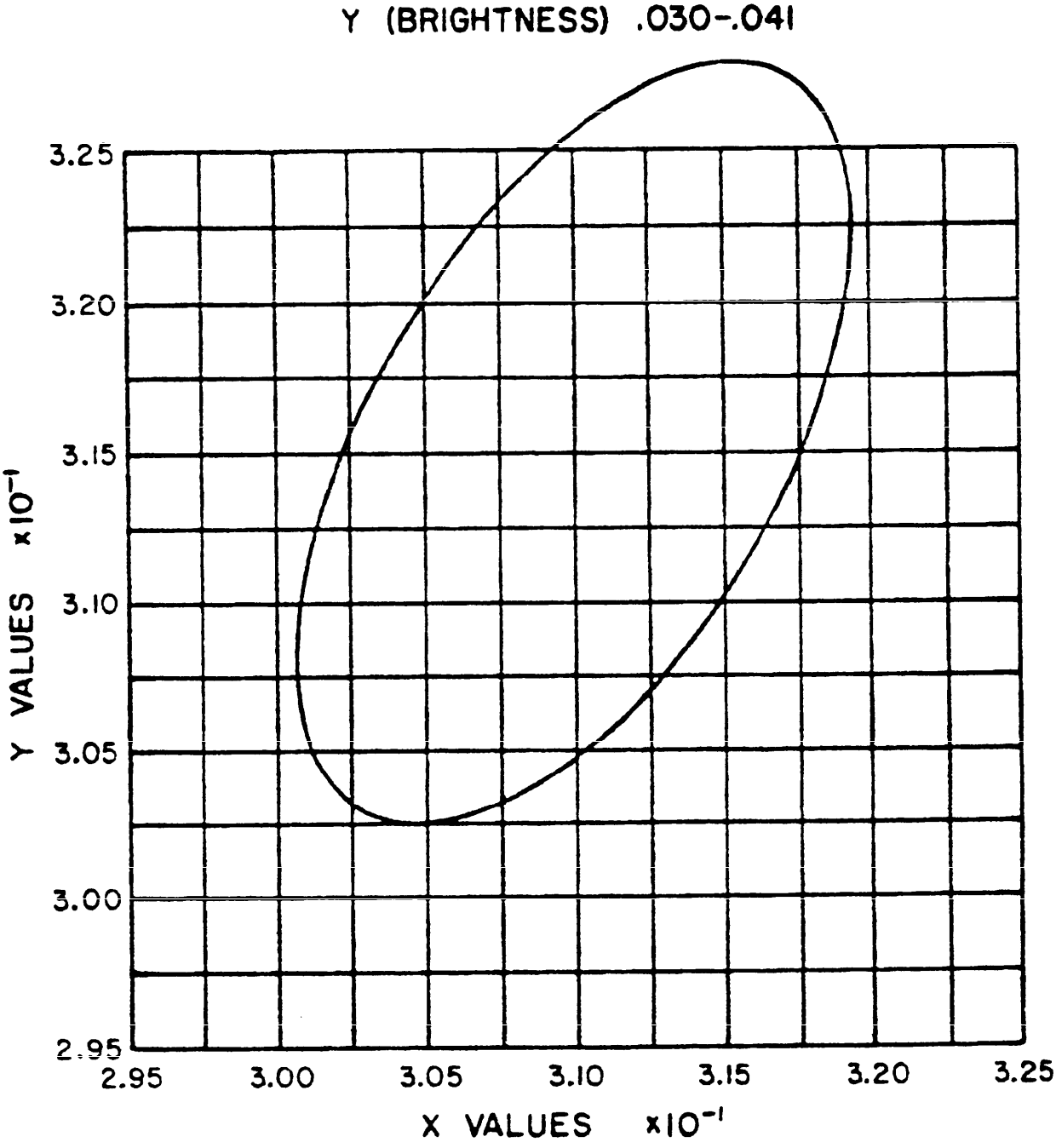
X-2799A



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

FIGURE 7. Chromaticity diagram for camouflage paint, color-sand 33303.

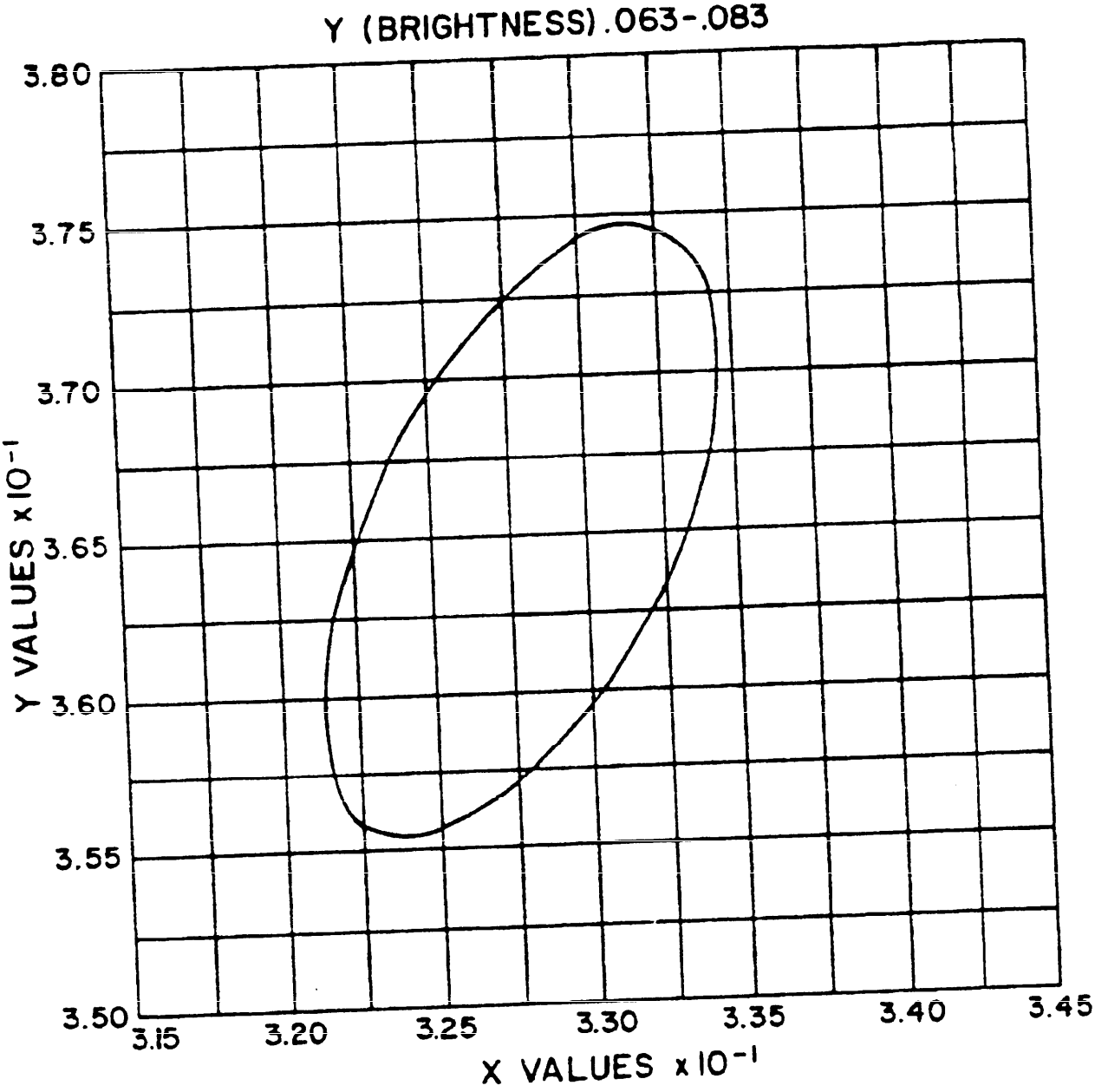
X-2800A



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

FIGURE 8. Chromaticity diagram for camouflage paint, color-black 37030.

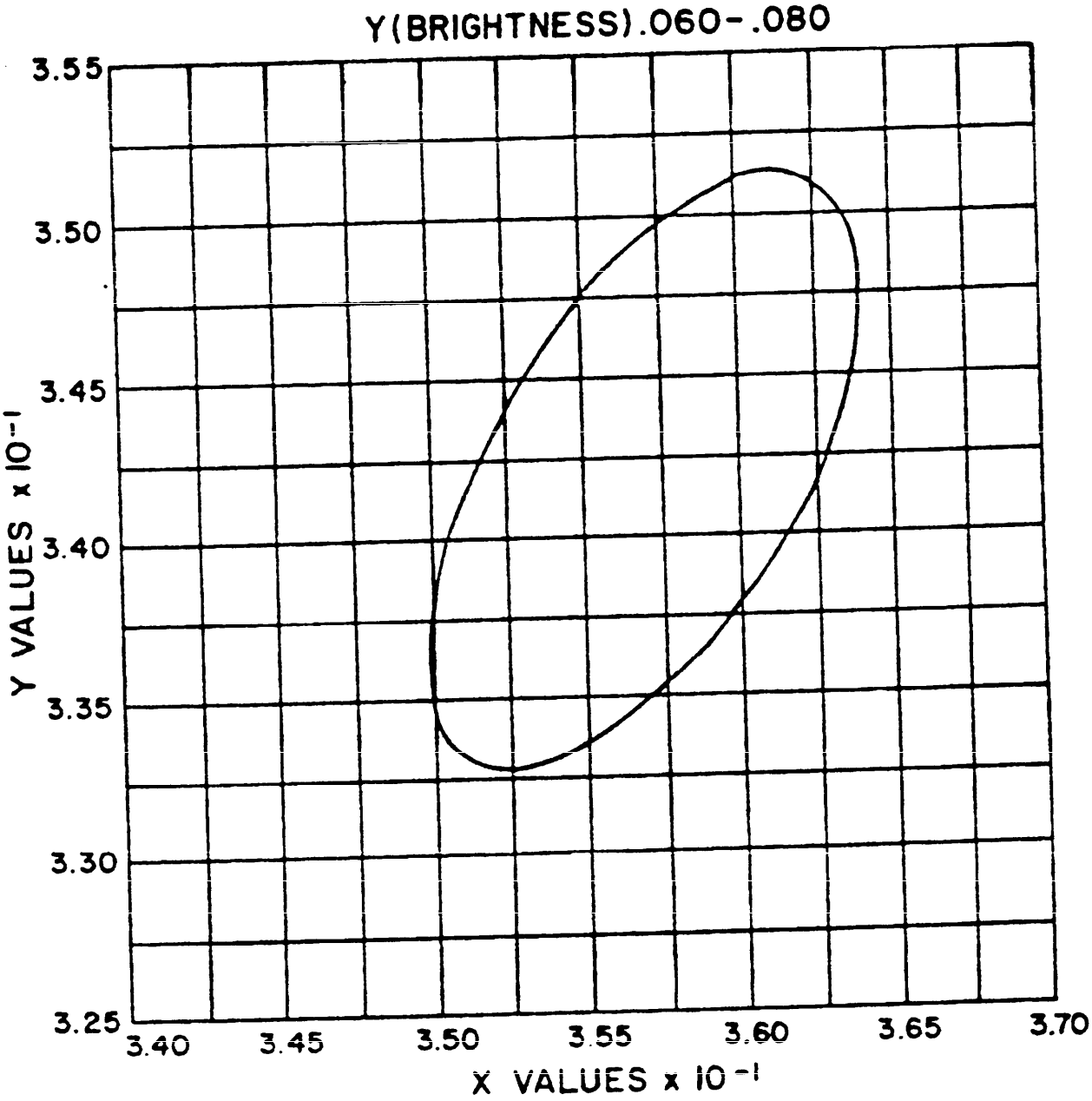
X-2804A



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

FIGURE 9. Chromaticity diagram for camouflage paint, color - green 383, 34094.

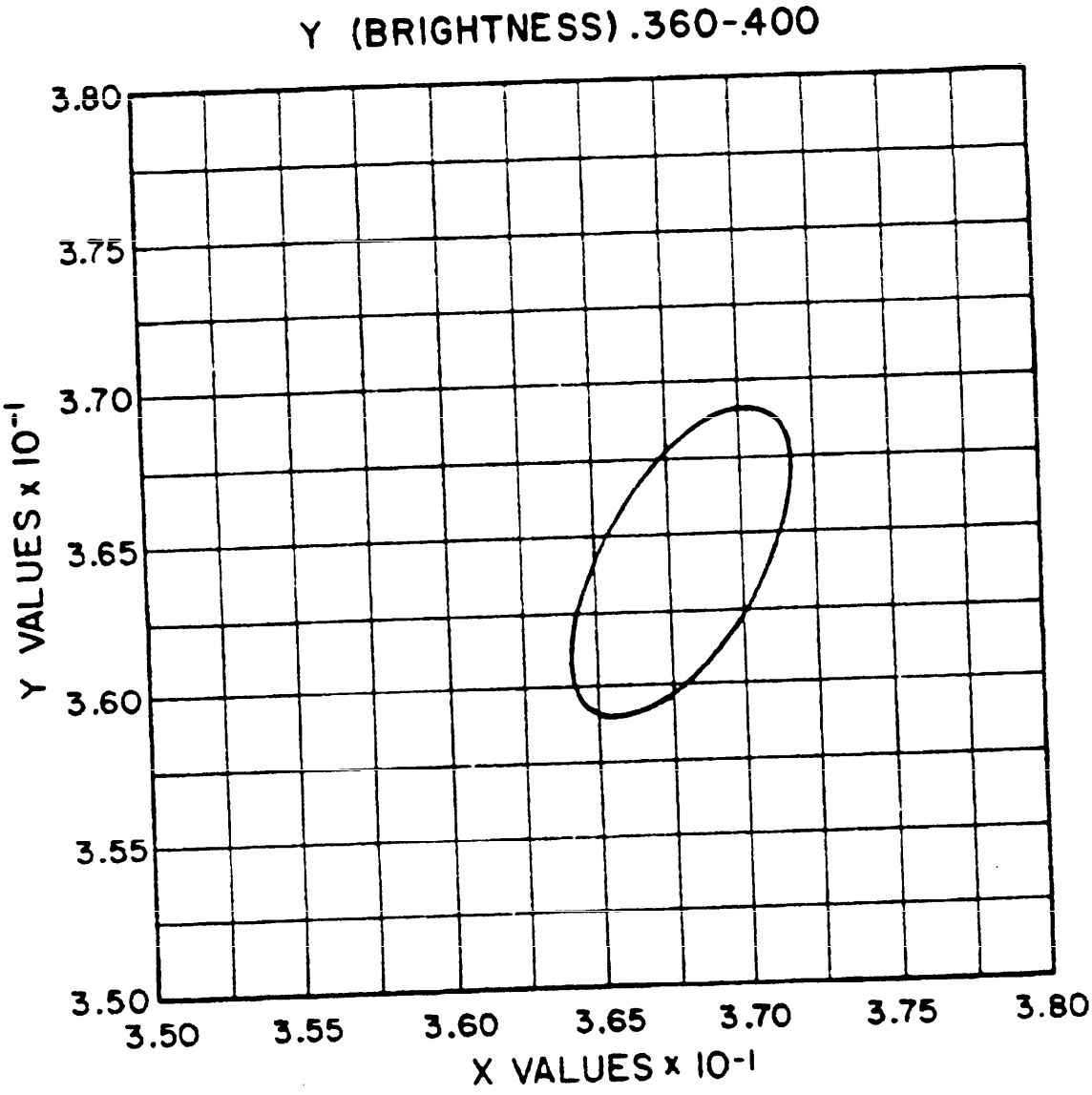
X-4266A



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

FIGURE 10. Chromaticity diagram for camouflage paint, color - brown 383, 30051.

X-4267A



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

FIGURE 11. Chromaticity diagram for camouflage paint, color - tan 686, 33440

X-4697A

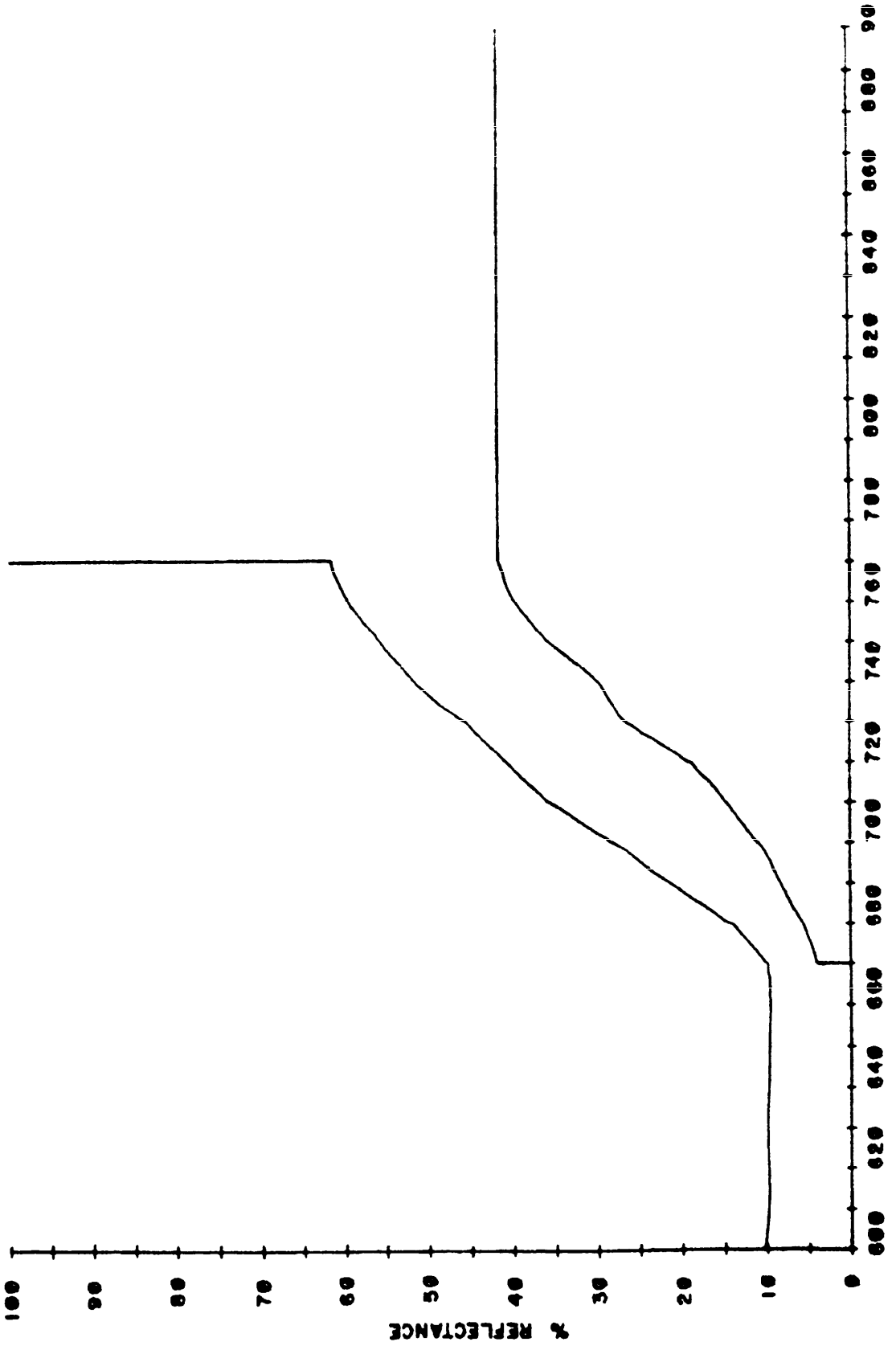


FIGURE 12. SPECTRAL REFLECTANCE LIMITS

APPENDIX A

METHODS OF ANALYSIS FOR CHEMICAL AGENTS HD AND GD

10. SCOPE

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

10.2 CAUTION: Extremely toxic materials are used in this testing. Agent HD is a known carcinogen. Appropriate measures to protect individuals at risk of exposure must be taken.

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

20.1 Reagents.

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

20.1.2 Acetone (CP or reagent grade).

20.1.3 Piperidine.

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

20.3 Standard curve. Place about 20 mL of diethyl phthalate in a 50 mL volumetric flask. Weigh into it about 75 milligrams (mg) of HD. Record the exact weight of HD added and dilute to 50 mL with diethyl phthalate. Label the flask "A". Divide the weight of HD added by the 50 mL volume and multiply by 1000 to obtain the concentration in micrograms per millilter (μg/mL). Place 20 mL of diethyl phthalate in a second 50 mL volumetric flask. Add 1 mL of solution "A" and fill to the mark with diethyl phthalate. Label this flask "B" and calculate its concentration using the following formula:

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

APPENDIX A

Place 50 mL of diethyl phthalate in a 100 mL volumetric flask. Add 4 mL of Solution "A" and dilute to mark with diethyl phthalate. Label flask "C" and calculate concentration as shown above. Number 10 Klett tubes 1 through 10. Place 2 mL of diethyl phthalate in each of tubes 1 and 2. Place 1 mL of "B" and 1 mL of diethyl phthalate in each of tubes 3 and 4. Place 1 mL of solution "C" and 1 mL of diethyl phthalate in each of tubes 5 and 6. Place 1 mL of "B" and 1 mL of "C" to each of tubes 7 and 8. Place 2 mL of "C" in each of tubes 9 and 10. Place a stirring rod and 5 mL of the BD-3 solution (see 20.1.1) in each tube and stir well. Place the tubes in a water bath at 100 °C. for 10 minutes, remove, and cool to room temperature[1/]. Lift the stirring rods free of the liquid but do not remove them from the tubes. Add acetone to the 10 mL mark on each tube making sure the stirring rod remains above the liquid. Stir well. Add 1 mL piperidine, stir well, transfer to the reading tube (20.2) and read within 1 minute on the zeroed Klett-Summerson colorimeter with number 54 filter[2/]. Record the Klett readings and average the duplicates. Subtract the average for the blank (1 and 2) from the other averages. Plot the net Klett readings (vertical axis) versus the μg of agent analyzed (horizontal axis). The result should be a straight line. The slope of this line, net Klett reading/μg, is used in finding the amount of HD in the bubbler samples.

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

30. ANALYSIS FOR AGENT GD (PINACOLYLMETHYL PHOSPHONOFLUORIDATE)

30.1 Reagents.

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

1/ The cooling period should be the same for each sample since reaction continues to a degree after heating.
2/ The reading tube should be rinsed with acetone after each reading to avoid cross contamination of the samples.
3/ Klett readings over 500 are not very accurate. In such cases dilute the original sample and make the appropriate changes to the above calculation.

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

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

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

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

Place 20 mL of diethyl phthalate in a third 50 mL volumetric flask and add 5 mL of "A". Dilute to the mark and label "C". Calculate the concentration as shown above. Number 8 Klett tubes 1 through 8. Place 2 mL of diethyl phthalate in each of tubes 3 and 4. Place 2 mL of "B" in each of tubes 5 and 6. Place 1 mL of "C" and 1 mL of diethyl phthalate in each of tubes 7 and 8. Place a stirring rod in each tube, add 2.5 mL of o-dianisidine solution (30.1.1) to each tube and stir well. Set a timer to zero. Add 1 mL of sodium perborate solution (30.1.2) to Klett tube 1, start timer, and stir well. When the timer reads 1 minute add 1 mL of sodium perborate to Klett tube 2 and stir well. Continue adding 1 mL of sodium perborate to the Klett tubes at 1 minute intervals until all have received the perborate solution. When the timer reads 20 minutes transfer the contents of Klett tube 1 to the reading tube and read immediately on a zeroed Klett-Summerson colorimeter using a number 42 blue filter[4/]. At 21 minutes read the sample in Klett tube 2. Continue reading at 1 minute intervals until all the samples have been read. Average the duplicate reading and subtract the average for the blank (1 and 2) from the other average readings. Plot the net Klett reading (vertical axis) versus the μ g of agent (horizontal axis). The result should be a straight line. The slope of this line, net Klett reading/μ g GD, is used in finding the amount of GD in the bubbler samples.

30.4 Analyzing the bubbler samples. Transfer the contents of the bubbler to a test tube. Place 2 mL of the sample in a Klett tube. Place 2 mL of diethyl phthalate in a separate tube to be used as a blank. Place 2 mL of "B" in a Klett tube to serve as a check on the procedure. Add a stirring rod and 2.5 mL of o-dianisidine solution (30.1.1) to each Klett tube and stir well. Set a timer to zero. Add 1 mL of sodium perborate solution (30.1.2) to the first Klett tube, stir well, and start the timer. When the timer reads one minute add

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

1 mL of the sodium perborate solution to the second Klett tube. Continue adding 1 mL of sodium perborate solution at 1 minute intervals until all have received the perborate solution. When the timer reads 20 minutes transfer the contents of the first Klett tube to the reading tube and immediately read on the zeroed Klett-Summerson colorimerter using a number 42 blue filter. At 21 minutes read the sample in the second Klett tube. Continue reading at 1 minute intervals until all the samples have been read. Subtract the blank to obtain the net Klett reading, divide by the slope of the standard curve, net Klett/μg, to obtain the μg of GD in the sample. Divide by 2 to obtain μg/mL and multiply by 5 to obtain μg of GD collected.

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5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

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