

MIL-E-52929 (ME)
20 July 1977

MILITARY SPECIFICATION

ENAMEL, ALKYD, CAMOUFLAGE, FLASH DRY

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 flash dry camouflage alkyd enamel used as a finishing coat on military equipment and is suitable for use under air pollution regulations.

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:

SPECIFICATIONS

FEDERAL

QQ-A-250/5

- Aluminum Alloy Alclad 2024, Plate and Sheet.

TT-P-1757

- Primer Coating, Zinc Chromate, Low-Moisture-Sensitivity.

PSC 8010

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Mobility Equipment Research and Development Command, ATTN: DRDME-DS, Fort Belvoir, VA 22060 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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TT-S-735	- Standard Test Fluids, Hydrocarbon.
TT-T-291	- Thinner-Paint, Volatile Spirits Petroleum Spirits.
CCC-C-458	- Cloth, Flannel, Cotton.
PPP-P-1892	- Paint, Varnish, Lacquer, and Related Materials, Packaging, Packing, and Marking of.

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MII-T-704	- Treatment and Painting of Materiel.
MIL-L-2104	- Lubricating Oil, Internal Combustion Engine, Tactical Service.
MIL-C-5541	- Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
MIL-C-81706	- Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys.

STANDARDS

FEDERAL

FED. TEST METHOD STD. No. 141	- Paint, Varnish, Lacquer and Related Materials; Methods of Inspection, Sampling and Testing.
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(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 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 1296	- Odor of Volatile Solvents and Diluents.
D 1308	- Effect of House Hold Chemicals on Clear and Pigmented Organic Finishes.

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- D 1364 - Water in Volatile Solvents (Fischer Reagent Titration Method).
- D 1542 - Qualitative Tests for Rosin in Varnishes.
- D 2369 - Volatile Content of Paints.
- 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.)

SOUTHERN CALIFORNIA AIR POLLUTION CONTROL DISTRICT

Rule 102 - Photochemically Reactive Solvents

(Application for copies should be addressed to the Southern California Air Pollution Control District, 434 South 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.)

UNIFORM CLASSIFICATION COMMITTEE, AGENT

Uniform Freight Classification

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

NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, INC., AGENT

National Motor Freight Classification

(Application for copies should be addressed to the American Trucking Associations, Inc., ATTN: Traffic Department, 1616 P Street NW, Washington, DC 20036.)

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

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change in the formulation of a qualified product will necessitate its re-qualification. 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 shall be Forest Green and shall impart to the substrate the required spectral reflectance properties in the visible (380-700 nanometers) and near infrared (700-900 nanometers) spectra. The color of this system shall fall within 2 National Bureau of Standards (NBS) (see 6.5) units under standard illuminant C of those specified in Figure 1 and reflectance values shall conform to the following limits and Table II and Figure 2:

<u>VISUAL (Y)</u>	<u>CHROMATICITY</u>		<u>INFRARED (1)</u>		<u>ALLOWANCE RATIO (2)</u>
	<u>X</u>	<u>Y</u>	<u>Min.</u>	<u>Max.</u>	<u>Min.</u>
0.058-0.075	0.333	0.357	—	60.0	5.2

(1) See Table I for wavelength definition.

(2) The ratio is calculated by dividing the value of the infrared by the value of the red spectral range.

TABLE I. Selected ordinates for determining infrared and red reflectance values from spectrophotometric curves
Ordinates

<u>Magenta</u> <u>Red Region</u> <u>Nanometers</u>		<u>Infrared Region</u> <u>Nanometers</u>	
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

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TABLE II. Spectral reflectance limits

<u>Wavelength</u> <u>Nanometers</u>	<u>% Reflectance</u>		<u>Wavelength</u> <u>Nanometers</u>	<u>% Reflectance</u>	
	<u>Max.</u>	<u>Min.</u>		<u>Max.</u>	<u>Min.</u>
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			

3.4 Composition.

3.4.1 Pigment. The hiding pigments shall be acid insoluble green pigment predominantly composed of cobalt, zinc, and chromium oxides with other oxides permitted, chrome yellow, light stable molybdate orange, carbasole dioxazine violet, yellow iron oxide, and red iron oxide. Small amounts of other tinting pigments may be used when necessary to match the spectral characteristics, provided that these additional pigments have good color stability. The extended pigments shall be siliceous matter and shall not exceed the amounts specified in Table IV.

3.4.2 Vehicle.

3.4.2.1 Vehicle solution. The vehicle solution shall be a phenol modified alkyd resin conforming to the physical and chemical requirements specified in Table III, together with the necessary additions of suitable thinners and driers. Small amounts of antiskinning agents, wetting agents, antidrier adsorption agents and stabilizers may be added at the discretion of the manufacturer.

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TABLE III. Physical and Chemical Requirements of Vehicle Solution

Characteristics	Requirements	
	Minimum	Maximum
Phthalic anhydride, percent by weight of resin solids	39	—
Unaponifiable matter, percent by weight of resin solids	—	5.0
Fatty acids, percent by weight of resin solids	36	41
Saponification number, resin solids	375	400
Iodine number of fatty solids	120	140
Refractive index of fatty acids at 25°C.	1.466	1.473
Ash, percent by weight of resin solids	—	0.5
Nonvolatile content, percent by weight	49	51
Viscosity, as received, at 25°C. (Gardner-Boldt)	—	Y
Viscosity, reduced to 37.5 percent solids in xylene, at 25°C. (Gardner-Boldt)	B	F
Specific gravity of solution, as received, 25°/25°C.	0.968	0.988
Acid number of solution	3	10
Refractive index of solution, at 25°C.	1.50	1.51
Color of solution	Not darker than Color Standard No. 13 (Gardner Color Standards 1953)	
Appearance of solution	Clear, transparent, homogeneous	
Compatibility with mineral spirits, 300 percent reduction with TT-T-291, Type II, thinner	No clouding or precipitation	
Phenol test	Positive	
Rosin test	Negative	

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3.4.2.2 Volatile vehicle. The volatile portion of the enamel shall conform to the following requirements by volume when analyzed in accordance with 4.4. The volatile portion shall contain no benzol, methanol, chlorinated solvents or any other solvent of a highly toxic nature.

- (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.

3.5 Quantitative requirements. The enamel shall conform to the requirements in Table IV when tested as in 4.3.

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TABLE IV. Quantitative Requirements

Characteristics	Requirements	
	Min.	Max.
Total solids, percent by weight of enamel.....	62	—
Pigment, percent by weight of enamel.....	42	46
Extender, pigment, percent by weight of total pigment.....	—	50
Vehicle solids, percent by weight of enamel.....	19	—
Phthalic anhydride, percent by weight of nonvolatile vehicle.....	38	—
Drying oil acids, percent by weight of nonvolatile vehicle.....	36	41
Unaponifiable matter, percent by weight of nonvolatile vehicle.....	—	5.0
Rosin, on isolated vehicle.....	Negative	
Phenol, on isolated vehicle.....	Positive	
Pigment, antimony sulfide.....	Negative	
Water, percent by weight of enamel.....	—	1.0
Coarse particles and skins, percent by weight of pigment.....	—	0.5
Hiding power (contrast ratio).....	0.98	—
60 degree specular gloss.....	—	1.0
85 degree specular gloss.....	—	3.0
Fineness of grind		
Hegman.....	4	—
ASTM, Microns.....	—	50
Consistency; Package, Krebs stormer, shearing rate - 200 R.P.M.		
Grams.....	125	175
Krebs units.....	70	80
Drying time:		
Set to touch, minutes.....	4	15
Dry through, hours.....	—	8
Full hardness, hours.....	—	36
Baking:		
Dry through, 250° F or equivalent heat treatment, minutes.....	—	45

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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 IV.

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 Table VI. 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 may show a slight trace of 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.

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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 degree 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. 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 3.3. The infrared reflectance and allowable ratio shall remain within those limits originally specified.

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3.6.14 Weather resistance. A film of enamel tested as in 4.3.12, shall show no checking, cracking, or appreciable film deterioration. There shall be no more than light chalking (No. 6 Method 6411 of FED. TEST METHOD STD. No. 141). The film shall show no excessive change in value or 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 to specified requirements for the following characteristics:

Phthalic Anhydride	Flexibility
Drying Oil Acids	Knife Test
Color - Spectral Reflectance	Water Resistance

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Fineness of Grind
 60 Degree Gloss
 85 Degree Gloss

Hydrocarbon Fluid Resistance
 Acid Resistance

4.2.4 Validation. The contracting officer shall require that at least a quart sample from each production lot be forwarded to the Organic and Chemical Coatings Research Group, Material Technology Lab, ATTN: DRDME-VO, USA MERADCOM, Fort Belvoir, VA 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 V) shall be conducted in accordance with FED. TEST METHOD STD. No. 141, or ASTM, 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.

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TABLE V. Index

Item	Test Method		Para. of this Specification giving further references	Para. of this Specification giving requirements
	Application Method in FED. TEST METHOD STD. No. 141	Applicable ASTM Test Method		
Color and spectral reflectance	4251, 6241	-	4.3.2	3.3, TABLE I
Total solids	4041	D 2369	-	TABLE IV
Pigment content	4022	D 2698	-	TABLE IV
Vehicle solids	4052	D 2698	-	TABLE IV
Pigment analysis	-	-	4.3.3	3.4.1, TABLE IV
Phthalic anhydride	7014	-	-	TABLE IV
Drying oil acids	7014	-	-	TABLE IV
Unsaponifiable	7014	-	-	TABLE IV
Aromatic compounds	7355, 7356	-	-	3.4.2.2
Olefinic and cyclo-olefinic	7355, 7356	-	-	3.4.2.2
Ketones	7355, 7356	-	-	3.4.2.2
Benzol	5091	-	-	3.4.2.2
Methanol	5133	-	-	3.4.2.2
Chlorinated solvents	5132	-	-	3.4.2.2
Rosin	5031	D 1542 Sec. 4 A	-	TABLE IV
Phenol	5141	-	-	TABLE IV
Antimony sulfide	-	-	4.3.4	TABLE IV
Water	4082	D 1364	-	TABLE IV
Coarse particles and skins	4092	-	-	TABLE IV
Hiding power (contrast ratio)	4122	-	4.3.5	TABLE IV
60° specular gloss	6101	-	4.3.6	TABLE IV
85° specular gloss	6103	-	4.3.7	TABLE IV
Fineness of grind	4411	D 1210	-	TABLE IV
Consistency	4281	D 562	-	TABLE IV
Drying time	4061	-	4.3.8	TABLE IV
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

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TABLE V. Index (Cont'd)

Item	Test Method			
	Application Method in FED. TEST METHOD STD. No. 141	Applicable ASTM Test Method	Para. of this Specification giving further references	Para. of this Specification giving requirements
Full container	3022	-	4.3.10.2	3.6.2.2
Dilution stability	4203	-	4.3.11	3.6.3
Brushing properties	4321, 2141	-	4.3.12	3.6.4
Spraying properties	4331, 2131	-	4.3.13	3.6.5
Flexibility	6221	-	4.3.14	3.6.6
Knife test	6304	-	4.3.15	3.6.7
Recoatibility	-	-	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 Moresst card using a 0.0040-inch (0.0080-inch gap clearance) film applicator. Dry for 48 hours at a temperature of $23^{\circ} \pm 1.1^{\circ} \text{C}$ ($73.4 \pm 2^{\circ} \text{F}$), 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. 2. 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 Moresst 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

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only permissible pigments were used. Examination of the acid insoluble portion of the pigment by X-ray diffraction shall show the presence of the acid insoluble green pigment and silica. Determine the acid insoluble pigment as in Method 5271 of FED. TEST METHOD STD. No. 141, as specified in 4.1 using 0.4 grams of the extracted pigment. Nonconformance to the requirements of 3.4.1 and Table IV shall constitute failure of this test.

4.3.4 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 Table IV shall constitute failure of this test.

4.3.5 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 IV 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 IV 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 IV 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 IV 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 IV shall constitute failure of this test.

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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.

4.3.10.1 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 Table VI. Test according to Method 4203 of FED. TEST METHOD STD. No. 141. Nonconformance to 3.6.3 shall constitute failure of this test.

4.3.12 Brushing properties. Apply the enamel as packaged or reduced not more than 10 parts by volume of thinner conforming to Table VI, to 90 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.

^{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, NJ.

TABLE VI. Thinner

<u>Ingredient</u>	<u>Percent by weight</u>
VMP Naphtha (8% maximum aromatic)	65
n-Butyl alcohol	20
Toluene	15

4.3.13 Spraying properties. Reduce four parts of enamel with one part by volume with thinner conforming to Table VI. 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 4331 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

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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 $23^{\circ} + 1^{\circ}$ 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 $23^{\circ} + 1^{\circ}$ C in a hydrocarbon fluid conforming to TT-8-735, 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 by 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.

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

- 50 parts Synthetic yellow iron oxide (ASTM Method D 768, or NSB Standard No. 316).
- 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 thoroughly and determine the sheen of the area in the center of the panel by Method 6103 of FED. TEST METHOD STD. No. 141. Nonconformance to 3.6.12 shall constitute failure of this test.

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,

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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.

4.4.1 Preproduction pack examination. The preproduction pack shall be examined for the characteristics as listed in PPP-P-1892 for possible defects. Presence of one or more defects shall be cause for rejection.

4.4.2 Quality conformance inspection of pack.

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

4.4.2.2 Examination. Each completed pack shall be examined for the characteristics listed in PPP-P-1892 for possible defects. Presence of one or more defects shall be cause for rejection.

5. PACKAGING

5.1 Packaging, packing, and marking. The enamel shall be packaged, packed, and marked in accordance with PPP-P-1892. The level of packaging shall be A or C (Commercial) and the level of packing shall be A, B, or C as specified (see 6.2). Commercial packing shall insure protection from damage during shipment and handling and assure carrier acceptance and safe delivery to the destination at the lowest ratings of the carrier in accordance with the Uniform Freight Classification or National Motor Freight Classification rules. The marking shall reflect as a minimum, the item name, National Stock Number, quantity, contract number and appropriate address markings. The marking shall be applied with a waterproof material, be legible and shall provide a definite contrast. The enamel shall be furnished in 1 quart or 1 gallon multiple friction top containers, in 5 gallon lug cover steel pails; or in 55 gallon steel drums as specified (see 6.2).

5.2 Special markings. Each container shall be legibly marked with the following instructions:

Thinning Directions. For application the manufacturer shall include on the label thinning recommendations and solvent blend.

CAUTION: Flammable liquid. No smoking. During application avoid skin contact and inhalation of vapors.

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6. NOTES

6.1 Intended use. This coating is a flash drying alkyd enamel 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 which may be used as the finish coat for systems employing TT-E-485 as a primer. It may be used over epoxy primer MIL-P-23377, commonly used on Army-Navy, Air Force military equipment. This enamel may be used in place of TT-E-522 camouflage by reducing 10-15 percent with cellosolve acetate or butyl alcohol for improved brushing properties. 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) Level of packaging and packing required (see 5.1).
- (c) 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 product 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, Materials Technology Laboratory, DRIME-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 Color difference equation. The correct color difference equation is entitled "Hunter's Revised National Bureau of Standards (NBS) Color Difference Equation." One reference source is "Color in Business, Science, and Industry," Second Edition, Wiley, NY, 1963, Page 294 (Equation 2.29).

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

Forest Green Pigmentation

Acid Insoluble Green Pigment	35.1 lbs.
C.P. Medium Chrome Yellow	12.5 lbs.
Carbazole Dioxazine Violet	1.1 lbs.
Molybdate Orange	1.9 lbs.
Organo Montmorillonite	1.1 lbs.
Micro Talc	19.3 lbs.
Diatomaceous Silica	<u>29.0 lbs.</u>
	100.0

Custodian:
Army - ME

Preparing activity:
Army - ME

Review activities:
Army - AV, EL, MD, MI, MR

Project 8010-A123

User activity:
Army - AT

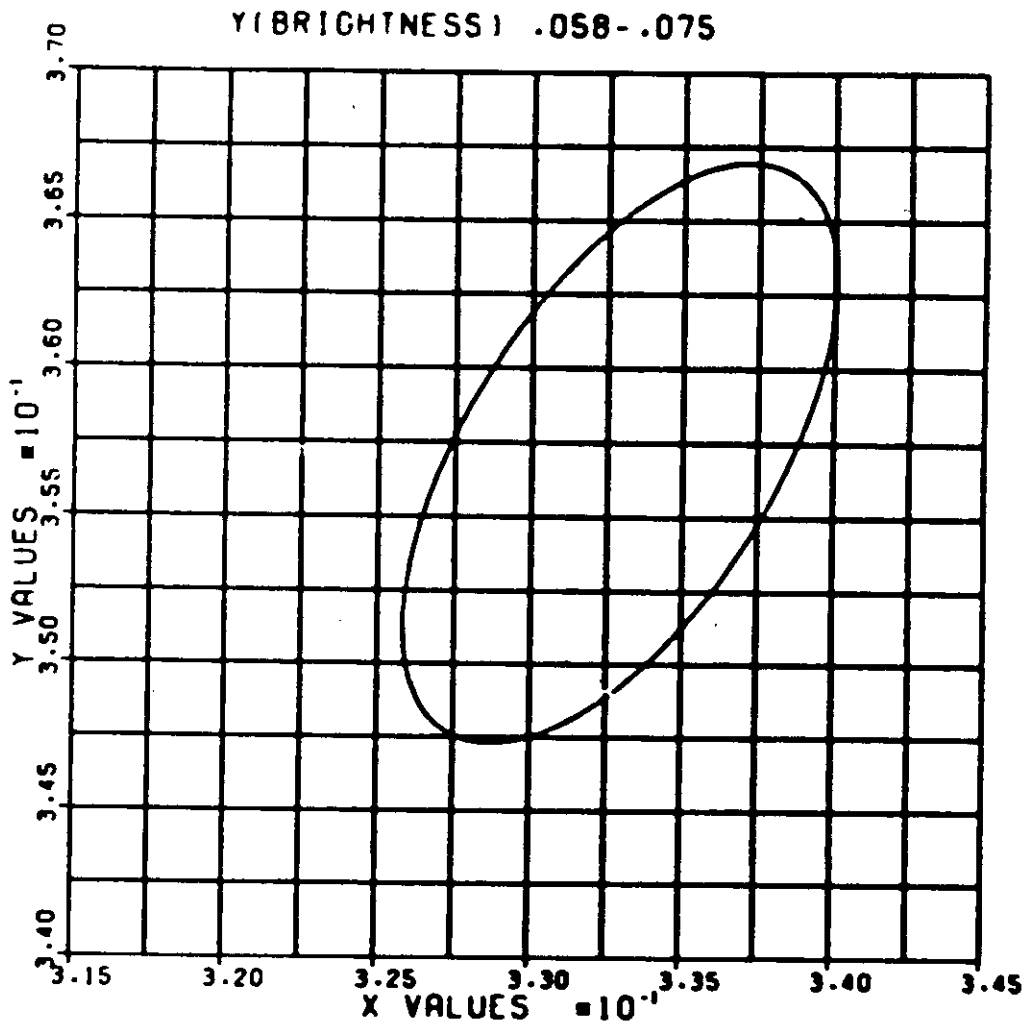
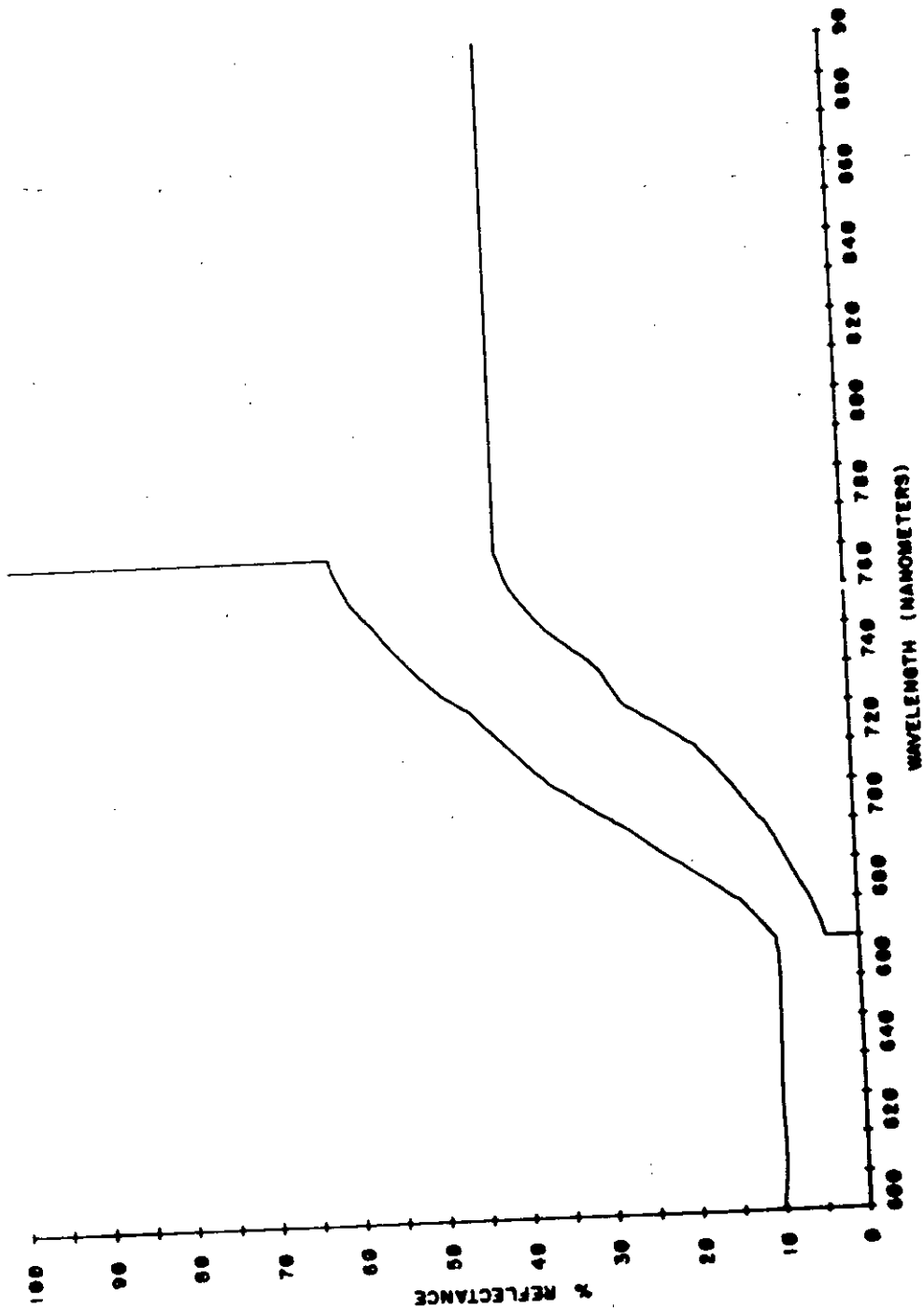


FIGURE 1.

CHROMATICITY DIAGRAM FOR CAMOUFLAGE PAINT
COLOR- FOREST GREEN

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

X-2795



X-3013A

FIGURE 2. SPECTRAL REFLECTANCE LIMITS