TT-E-516A
January 7, 1969
SUPERSEDING
Fed. Spec. TT-E-516
December 2, 1963 and
MIL-E-10687B
18 February 1959

FEDERAL SPECIFICATION

ENAMEL, LUSTRELESS, QUICK-DRYING STYRENATED ALKYD TYPE

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers one type and one grade of quick drying synthetic lustreless enamel used as a finishing coat on ammunition and other metal surfaces. It provides for an additional type of material suitable for use under AIR POLLUTION REGULATIONS (see 6.7).

1.2 Classification. The enamel covered by this specification shall be of the following compositions as specified:

Composition G - General use.
Composition L - Limited use (see 6.7).

2. APPLICABLE DOCUMENTS

2.1 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:

Federal Specifications:

TT-C-490 - Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings.
TT-P-143 - Paint, Varnish, Lacquer, and Related Materials; Packaging, Packing, and Marking of.
TT-P-320 - Pigment, Aluminum; Powder and Paste, for Paint.
TT-P-442 - Pigment, Titanium Dioxide (For Protective Coatings).

TT-T-306 - Thinner; Synthetic-Enamel.
PPP-T-60 - Tape; Pressure Sensitive Adhesive, Waterproof for Packaging and Sealing.

Federal Standards:

Fed. Test Method Std. No. 141 - Paint, Varnish, Lacquer, and Related. Materials; Methods of Inspection, Sampling and Testing.
Fed. Std. No. 595 - Colors.

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.)

(Single copies of this specification and other Federal Specifications required by activities outside the Federal Government for bidding purposes are available without charge from Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Washington, D.C., Atlanta, Chicago, Kansas City, Mo., Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, Wash.)

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

3. REQUIREMENTS

3.1 Qualification. Enamel furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 6.4). Any change in the formulation of a qualified product will necessitate its requalification. The material supplied under the contract shall be identical, within manufacturing tolerances, to the product receiving qualification.

3.2 Color. The enamel shall be furnished in Fed. Std. No. 595 Color number specified in the contract or purchase order (see 6.2). When tested as specified in 4.3.10, it shall acceptably match the standard color chip in Fed. Std. No. 595 (see 6.5).

3.3 Composition.

3.3.1 Vehicle.

3.3.1.1 Composition G. The vehicle shall be a styrenated phthalic alkyd resin (see 6.6.1) together with the necessary amounts of driers and volatile solvents. The resin solution shall have a color value at 50 percent solids content no darker than 10 (Gardner Color Standards of 1953). Small amounts of antioxidants, wetting agents, and stabilizers may be present. The vehicle shall show a negative test for rosin and phenolic resin. The volatile material shall contain no benzol, methanol, chlorinated or other solvent of highly toxic nature.

3.3.1.2 Composition L. The vehicle shall be the same as 3.3.1.1 except the volatile solvents used shall conform to the following requirements by volume when tested as in 4.3.3.

(a) Aromatic compounds with eight or more carbon atoms except ethyl benzene: 8% maximum.

(b) Ethyl benzene and toluene: 20% maximum.

(c) Solvents with an olefinic or cyclo-olefinic type of unsaturation: negative test (see 6.8).

(d) Ketones - negative.

(e) Total of a + b: 20% maximum.

3.3.2 Pigment. Any combination of the pigments listed in table I for any specific color shall make up the basic hiding pigmentations for that color. Hiding pigments shall be chemically pure and free from extenders. The titanium dioxide shall be rutile chalk resisting type conforming to type III of TT-P-442. The aluminum pigment shall be an extra fine lining class conforming to TT-P-320, type I or type II, class I. Small amounts of other shading pigments may be used when necessary to match the color chips, provided these additional pigments have good color permanence. Extender pigments shall be siliceous matter or siliceous matter and barytes and shall not exceed the amount specified in table II. The amount of bartyes shall not exceed 20 percent of the extender content by weight. Calcium sulfate or carbonate shall not be employed alone or as a component part of any pigment.

TABLE I. Pigmentation

Color	Fed. Std. No. 595 Color No.	Pigmentation
Brown	30117	Red or yellow iron oxide, carbon or lampblack, titanium dioxide.
Red	31136	Toluidine red.
Light red	31158	Quinacridone red, molybdate orange, titanium dioxide.
Orange	32246	Chrome orange, molybdate orange.
Yellow	33538	Medium chrome yellow, yellow iron oxide.
Olive drab	X34087 (see 6.5)	Red or yellow iron oxide, carbon or lampblack, medium chrome yellow, titanium dioxide.
Green	34108	Chrome green or chrome yellow for green, and iron blue.
Light green	34558	Titanium dioxide, yellow iron oxide, chrome yellow, phthalocyanine blue or green, carbon or lampblack.
Medium blue	35109	Iron blue, titanium dioxide, lampblack, yellow iron oxide.
Light blue	35193	Iron blue, titanium dioxide, chrome yellow.
Slate	1/ 26132	Titanium dioxide, carbon or lampblack, yellow iron oxide.
Ocean gray	36176	Titanium dioxide, carbon or lampblack, milori blue.
Blue gray	36231	Titanium dioxide, carbon or lampblack, yellow iron oxide.
Black	37038	Black iron oxide, carbon or lampblack.
Magenta	1/ 27142	Quinacridone violet, quinacridone red, titanium dioxide.
Purple	37144	Thioindigoid maroon, titanium dioxide, dichloro-iso-dibenzanthrone violet.
Aluminum	1,2/ 17178	Aluminum pigment.
White	37875	Titanium dioxide.

1/ The gloss of color standard 26132, 27142, and 17178 should be disregarded.

2/ The aluminum enamel does not match 17178 but is a light neutral gray.

3.4 Quantitative requirements.

3.4.1 Specific quantitative requirements. Each color shall conform to its specific requirements in table II when tested as specified in 4.3.

TABLE II. Specific quantitative requirements

Color corresponding to table I	Solids, percent by weight of enamel			Pigment, percent by weight of total pigment		Pigment volume, percent of total solids volume	Contrast ratio
	Total solids	Pigment solids		Prime pigment 1/	Extender pigment		
	Min.	Min.	Max.	Min.	Max.	Max.	Min.
Brown	55	32	36	27(Fe_2O_3)	65	39	0.98
Red	50	24	28	--	70	39	.92
Light red	52	30	34	15(TiO_2)	65	42	.96
Orange	55	36	40	--	55	42	.86
Yellow	55	34	38	37($PbCrO_4$)	55	42	.95
Olive drab	55	33	37	2/ 24(Fe_2O_3)	65	39	.98
Green	55	33	37	--	65	39	.98
Light green	55	36	40	37(TiO_2)	55	45	.98
Medium blue	52	30	34	24(TiO_2)	65	39	.98
Light blue	55	34	38	24(TiO_2)	65	42	.98
Slate	55	34	38	35(TiO_2)	55	42	.98
Ocean gray	55	32	36	30(TiO_2)	65	39	.98
Blue gray	55	34	38	37(TiO_2)	55	42	.98
Black	52	34	38	15(Fe_3O_4)	83	39	.98
Magenta	52	30	34	26(TiO_2)	60	39	.93
Purple	52	32	36	24(TiO_2)	65	39	.98
Aluminum	50	28	32	--	83	37	.98
White	55	34	38	47(TiO_2)	50	42	.92

1/ On analysis compute prime pigment as indicated in parenthesis.

2/ Lead chromate ($PbCrO_4$) may be substituted on an equal weight basis.

3.4.2 General quantitative requirements. The enamel tested as in 4.3 shall comply with the requirements of table III.

TABLE III. General quantitative requirements

Characteristics	Requirements	
	Minimum	Maximum
Vehicle solids, percent by weight of enamel (except red No. 31136)	17	--
Vehicle solids, percent by weight of red No. 31136	22	--
Phthalic anhydride, percent by weight of vehicle solids	18	26
Rosin and rosin derivatives	Negative	
Phenolic resin	Negative	
Water, percent by weight of enamel	--	1.0
Coarse particles and skins, percent by weight of pigment	--	1.0
Viscosity:		
Package, Krebs Stormer shearing rate - 200 r.p.m.:		
Grams	125	175
Equivalent Krebs' Units (K.U.)	67	77
Reduced, No. 4 Ford cup, seconds	15	25
Fineness of grind	5	--
Specular gloss	2	8
Directional reflectance, white only, percent	83	--
Drying time:		
Set to touch, minutes	3	6
Dry hard, minutes	--	10
After tack free, minutes	--	15
Dry through, minutes	--	20
Full hardness, hours	--	72

3.5 Qualitative requirements.

3.5.1 Condition in container. The enamel, tested as in 4.3.11, shall be free from grit, seeds, skins, lumps, or livering in a freshly opened full container and shall show no more pigment settling or caking than can be easily and completely reincorporated to a smooth homogeneous state.

3.5.2 Storage stability.

3.5.2.1 Partially full container. The enamel shall show no skinning when tested as in 4.3.12.1 and, after aging as specified in 4.3.12.1 the enamel shall show no livering, curdling, tough gummy sediment, nor hard caking. It shall mix readily to a smooth homogeneous state, and any skin formed shall be continuous and easily removed.

3.5.2.2 Full container. The enamel shall show no skinning, livering, curdling, hard caking, nor tough gummy sediment when tested as in 4.3.12.2. It shall remix readily to a smooth homogeneous state, shall have a maximum viscosity of 89 Krebs' Units and shall meet all other requirements of this specification.

3.5.3 Dilution stability. When tested as in 4.3.13, the enamel shall remain stable and uniform showing no precipitation, curdling, or separation. Slight pigment settling shall be permitted.

3.5.4 Suspension properties. The enamel shall completely redisperse to a smooth homogeneous state when tested as in 4.3.14.

3.5.5 Brushing properties. The enamel, tested as in 4.3.15, shall brush satisfactorily in all respects and shall dry to a smooth, uniform film free from seeds, runs, sags, or streaks.

3.5.6 Dipping properties. When tested as in 4.3.16, the enamel shall show satisfactory dipping properties and shall present a smooth appearance, free from sagging, running, or excessive silking.

3.5.7 Spraying properties. The enamel, tested as in 4.3.17, shall spray satisfactorily in all respects and shall show no running, sagging, streaking, or blushing. The dried film shall show no dusting, mottling, or color separation, and shall present a smooth lustreless finish free from seeds.

3.5.8 Flexibility. A film of enamel tested as in 4.3.18 shall withstand bending without cracking or flaking.

3.5.9 Knife test. A film of enamel tested as in 4.3.19 shall adhere tightly and not flake, crack, or powder from the metal. The cut shall show beveled edges.

3.5.10 Adhesion. A film of enamel tested as in 4.3.20 shall show no removal of the coating by the adhesive tape beyond one-sixteenth inch on either side of the score line.

3.5.11 Water resistance. A film of enamel tested as in 4.3.21 shall show no wrinkling or blistering immediately after removal of the panel from the water. The enamel shall be no more than slightly affected when examined 2 hours after removal. After 24 hours air drying the portion of the panel which was immersed shall be almost indistinguishable with regard to hardness, color and gloss from a panel prepared at the same time but not immersed.

3.5.12 Recoating. A film of enamel tested as in 4.3.22 shall not blister, wrinkle, or show other evidence of lifting. With the exception of red (color number 31136), the film shall contain no bleeding pigments which will discolor the white enamel.

3.5.13 Salt spray resistance. A film of enamel tested as in 4.3.23 and examined immediately after removal from the test shall show no rust creepage or undercutting beyond one-eighth inch from the score mark. At all other points of the panel there shall be no more than a trace of rusting (No. 9-1, method 6451 of Fed. Test Method Std. No. 141) and no more than 5 scattered blisters, none larger than 1 mm. in diameter. After removal of the enamel the surface of the steel shall show no more than a trace of rusting, pitting, or corrosion.

3.5.14 Accelerated weathering. A film of enamel tested as in 4.3.24 shall show no more than slight chalking (No. 8, method 6411 of Fed. Test Method Std. No. 141) and a color change equivalent to a lightness difference estimate not exceeding 4 units.

3.5.15 Weather resistance. A film of enamel prepared and exposed as in 4.3.25 shall show no checking, cracking, or appreciable film deterioration. There shall be no more than moderate chalking (No. 4, method 6411 of Fed. Test Method Std. No. 141) of colors light blue, medium blue, slate, blue gray, ocean gray, white, purple, magenta, light green, light red and no more than light chalking (No. 6, method 6411 of Fed. Test Method Std. No. 141) of all other colors. 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. On removal of the enamel, the surface of the steel shall show no more than a trace of rusting, pitting, or corrosion (No. 9-1, method 6451 of Fed. Test Method Std. No. 141). Rust creepage shall not extend beyond one-eighth inch from the score mark.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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 the 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.

(b) Acceptance of individual lots.

(c) Acceptance for use as component on end item.

4.2.1 Qualification tests. The qualification tests shall consist of tests for all requirements specified in section 3 (see 6.4).

4.2.2 Acceptance tests. Acceptance tests for acceptance of individual lots shall consist of tests specified in section 3 with the exception of storage stability (see 3.5.2.2 and 4.3.12.2) and weather resistance (see 3.5.15 and 4.3.25).

4.2.3 When approved by the cognizant activity, acceptance of lots for use as component on an end item shall be based on conformance with specified requirements for the following characteristics:

Phthalic anhydride
Gloss
Fineness of grind
Flexibility
Knife test
Water resistance

4.3 Test method.

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.

4.3.2 The following tests shall be conducted in accordance with Fed. Test Method Std. No. 141 and as hereinafter specified.

TABLE IV. Index

Test	Test method		Paragraph of this specification giving requirements
	Applicable method in Fed. Test Method Std. No. 141	Paragraph of this specification giving further reference	
Isolation of vehicle (super centrifuge)	4032	--	--
Phthalic anhydride	7021	--	Table III
Rosin in isolated vehicle	5031	--	Table III
Phenolic resin	5141	--	Table III
Benzol	5091 or 7360	--	3.3.1
Methanol	5133	--	3.3.1
Chlorinated solvents	5132	--	3.3.1
Aromatic hydrocarbon	--	4.3.3.2	3.3.1.2
Olefinic and cyclo-olefinic compounds	--	4.3.3.3	3.3.1.2
Ketones	--	4.3.3.4	3.3.1.2
Total solids	4041	--	Table II
Pigment solids	4022	--	Table II
Pigment analysis	4021	4.3.4	Table II
Fe_2O_3 - Iron oxide	7141	4.3.4.1	Table II
Fe_3O_4 - Iron oxide	7141	4.3.4.2	Table II
TiO_2 - Titanium dioxide	7083	4.3.4.3	Table II
$PbCrO_4$ - Lead	7131	4.3.4.4	Table II
Other pigments	--	4.3.4.5	Table I
Extender pigment, total	5271	4.3.5.1	Table II
Extender pigment analysis	7281	4.3.5.2	3.3.2
Pigment volume	4312	--	Table II
Hiding power (contrast ratio)	4122	4.3.6	Table II
Vehicle solids	4041	--	Table III
Water	4082	--	Table III
Coarse particles and skins	4092	--	Table III
Viscosity:			
Package	4281	4.3.7.1	Table III
Reduced	4282	4.3.7.2	Table III
Fineness of grind	4411	--	Table III
Specular gloss, 60°	6101	4.3.8	Table III
Directional reflectance	6121	--	Table III
Drying time:	4061	4.3.9	Table III
Set to touch	4061	--	Table III
Dry hard	4061	--	Table III
Free from after tack	4061	--	Table III
Dry through	4061	4.3.9.1	Table III
Full hardness	--	4.3.9.2	Table III
Color	4250	4.3.10	3.2
Condition in container	3011	4.3.11	3.5.1
Storage stability	--	4.3.12	3.5.2
Partially full container	3021	4.3.12.1	3.5.2.1
Full container	3022	4.3.12.2	3.5.2.2
Dilution stability	--	4.3.13	3.5.3

TABLE IV. Index (CONTINUED)

Test	Test method		Paragraph of this specification giving requirements
	Applicable method in Fed. Test Method Std. No. 141	Paragraph of this specification giving further reference	
Suspension properties	--	4.3.14	3.5.4
Brushing properties	4321, 2141	4.3.15	3.5.5
Dipping properties	4341, 2121	4.3.16	3.5.6
Spraying properties	4331, 2131	4.3.17	3.5.7
Flexibility	6221	4.3.18	3.5.8
Knife test	6304	4.3.19	3.5.9
Adhesion	--	4.3.20	3.5.10
Water resistance	6011	4.3.21	3.5.11
Recoating	--	4.3.22	3.5.12
Salt spray resistance	6061, 2011	4.3.23	3.5.13
Accelerated weathering	6152, 6122	4.3.24	3.5.14
Weather resistance	--	4.3.25	3.5.15

4.3.3 Solvent analysis for composition L.

4.3.3.1 Separation of volatile portion. Pour about 15 grams of the enamel into a 50 ml. distilling flask. Add 10 ml. of tricresyl phosphate and several anti-bumping stones or Berl saddles. Fit a release valve into the mouth of the flask and attach a delivery tube to the side arm, extending into a receiver. The receiver consists of a test tube (20 x 150 mm) with side arm for attaching to a vacuum pump. The glass delivery tube should reach 1-1/2 inches from the bottom of the tube. Immerse the receiver in a dry ice-acetone bath. Preheat a silicone oil bath to 180°C. Raise the oil bath until the oil reaches the sample level. Reduce the pressure slowly to 10 mm. of mercury. After all solvent has distilled, carefully release the vacuum using the valve that is connected to the distilling flask. Reserve the collected distillate for the aromatic solvent determination and the test for ketone, olefinic and cyclo-olefinic compounds.

4.3.3.2 Determination of aromatic hydrocarbons.

Apparatus: A gas chromatograph equipped with a thermal conductivity detector.

Column Preparation: Two lengths of 1/4-inch copper tubing, 6-ft. and 18-ft. long, are packed with 35% N,N-Bis(2-cyanoethyl) formamide on 60- to 80- mesh Chromosorb P.

Operating Conditions:	6-ft.	18-ft.
Detector cell temperature, °C.	300	300
Detector cell current, ma.	150	150
Injection port temperature, °C.	300	300
Helium flow at exit, cc/minute	175	110
Column temperature, °C.	125	70

4.3.3.2.1 Aromatic and oxygenated solvents - procedure A. Install the 6-ft. column and follow the operating conditions described above. Inject about 3 microliters of the isolated distillate and scan the chromatogram. The aliphatic solvents will emerge within 1 minute and the complete chromatogram should develop in about 5 minutes. From the position of the peaks observed on the chromatogram, select an internal standard that will be free of interference, such as cyclopentanol or cyclohexanol. Add 0.6 ml. of internal standard to 3 ml. of the distillate, analyze according to the above procedure. Peaks emerging after 1 minute are aromatic solvents along with any oxygenated solvents that may be present. Calculate the percent of aromatic and oxygenated solvents as follows:

$$\% \text{ aromatic and oxygenated solvents, v/v} = \frac{20^{*} \times A}{1.02^{**} \times B}$$

where, A = area of aromatic and oxygenated solvents
B = area of internal standard
* = is percent of internal standard added
** = is correction factor if cyclopentanol is used. If another internal standard is used, calibrate to determine the correction factor.

NOTE: If the above determination exceeds 8 percent, continue with the following procedure:

4.3.3.2.2 Total aromatic content - procedure B. Place 5 ml. of the distillate in a 10-ml. glass stoppered graduate. Add 5 ml. of 85 percent sulfuric acid slowly while the graduate is being cooled with tap water. After the acid has been added, shake vigorously for 2 minutes then allow the layers to separate. Remove as much of the top layer as possible and wash with distilled water. Carefully pipet 3 ml. of the washed solvent into a small flask followed by 0.6 ml. of the internal standard. Mix and analyze according to procedure A. Calculate the percent of aromatics after acid treatment in the same manner as in procedure A and the percent of total aromatic solvents as follows:

$$\% \text{ total aromatic solvents, v/v} = \frac{B \times (100 - A)}{100 - B}$$

where, A = percent of aromatic and oxygenated solvents from procedure A.
B = percent of aromatic solvents after acid treatment.

NOTE: If the total aromatic content of the solvent is between 8 percent and 20 percent continue with the following procedure:

4.3.3.2.3 Toluene and ethylbenzene - procedure C. Install the 18-ft. column and follow the operating conditions described for that column. Add 0.3 ml. of high purity benzene to the 3 ml. sample used in procedure A. If the results of procedures A and B indicated the presence of oxygenated solvents, treat this sample with 85 percent sulfuric acid (use 3 ml. acid) as described in procedure B. Inject about 3 microliters of sample and allow the chromatograph to develop until all of the xylene isomers appear. Purge the column by raising the column temperature to 120°C. After the high boiling materials emerge reset the column temperature to 100°C. Calculate the percent of toluene and ethylbenzene as follows:

$$\% \text{ toluene, v/v} = \frac{(\text{area of toluene peak})(1.017)^{*}\ (10)^{**}}{(\text{area of benzene peak})}$$

$$\% \text{ ethylbenzene, v/v} = \frac{(\text{area of ethylbenzene peak})(1.054)^{*}\ (10)^{**}}{(\text{area of benzene peak})}$$

where, * is the correction factor for the detector response.
** is the percentage of internal standard added.

NOTE: Sensitivity of the instrument should be adjusted to keep peaks from running off the scale. Appropriate corrections must be made for changes in sensitivity when computing the peak areas.

4.3.3.3 Test for olefinic or cyclo-olefinic compounds. Take 2 test tubes and place 2 drops of the distillate in each. Dissolve the first sample in 1 ml. of carbon tetrachloride and add 1 drop of 1 percent bromine in carbon tetrachloride. Shake and allow to set for 5 minutes. A positive test is indicated by the complete absence of yellow color when observed against a white background. Dissolve the second sample in 1 ml. of acetone and add 1 drop of 1 percent permanganate solution (1 gram of potassium permanaganate crystals in 95 mls. of acetone and 5 mls. of water). Shake and allow to set for 2 minutes. A positive test is indicated by the decolorization of the purple solution. The solvent is considered to fail the test for olefinic and cyclo-olefinic compounds if either of the above tests is positive (see 3.3.1.2 and 6.3).

4.3.3.4 Test for ketones.

4.3.3.4.1 Reagent. Two grams of 2,4-dinitrophenylhydrazine + 4 mls. of concentrated sulfuric acid + 30 mls. methanol (add slowly) + 10 mls. water.

4.3.3.4.2 Procedure. Pipette 1 ml. of reagent into a 20 x 170 mm. test tube. Add 10 drops of distillate (see 4.3.3.1) and shake for 30 seconds. A yellow precipitate or cloud in the reagent layer indicates the presence of ketones. Run a blank using one milliliter of reagent and 10 drops of mineral spirits.

4.3.4 Analysis of pigment. Extract the pigment as in method 4021 of Fed. Test Method Std. No. 141 using extraction mixture C.

4.3.4.1 Iron oxide (Fe_2O_3) content. Determine the iron oxide (Fe_2O_3) content on the extracted pigment in accordance with method 7141 of Fed. Test Method Std. No. 141.

4.3.4.2 Iron oxide (Fe_3O_4) content. Determine the iron oxide (Fe_3O_4) content on the extracted pigment in accordance with method 7141 of Fed. Test Method Std. No. 141 and calculate the total iron to Fe_3O_4.

4.3.4.3 Titanium dioxide (TiO_2) content. Determine the titanium dioxide (TiO_2) content on the extracted pigment in accordance with method 7083 of Fed. Test Method Std. No. 141.

4.3.4.4 Lead chromate ($PbCrO_4$) content. Determine the lead chromate ($PbCrO_4$) content on the extracted pigment in accordance with method 7131 of Fed. Test Method Std. No. 141.

4.3.4.5 Other permissible pigments. Make appropriate qualitative and quantitative tests on the extracted pigment to determine if permissible pigments were used in formulating the different colors of enamel.

4.3.5 Extender pigment.

4.3.5.1 Total extender pigment content. Determine matter insoluble in acid in the extracted pigment by method 5271 of Fed. Test Method Std. No. 141.

4.3.5.2 Extender pigment analysis. Determine barium sulfate, siliceous material, and calcium (sulfate or carbonate) by the applicable portions of method 7281 of Fed. Test Method Std. No. 141.

4.3.6 Hiding power (contrast ratio). Determine the contrast ratio in accordance with method 4122 of Fed. Test Method Std. No. 141. For red (31136), orange (32246), yellow (33538) and white (37875) use a film applicator that will deposit a 3 inch wide film with a dry film thickness of 0.0015 inch maximum and for all other colors a dry film thickness of 0.0010 inch maximum. Air dry for 72 hours. Determine the reflectance and verify the film thickness in the area in which the reflectance was measured. Calculate the contrast ratio and check for compliance with table II.

4.3.7 Viscosity.

4.3.7.1 Package. Proceed as in method 4281 of Fed. Test Method Std. No. 141 except that the method of mixing shall be to agitate the can for 3 minutes on a paint shaker[1/].

4.3.7.2 Reduced viscosity. Reduce 3 parts by volume of enamel with one part by volume of thinner conforming to TT-T-306 (except that the thinner used with composition L shall conform to table V) and determine viscosity as in method 4282 of Fed. Test Method Std. No. 141. Check for compliance with table III.

TABLE V - Thinner for composition L

Ingredient	Percent by weight
VMP Naphtha (8% max. aromatic)	65
n-Butyl alcohol	20
Toluene	15

4.3.8 60° specular gloss. Draw down the package material using a 0.002 inch (0.004 inch gap clearance) film applicator. Measure the gloss as specified in method 6101 of Fed. Test Method Std. No. 141.

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, N.J.

4.3.9 Drying time. Determine drying time in accordance with method 4061 of Fed. Test Method Std. No. 141 under referee conditions, except that the enamel shall be drawn down with a 0.002 inch (0.004 inch gap clearance) film applicator.

4.3.9.1 Dry through. Determine dry through in accordance with method 4061 except the enamel shall be drawn down with a 0.002 inch (0.004 inch gap clearance) film applicator on a 4 by 12 inch steel panel that has been phosphoric acid etched as in method 2011, procedure B of Fed. Test Method Std. No. 141.

4.3.9.2 Full hardness. Determine full hardness on a panel prepared as in 4.3.9.1. The film shall be considered to have reached full hardness when it is very difficult to remove with a knife blade.

4.3.10 Color. In accordance with method 4250 of Fed. Test Method Std. No. 141, compare the color with the film of enamel on the white carrara glass panel prepared for the hiding power test and observe for compliance with 3.2.

4.3.11 Condition in container. Determine package condition for acceptance testing in accordance with method 3011 of Fed. Test Method Std. No. 141. For qualification testing determine pigment settling or caking as follows: Proceed as in method 3011 of Fed. Test Method Std. No. 141, but do not stir. Reseal and then agitate the can for 3 minutes on a paint shaker. On re-examination of the contents, the disclosure of any gel bodies or undispersed pigment indicates unsatisfactory settling properties. Observe for compliance with 3.5.1.

4.3.12 Storage stability.

4.3.12.1 Partially full container. Determine 48 hour skinning in accordance with method 3021 of Fed. Test Method Std. No. 141 and observe for compliance with 3.5.2.1. Reseal and age for 7 days at 60°C. and observe for compliance with 3.5.2.1.

4.3.12.2 Full container. In accordance with method 3022 of Fed. Test Method Std. No. 141, allow a full standard quart can of the packaged enamel to stand undisturbed for 6 months and examine the contents. Evaluate pigment settling or caking as in 4.3.11, but agitate the can for 5 minutes on the paint shaker prior to re-examination. Determine viscosity and examine for compliance with 3.5.2.2.

4.3.13 Dilution stability. Reduce one volume of packaged enamel with one volume of thinner conforming to TT-T-306 by slowly adding the thinner to the enamel with constant stirring. For composition L the thinner shall conform to table V. Allow to stand 24 hours, thoroughly remix, and using a 0.0005 inch (0.0010-inch-gap clearance) film applicator, draw down a film of the mixture on clear plate glass. Before and after the film is dry, examine by transmitted light for compliance with 3.5.3.

4.3.14 Suspension properties. Reduce the enamel as in 4.3.7.2. Place 6 ounces of the reduced enamel in an 8-ounce glass jar. Allow the stoppered jar to remain undisturbed for 24 hours and then place the unopened jar on a paint shaker as in 4.3.11 and agitate the contents for 20 seconds. Re-examine the material for any evidence of nonhomogeneity or undispersed pigment. Observe for compliance with 3.5.4.

4.3.15 Brushing properties. Apply the enamel to a 4- by 12-inch steel panel, using a 1-1/2 inch brush, and observe for brushing properties in accordance with method 4321 of Fed. Test Method Std. No. 141 for compliance with 3.5.5.

4.3.16 Dipping properties. Reduce three parts by volume of enamel with one part by volume of thinner conforming to TT-T-306 except the thinner used with composition L shall conform to table V. Test the dipping properties of the thinned enamel in accordance with method 4341 of Fed. Test Method Std. No. 141 and observe for compliance with 3.5.6.

4.3.17 Spraying properties. Reduce the enamel as in 4.3.7.2. Spray on a steel panel to give a dry film thickness of 0.0009 to 0.0011 inch and observe for spraying properties in accordance with method 4331 of Fed. Test Method Std. No. 141 and observe for compliance with 3.5.7. For referee test use automatic application per method 2131 of Fed. Test Method Std. No. 141.

4.3.18 Flexibility. Determine flexibility in accordance with method 6221 of Fed. Test Method Std. No. 141. Draw down a 2-inch wide film of enamel with suitable film applicator that will give a dry film thickness of 0.0009 to 0.0011 inch on a flat tin plate panel prepared in accordance with method 2012 of Fed. Test Method Std. No. 141 using the petroleum naphtha ethylene glycol monoethylether mixture. Allow the test panel to air dry 1/2 hour and then bake for 24 hours at 105° $\pm$ 2°C. (221° $\pm$ 4°F.). Condition the panel for 1/2 hour at 25° $\pm$ 1°C. Bend over a 1/4 inch mandrel and examine for compliance with 3.5.8.

4.3.19 Knife test. Perform the knife test in accordance with method 6304 of Fed. Test Method Std. No. 141 using a flat portion of the baked panel from the flexibility test. Observe for compliance with 3.5.9.

4.3.20 Adhesion, tape test.

4.3.20.1 Panel preparation. Using a 0.0020-inch (0.0040-inch gap clearance) film applicator, draw down a 2-inch wide film of the enamel on a steel panel, solvent cleaned and phosphoric acid etched as in procedure B, method 2011 of Fed. Test Method Std. No. 141.

4.3.20.2 Procedure. Air dry the specimen for 1 hour under referee conditions and then score a line through to the metal across the width of the film using a sharp pointed knife. The film shall then be taped perpendicular to and across the score line with waterproof, pressure-sensitive adhesive tape (3/4 inch wide) conforming to PPP-T-60, type IV. The tape shall be pressed in firm contact with the film and shall extend for approximately 1 inch on each side of the score line. All air bubbles shall be rolled out by firm pressure of the thumb. Allow approximately 10 seconds for the test area to return to room temperature. Grasp a free end of the tape, at a rapid speed, strip it from the specimen by pulling the tape back upon itself at an angle of 180°. Observe the specimen for compliance with 3.5.10.

4.3.21 Water resistance. Prepare two panels as in 4.3.20 and air dry for 72 hours. Coat all exposed, uncoated metal surfaces with wax or other suitable coating and immerse one of the panels for 18 hours in distilled water at 23° ± 1°C. (73.4° ± 2°F.) in accordance with method 6011 of Fed. Test Method Std. No. 141. At the end of the test period remove the panel from the water and inspect for compliance with 3.5.11.

4.3.22 Recoating. Prepare two panels as in 4.3.20 and air dry for 24 and 72 hours, respectively. At the end of its drying period immerse each panel to a depth of 2-1/2 inches in a white enamel conforming to this specification which has been reduced with one part by volume of thinner conforming to TT-T-306 for composition G and table V for composition L to four parts by volume of package material. At the end of 5 seconds remove the panel, dry in a vertical position, and examine for compliance with 3.5.12.

4.3.23 Salt spray resistance. Solvent clean three 4- by 12-inch steel panels in accordance with 2011 of Fed. Test Method Std. No. 141 and apply a phosphate coating conforming to TT-C-490, type I. Reduce the enamel as in 4.3.7.2 and spray the test panels to a uniform dry film thickness of 0.0009 to 0.0011 inch. Air dry for 72 hours, score, and expose to 5 percent salt spray for 48 hours as in method 6061 of Fed. Test Method Std. No. 141. Upon removal, wash the panels gently in running water not warmer than 100°F. until free from any visible salt deposits and examine immediately for compliance with 3.5.13. Strip the enamel film from the panels by means of lacquer thinner and inspect the steel for rust, pitting, or corrosion.

4.3.24 Accelerated weathering. Prepare a film of the enamel as in 4.3.18 and air dry for 72 hours. Measure the directional reflectance and expose the panel to accelerated weathering for 168 hours in accordance with method 6152 of Fed. Test Method Std. No. 141 using a twin arc apparatus. Examine the exposed panel for chalking by rubbing with a piece of velvet or cheesecloth wrapped around the finger. Using moderate pressure, draw the cloth across the width of the panel in two different directions. Measure the directional reflectance (method 6121) on an unrubbed area of the exposed panel and determine the amount of color change, expressed as lightness index difference (ΔL), using method 6122 of Fed. Test Method Std. No. 141. Check for compliance with 3.5.14.

4.3.25 Weather resistance. Prepare two scored test panels as in 4.3.23. Air dry for 72 hours and place on outdoor exposure for 18 months at an angle of 45° South in the climate of Washington, D. C. At the conclusion of the exposure period inspect the panels for compliance with 3.5.15. Determine chalking as in 4.3.24. Wash the panels with a warm soap solution using a soft sponge or cloth; rinse dry, and examine for color change. Completely strip the enamel from the panels by means of lacquer thinner and inspect the steel for rust, pitting or corrosion.

4.3.26 Packaging, packing, and marking. The enamel shall be inspected for compliance with the packaging, packing, and marking requirements of section 5.

5. PREPARATION FOR DELIVERY

5.1 Packaging, packing and marking. The enamel shall be packaged, packed, and marked in accordance with TT-P-143. The level of packaging shall be A, B or C, and the level of packing shall be A, B, or C, as specified (see 6.2). 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).

6. NOTES

6.1 Intended use. The enamel covered by this specification is intended for use as a finish coat on phosphated or primed metal surfaces and on ammunition components. IT IS NOT INTENDED for use where gasoline resistance is a prime requisite such as automotive equipment.

6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number, and date of this specification.

(b) Color and color number (see 3.2 and 6.5).

(c) Composition required.

(d) Size of container required (see section 5).

(e) Level of packaging and level of packing (see section 5).

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

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 the suppliers 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 U. S. Army Coating and Chemical Laboratory, Aberdeen Proving Ground, Maryland, and information pertaining to qualification of products may be obtained from that activity.

6.5 Color standards for olive drab number X-34087 should be obtained from Commanding Officer, U. S. Army Coating and Chemical Laboratory, Aberdeen Proving Ground, Maryland.

6.6 The olive drab enamel is contemplated to be comparable in performance to the following approximate composition by weight:

280	lbs.	Synthetic yellow orange iron oxide
13.5	lbs.	Carbon black
72.5	lbs.	Rutile titanium dioxide
2.5	lbs.	Synthetic medium red iron oxide
190	lbs.	Fibrous magnesium silicate
445	lbs.	Acicular talc
430	lbs.	Styrenated alkyd resin (R-T at 50 percent solids in xylol)
550	lbs.	Xylol
3	lbs.	Diethylamine

Grind 18 - 24 hours in a porcelain ball mill using a 2 - 1 ratio of porcelain balls by weight and reduce as follows:

755	lbs.	Styrenated alkyd resin (R-T at 50 percent solids in xylol)
155	lbs.	Xylol
3	lbs.	Cobalt naphthenate
3	lbs.	Antiskinning agent

At low viscosities the use of small amounts of suspension agents will improve settling properties.

6.6.1 The styrenated alkyd resins used in these formulations are copolymers of styrene and phthalic alkyd resins modified with drying vegetable oils. It has generally been found that the finished enamel must be finely ground in order to ensure adequate salt spray resistance and good ballistic performance when applied on ammunition.

6.6.2 Enamels of this type show some tendency to be thixotropic at higher viscosities. The use of a material such as diethylamine to the extent of 0.5 to 1.0 percent on the resin solids basis has been found to reduce this condition materially and improve the package stability.

6.7 Composition L enamels should be specified for use in areas with regulations controlling the emission of solvents into the atmosphere.

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

Custodians:
Army - MR
Navy - OS
Air Force - 84
Civil agency - GSA

Review activities:
Army - MD, MI, MR, MU, WC
Air Force - 84, 85
DSA - IS
Civil agencies - GSA

User activities:
Navy - OS

Preparing activity:
Army - MR

☆ U. S. GOVERNMENT PRINTING OFFICE : 1969 O - 342-510 (3412)

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SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity *(as indicated on reverse hereof)*.

SPECIFICATION

ORGANIZATION *(Of submitter)* | CITY AND STATE

CONTRACT NO. | QUANTITY OF ITEMS PROCURED | DOLLAR AMOUNT $

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO IF "YES", IN WHAT WAY?

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity)* | DATE

DD FORM 1 APR 63 1426

REPLACES NAVSHIPS FORM 4863, WHICH IS OBSOLETE

PLATE 1. 15419