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September 17, 1968
SUPERSEDING
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April 29, 1966

FEDERAL SPECIFICATION

ENAMEL, SEMIGLOSS, RUST-INHIBITING

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

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers four types of semigloss rust-inhibiting enamel for use on metal as a one or two coat primer or finishing system. It provides for a formulation suitable for use under AIR POLLUTION REGULATIONS (see 6.9).

1.2 Classification.

1.2.1 Types. Rust-inhibiting enamel covered by this specification shall be a combination air drying and baking enamel of the following types, as specified:

Type I - Dip application.
Type II - Brush and spray application.
Type III - Roller coat application.
Type IV - Flash dry application.

When this specification is required without reference to type, type II shall be supplied. Types I, III, or IV shall be furnished only when specified in the contract or order (see 6.2).

1.2.2 Compositions. The enamels covered by this specification shall be of the following compositions, as specified:

Composition G - General use.
Composition L - Limited use (see 6.9).

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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-P-143 - Paint, Varnish, Lacquer, and Related Materials; Packaging, Packing, and Marking of.
TT-R-266 - Resin, Alkyd; Solutions.
TT-S-735 - Standard Test Fluids; Hydrocarbon.
TT-T-291 - Thinner; Paint, Volatile Spirits (Petroleum-Spirits).
TT-T-306 - Thinner, Synthetic Resin Enamel.

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 product specifications required by activities outside the Federal Government for bidding purposes are available without charge 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

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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 4.2 and 6.3). Any change in formulation of the qualified product will necessitate its requalification. The materials supplied under the contract shall be identical, within manufacturing tolerances, to the product receiving qualification.

3.2 Color. The color shall be either olive drab, olive green, Marine Corps green, or natural color with no tinting, as specified in the contract or order. Olive drab shall be furnished when color is not specified in the contract or order (see 6.2). When tested as in 4.3.10, the olive drab shall acceptably match color X24087; olive green shall acceptably match color 24064 of Fed. Std. No. 595; and Marine Corps green shall match Marine Corps green No. 23, semigloss (see 6.4).

3.3 Composition.

3.3.1 Pigment. The pigment portion of the enamel shall consist of ingredients in the proportions by weight specified in table I (see 6.5). When the enamel is tested in accordance with section 4, the pigment analysis shall conform to the requirements of table III.

TABLE I. Pigment composition

Characteristics	Requirements	
	Minimum	Maximum
C.P. medium chrome yellow	36	--
Red lead (97 percent Pb_3O_4)	17	--
Zinc oxide	9	--
Channel type carbon black, tinting and siliceous extending pigments[1]	--	38

[1] In type IV enamel, barytes may be substituted for 50 percent by weight of the siliceous extending pigments.

3.3.2 Vehicle.

3.3.2.1 Types I, II, and III - composition G. The vehicle for types I, II, and III enamel shall conform to type III or IV of TT-R-266 or a blend thereof, together with necessary additions of suitable aliphatic and aromatic solvents and driers. Small amounts of antiskinning agents, wetting agents, stabilizers, and antidrier adsorption agents may be added at the discretion of the manufacturer.

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3.3.2.2 Types I, II, and III - composition L. The vehicle shall be the same as 3.3.2.1 except the volatile solvents used shall conform to the following requirements by volume when tested as in 4.3.4.

(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 6.10).

(d) Ketones: negative.

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

3.3.2.3 Type IV - composition G. The vehicle for type IV enamel shall be a phenol modified alkyd resin conforming to the physical and chemical requirements specified in table II, together with the necessary additions of suitable aromatic thinners and driers. Small amounts of antiskinning agents, wetting agents, antidrier adsorption agents and stabilizers may be added at the discretion of the manufacturer.

3.3.2.4 Type IV - composition L. The vehicle shall be the same as 3.3.2.3 except the volatile solvents used shall conform to the requirements of 3.3.2.2.

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TABLE II. Physical and chemical requirements of type IV resin solution

Characteristics	Requirements	
	Minimum	Maximum
Phthalic anhydride, percent by weight of resin solids	39	--
Unsaponifiable 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-Holdt)	--	Y
Viscosity, reduced to 37.5 percent solids in xylene, at 25°C. (Gardner-Holdt)	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, grade 1, thinner	No clouding or precipitation	
Phenol test	Positive	
Rosin test	Negative	

3.3.2.5 Nitrogeneous resin modified. When specified, where improved hardness and baking properties are desired, a maximum of 20 percent of urea- or melamine-formaldehyde resin (on the vehicle solids basis) may be substituted for an equivalent weight of the alkyd resin in types I, II, and III enamel on approval by the purchaser. An enamel thus modified shall not be used as an air drying type finish (see 6.6).

3.4 Quantitative requirements. The enamel tested as in 4.3 shall meet the requirements specified in table III.

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TABLE III. Quantitative requirements

Characteristics	Requirements Minimum	Requirements Maximum
Total solids, percent by weight of enamel:		
Type I	75	--
Types II and III:		
Olive drab, olive green, and natural	65	--
Marine Corps green	60	--
Type IV:		
Olive drab, olive green, and natural	60	--
Marine Corps green	56	--
Pigment, percent by weight of enamel:		
Type I	50	55
Types II and III:		
Olive drab, olive green, and natural	40	45
Marine Corps green	35	40
Type IV:		
Olive drab, olive green, and natural	34	38
Marine Corps green	30	34
Vehicle solids, percent by weight of enamel:		
All types and colors	21	--
Phthalic anhydride, percent by weight of nonvolatile vehicles:		
Types I, II, and III	30	--
Type IV	38	--
Drying oil acids, percent by weight of nonvolatile vehicle:		
Types I, II, and III	45	55
Type IV	36	41
Unsaponifiable, percent:		
Types I, II, and III	--	1.0
Type IV	--	5.0
Rosin, on isolated vehicle	Negative	
Phenol, on isolated vehicle:		
Types I, II, and III	Negative	
Type IV	Positive	
Pigment, percent by weight of total pigment:		
Total lead as lead sulfate ($PbSO_4$)	52	--
Total chromium as lead chromate ($PbCrO_4$)	32	--
Red lead as (Pb_3O_4)	14	--
Zinc oxide as ZnO	8	--
Calcium carbonate ($CaCO_3$)	--	4
Water, percent by weight of enamel	--	1.0
Coarse particles and skins (retained on No. 325 sieve), percent by weight of pigment	--	0.5

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TABLE III. Quantitative requirements (con.)

Characteristics	Requirements	
	Minimum	Maximum
Viscosity (package), types II and IV, No. 4 Ford cup, seconds	75	200
Viscosity (reduced), types II and IV Ford cup, seconds	15	25
Weight per gallon, pounds:		
Type I	12	--
Types II and III, natural, olive drab, and olive green	11	--
Types II and III, Marine Corps green	10.5	--
Type IV natural, olive drab, and olive green	10.7	--
Type IV Marine Corps green	10.2	--
Flash point, Pensky-Martens, type IV, composition G, °F.	60	--
Drying time:		
Air-drying:		
Set to touch:		
Types I, II, and III, hours	--	3
Type IV, minutes	4	10
Dry through, hours:		
Types I, II, and III	--	16
Type IV	--	8
Full hardness, hours:		
Types I, II, and III	--	72
Type IV	--	36
Baking:		
Dry through at 250°F. or equivalent heat treatment, minutes	--	45
Gloss:		
Sixty degrees specular:		
Type I	15	25
Types II, III, and IV	20	45
Fineness of grind	6	--
Hiding power (contrast ratio):		
Olive drab, olive green, Marine Corps green	0.98	--
Natural	0.85	--

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3.5 Qualitative requirements.

3.5.1 Silk screen stencil resistance - type IV only. When tested as in 4.3.11 the enameled panel shall not adhere to the screen when the latter is lifted. The enamel shall not be marred by the stenciling operation and shall be satisfactory for moderate handling without damage to the paint film.

3.5.2 Condition in container. The enamel, tested as in 4.3.12, shall be free from grit, seeds, skins, abnormal thickening, or livering in a freshly opened full can, and shall show no more pigment settling or caking than can be completely reincorporated to a smooth homogeneous state by three minutes agitation on a paint shaker.

3.5.3 Storage stability.

3.5.3.1 Partially full container. The enamel shall show no skinning when tested as in 4.3.13.1. After aging as in 4.3.13.1, the enamel shall show no livering, curdling, hard caking, or tough gummy sediment. It shall mix readily to a smooth homogeneous state, and any skin formed shall be continuous and easily removed.

3.5.3.2 Full container. The enamel, tested as in 4.3.13.2, shall show no skinning, livering, hard dry caking, or tough gummy sediment. The enamel shall remix readily to a smooth homogeneous state, shall have a maximum viscosity of 300 seconds (No. 4 Ford cup), and meet all other requirements of the specification.

3.5.4 Dilution stability. When tested as in 4.3.14, the enamel shall show no signs of precipitation or curdling and shall remain stable and uniform. A flow-out on glass shall show no seeds or clear areas lacking color. Slight pigment settling shall be permitted.

3.5.5 Application properties.

3.5.5.1 Brushing properties. Types II and IV enamel, tested as in 4.3.15.1, shall have satisfactory brushing properties and shall dry to a smooth uniform film free from grits, seeds, streaks, and flooding. Type IV may show a slight trace of brush marks.

3.5.5.2 Spraying properties. Types II and IV enamel, tested as in 4.3.15.2, shall have satisfactory spraying properties and shall dry to a smooth uniform film free from grit, seeds, running, sagging, dusting, floating, wrinkling, streaking, pinholing, or cratering.

3.5.5.3 Dipping properties. Types I and IV enamel, tested as in 4.3.15.3, shall show satisfactory dipping properties and shall dry to a smooth uniform film free from drips, runs, fatty edges, and nonuniformity of color.

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3.5.5.4 Roller coating properties. Type III enamel, tested as in 4.3.15.4, shall be satisfactory for roller coat application, shall show good leveling and flow characteristics, and shall dry to a smooth uniform film with a minimum of roller marks or color flotation.

3.5.6 Odor. The odor of the wet enamel and of the film at any interval of drying, shall not be obnoxious when tested as in 4.3.16.

3.5.7 Flexibility. A film of the enamel shall show no cracking, flaking, or loss of adhesion, when tested as in 4.3.17.

3.5.8 Knife test. A film of the enamel, tested as in 4.3.18, shall adhere tightly and not flake, crack, or powder from the metal. The cut shall show beveled edges.

3.5.9 Recoating. A film of the enamel, tested as in 4.3.19, shall produce no film irregularity except that a slight loss in gloss will be permitted.

3.5.10 Water resistance. A film of enamel, tested as in 4.3.20, shall show no wrinkling or blistering immediately upon removal from the water. The enamel shall be only slightly affected with regard to hardness and adhesion when observed 2 hours after removal from the water. After 24 hours air drying, the portion of the panel which was immersed shall be almost indistinguishable with regard to hardness and adhesion from the portion which was not immersed. It shall show a color change equivalent to a lightness index difference not exceeding 2 units or a loss of gloss exceeding 5 units.

3.5.11 Hydrocarbon-fluid resistance. A film of enamel, tested as in 4.3.21, shall show no wrinkling or blistering immediately upon removal from the fluid. The enamel shall be no more than slightly affected when observed 2 hours after removal. After 24 hours air drying, the portion of the enamel which was immersed shall be almost indistinguishable with regard to hardness and adhesion from a film of enamel prepared at the same time but not immersed. It shall show a color change equivalent to a lightness index difference not exceeding 2 units or a loss of gloss exceeding 5 units.

3.5.12 Salt spray resistance. A film of enamel, tested as in 4.3.22 and examined immediately after removal from the test, shall show no rust creepage or undercutting beyond one-eighth inch from the score. At all other points, there shall be no rusting, wrinkling, or blistering. After 24 hours air drying, the enamel shall be no softer than an unexposed film of the enamel prepared in the same manner. On removal of the coating, 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).

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3.5.13 Accelerated weathering. A film of the enamel, tested as in 4.3.23, shall show no more than a slight chalking (No. 8, method 6411 of Fed. Test Method Std. No. 141), and a color change equivalent to a lightness index difference not exceeding plus 6 units. Loss of gloss shall not exceed 65 percent of the original gloss of the test panel.

3.5.14 Weather resistance. A film of the enamel, tested as in 4.3.24, shall show no cracking, checking, flaking, or loss of adhesion, and no more than slight chalking (No. 8, method 6411 of Fed. Test Method Std. No. 141), and a color change equivalent to a lightness index difference not exceeding plus 6 units. On removal of the coating, 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) and there shall be no rust creepage beyond 1/8 inch on either side of the score.

3.5.15 Toxicity. The product shall contain no benzol (benzene) or chlorinated solvents (see 4.3.25).

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 6.3).

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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 3.5.3.2 and 4.3.13.2) and weather resistance (see 3.5.14 and 4.3.24).

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

Phthalic anhydride
Drying oil acids
Total lead
Total chromium
Red lead
Zinc oxide
Calcium carbonate
Flexibility
Knife test
Water resistance
Hydrocarbon-fluid resistance
Salt spray resistance

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.

4.3.2 The following tests shall be conducted in accordance with Fed. Test Method Std. No. 141 and as hereinafter specified. Film tests on type III enamel and enamel approved by the purchaser to contain urea- or melamine-formaldehyde resin (see 3.3.2.5) shall be made after the coating has been air dried 5 to 10 minutes and then baked 45 minutes at 250°F., or as recommended by the manufacturer.

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TABLE IV. Index

Item	Test Method: Applicable method in Fed. Test Method Std. No. 141	Test Method: Section of this specification giving further reference	Section of this specification giving requirements
Color	4250	4.3.10	3.2
Aromatic hydrocarbon	--	4.3.4.2	3.3.2.2
Olefinic and cyclo-olefinic compounds	--	4.3.4.3	3.3.2.2
Ketones	--	4.3.4.4	3.3.3.2
Pigment analysis	--	4.3.5	Tables I, III
Extraction of pigment	4021	4.3.5.1	--
Total lead	--	4.3.5.2	Table III
Zinc oxide	7340	4.3.5.3	Tables I, III
Lead chromate	7131	4.3.5.4	Tables I, III
Red lead	7071	4.3.5.5	Tables I, III
Tinting and extending pigments	--	4.3.5.6	Table I
Carbonate and sulfate	--	4.3.5.6.1	Table III
Acid insoluble	--	4.3.5.6.2	Table I
Total solids	4041	--	Table III
Pigment solids	4022	--	Table III
Vehicle solids	4052	--	Table III
Unsaponifiable	--	4.3.3.1	Table III
Drying oil acids	--	4.3.3.2	Table III
Phthalic anhydride	--	4.3.3.3	Table III
Rosin	5031	--	Table III
Phenol	5141	--	Table III
Viscosity	4282	4.3.6	Table III
Weight per gallon	4184	--	Table III
Flash point	4293	--	Table III
Drying time	--	4.3.7	--
Set to touch	4061	--	Table III
Dry through	4061	--	Table III
Full hardness	--	4.3.7.1	Table III
Baking	4061	--	Table III
Gloss 60° specular	6101	4.3.8	Table III
Fineness of grind	4411	--	Table III
Hiding power (contrast ratio)	4122	4.3.9	Table III
Silk screen resistance	--	4.3.11	3.5.1
Condition in container	3011	4.3.12	3.5.2
Storage stability	--	--	3.5.3
Partially full container	3021	4.3.13.1	3.5.3.1
Full container	3022	4.3.13.2	3.5.3.2

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TABLE IV. Index (con.)

Item	Test Method: Applicable method in Fed. Test Method Std. No. 141	Test Method: Section of this specification giving further reference	Section of this specification giving requirements
Dilution stability	4203	4.3.14	3.5.4
Application properties	--	4.3.15	3.5.5
Brushing properties	4321, 2141	4.3.15.1	3.5.5.1
Spraying properties	4331, 2131	4.3.15.2	3.5.5.2
Dipping properties	4341, 2121	4.3.15.3	3.5.5.3
Roller coating properties	--	4.3.15.4	3.5.5.4
Odor	4401	4.3.16	3.5.6
Flexibility	6221	4.3.17	3.5.7
Knife test	6304	4.3.18	3.5.8
Recoating	--	4.3.19	3.5.9
Water resistance	6011	4.3.20	3.5.10
Hydrocarbon resistance	6011	4.3.21	3.5.11
Salt spray resistance	6061	4.3.22	3.5.12
Accelerated weathering	6152	4.3.23	3.5.13
Weather resistance	6160	4.3.24	3.5.14
Toxicity	--	4.3.25	3.5.15

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4.3.3 Analysis of vehicle.

4.3.3.1 Unsaponifiable. Weigh by difference, a sample of approximately 5 grams (g.) of the isolated vehicle into a 250 ml. Erlenmeyer flask with a standard 24/40 joint and dissolve in 10 ml. of benzene. Add 50 ml. of 95 percent ethyl alcohol, 5 ml. of 50 percent aqueous sodium hydroxide, and 5 ml. of water. Mix thoroughly, attach an air condenser, and reflux gently in a water bath for two hours. Cool, transfer to a 500 ml. separatory funnel, and dilute to 200 ml. with water. Wash the flask with 100 ml. of ethyl ether and transfer to the separatory funnel. Shake the funnel thoroughly and allow complete separation of liquid layers. Draw off the lower aqueous layer and set aside for oil acids determination. Wash the ether extract about 5 times with 20 ml. portions of water until neutral and add all the washings to the aqueous portion already collected. Filter the ether through a rapid filter paper that is damp with ether into a weighed 250 ml. beaker. Place a raised cover glass on the beaker and allow the ether to evaporate at room temperature (approximately 18 to 24 hours). Finally, dry the sample at 85°C. in a vacuum oven for one hour. Cool and weigh the unsaponifiable. Dissolve the unsaponifiable matter in 50 ml. of 95 percent ethyl alcohol, add a few drops of phenolphthalein and titrate with 0.1N sodium hydroxide. Calculate the percent unsaponifiable using the following formula:

$$\text{Percent unsaponifiable (corrected)} = \frac{[A - (B \times C \times 0.282)] \times 100}{S \times N}$$

Where, A = Weight of extracted unsaponifiable matter.
B = Ml. of NaOH used in the titration.
C = Normality of NaOH.
S = Weight of vehicle sample.
N = Vehicle nonvolatile fraction.

4.3.3.2 Drying oil acids. Place the water layer and washings collected in 4.3.3.1 from the unsaponifiable determination, in a separatory funnel and add concentrated hydrochloric acid in one ml. portions followed by swirling until a permanent cloud forms, then add 2 additional ml. Add 100 ml. chloroform and shake vigorously. Upon separation, draw off the lower chloroform layer into another separatory funnel and extract the aqueous layer once more with 50 ml. of chloroform. Combine the two chloroform extracts and transfer the aqueous layer to a liter volumetric flask to be retained for the phthalic anhydride determination. Wash the combined chloroform twice with 200 ml. of water and retain the water washings in the liter flask. Filter the chloroform, through rapid filter paper that is wet with chloroform, into a weighed 250 ml. beaker. Evaporate the solvent in a water bath at 55°C. with the aid of a gentle current of air, removing the beaker as soon as the solvents have evaporated. Dry the beaker, containing the oil acids, in a vacuum oven at 85°C. to constant weight, about 2 hours. Calculate the percent oil acids on the nonvolatile vehicle basis. If white crystals can be observed in the isolated fatty acids, they may be isophthalic acid and will cause a high oil acid yield. A correction for such interference can be made by redissolving the oil acids in benzene, filtering into a weighed beaker and redrying and calculating.

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4.3.3.3 Phthalic anhydride. Dilute the combined aqueous layer and washings retained from 4.3.3.2 to one liter with water. Withdraw a 2 ml. aliquot with a pipet and transfer to a 25 ml. volumetric flask and dilute to the mark with 0.1 N hydrochloric acid. Using a prism spectrophotometer suitable for the ultraviolet region and a slit width of 0.6 mm, determine the absorbance at 276 millimicrons with 0.1 N HCl in the reference cell. Apply cell corrections if necessary. If the absorbance falls outside the range of 0.25 to 0.50, withdraw another aliquot of appropriate size and obtain new absorbance readings. Calculate the concentration of phthalic anhydride in the aliquot as follows:

$$\text{Concentration (g. per liter)} = \frac{\text{Absorbance}}{8.77 \times \text{cell length in cm.}}$$

Calculate the percent of phthalic anhydride in the nonvolatile vehicle as follows:

$$\text{Percent phthalic anhydride} = \frac{1250 \times \text{concentration, g. per liter}}{\text{Nonvolatile sample weight}}$$

Note 1. The factor 1250 assumes the use of a 2 ml. aliquot; if larger or smaller aliquots are used, the calculation is adjusted accordingly.

4.3.4 Solvent analysis for composition L.

4.3.4.1 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.

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4.3.4.2 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

4.3.4.2.1 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%, continue with the following procedure:

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4.3.4.2.2 Total aromatic content - procedure B. Place 5 ml. of the distillate in a 10 ml. glass stoppered graduate. Add 5 ml. of 85% 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% and 20% continue with the following procedure:

4.3.4.2.3 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% 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 that 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.

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4.3.4.3 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% 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% permanganate solution (1 gram of potassium permanganate 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 3.3.2.2 and 6.10).

4.3.4.4 Test for ketones.

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

4.3.4.4.2 Procedure. Pipette 1 ml. of reagent into a 20 x 170 mm. test tube. Add 10 drops of distillate 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.

4.3.5 Pigment analysis.

4.3.5.1 Extraction of pigment. Extract the pigment as in method 4021 of Fed. Test Method Std. No. 141 using any suitable solvent or extraction mixture.

4.3.5.2 Total lead. Place 1 gram (g.) of the pigment in a 400 ml. beaker; moisten with a few drops of alcohol; add 25 ml. of concentrated hydrochloric acid; cover and boil for 5 to 10 minutes. Dilute to 100 ml. with hot water and boil again for 5 minutes; filter the hot solution and wash with boiling water until the washings are free from lead and chlorine. Add ammonium hydroxide to the filtrate until a faint precipitate appears; then add 5 ml. of concentrated hydrochloric acid; dilute to 500 ml; and pass into the clear solution a rapid current of hydrogen sulfide until all the lead is precipitated as lead sulfide. Let the precipitate settle; filter and wash with water containing a little hydrogen sulfide. Boil the filter paper and precipitate with diluted nitric acid (1:3) until all of the lead sulfide has dissolved; filter and wash thoroughly with hot water. To the filtrate add 10 ml. of sulfuric acid (1:1); evaporate until copious fumes of sulfuric acid are evolved; cool; add about 75 ml. of water and then 75 ml. of 95 percent ethyl alcohol. Let stand about 1 hour; filter on a Gooch crucible; wash with diluted alcohol; dry; ignite and weigh as lead sulfate ($PbSO_4$). Observe for compliance with table III.

4.3.5.3 Zinc oxide. Determine zinc oxide content on the extracted pigment in accordance with method 7340 of Fed. Test Method Std. No. 141 after checking for presence of zinc chromate as per 4.3.5.3.1. Check results for compliance with table III.

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4.3.5.3.1 Qualitative test for zinc chromate. Place 1 or 2 g. of pigment in a 100 ml. glass stoppered graduate. Add 50 ml. of a 10 percent aqueous ammonium chloride solution; stopper and shake vigorously for several minutes. Filter through a double thickness of the most retentive filter paper available and examine the filtrate for color. A colorless or extremely pale yellow filtrate will indicate the absence of zinc chromate and the analysis can proceed as in method 7340 of Fed. Test Method Std. No. 141. If zinc chromate is present, weigh one g. of the pigment accurately into a large centrifuge tube and wash repeatedly with 10 percent ammonium chloride solution until free of soluble chromate, as indicated by colorless extractions, then proceed with the quantitative analysis.

4.3.5.4 Lead chromate[1]. Determine lead chromate content on the extracted pigment in accordance with method 7131 of Fed. Test Method Std. No. 141 and check for compliance with table III.

4.3.5.5 Red lead[2,3]. Determine red lead content on the extracted pigment in accordance with method 7071 of Fed. Test Method Std. No. 141 and check for compliance with table III.

4.3.5.6 Tinting and extending pigments.

4.3.5.6.1 Test for carbonate and sulfate. Place 1 g. of the pigment in a porcelain dish, moisten with a few drops of alcohol, and add several drops of hydrochloric acid (1:1). Observe immediately for evidence of effervescence. The absence of effervescence indicates that no more than a trace of calcium carbonate is present, and its determination (see table III) may be omitted. If effervescence does occur, determine carbon dioxide on a 2 g. sample of the pigment as in method 7041 of Fed. Test Method Std. No. 141 (using method for determination of CO_2 in lead carbonate). The factor to convert CO_2 to $CaCO_3$ is 2.2742. Observe for compliance with table III. Test for acid soluble sulphate by heating the pigment-hydrochloric acid mixture on the steam bath for 15 minutes. Add 25 ml. of hot distilled water; filter through filter paper. Test some of the clear filtrate by heating to boiling and adding an excess of hot barium chloride solution, drop by drop. Set on the steam bath for about 5 minutes. The formation of an appreciable white precipitate in the hot solution indicates acid soluble sulfate (calcium sulfate, for example) which would be cause for rejection (see table I). A very small amount (coming from the chrome yellow) may be ignored. It should not exceed 1.0 percent by weight of the pigment.

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[1] If the qualitative test described in 4.3.5.3.1 indicates the presence of zinc chromate, wash the weighed pigment sample with 10 percent ammonium chloride solution until free of soluble chromate before proceeding with method 7131.

[2] If the qualitative test described in 4.3.5.3.1 indicates the presence of zinc chromate, wash the weighed pigment sample with 10 percent ammonium chloride solution until free of soluble chromate before proceeding with the determination of red lead content.

[3] This volumetric procedure must be conducted without interruption for reliable results.

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4.3.5.6.2 Acid insoluble matter. Place 1 g. of the pigment in a porcelain dish; moisten with a few drops of alcohol; add 20 ml. of concentrated hydrochloric acid; cover, and heat on a steam bath for 15 minutes. Remove cover and evaporate to dryness; moisten with hydrochloric acid; add 25 ml. of water; filter on a weighed Gooch or alundum crucible, wash thoroughly with hot water. Dry the crucible and contents at 105° to 110°C. for 2 hours. Cool; weigh; and calculate the percentage of acid insoluble matter against maximum limit for carbon black, tinting, and extending pigments.

4.3.6 Viscosity (reduced).

4.3.6.1 Type II. Reduce 4 parts by volume of enamel with one part by volume of thinner conforming to TT-T-291, grade 1 except that thinner used with composition L shall have a maximum of 8% aromatic content. Test as in method 4282 of Fed. Test Method Std. No. 141 and check for compliance with table III.

4.3.6.2 Type IV. Reduce 4 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 (Type IV)

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

4.3.7 Drying time. Using a 0.0015 inch film applicator (0.0030 inch gap clearance), draw down a 2 inch wide film of the enamel on a clean plate glass panel. Determine drying time in accordance with method 4061 of Fed. Test Method Std. No. 141 under referee conditions.

4.3.7.1 Full hardness. The film shall be considered to have reached full hardness when it is very difficult to remove with a knife blade.

4.3.8 Specular gloss. Draw down the packaged enamel using a 0.0015 inch (0.0030 inch gap clearance) film applicator. Test as in method 6101 of Fed. Test Method Std. No. 141 for compliance with table III.

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4.3.9 Hiding power (contrast ratio). Determine the contrast ratio in accordance with method 4122 of Fed. Test Method Std. No. 141. Use a film applicator that will deposit a 3-inch wide film with a dry film thickness of 0.0010 inch maximum and 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 III.

4.3.10 Color. In accordance with method 4250 of Fed. Test Method Std. No. 141 compare the specified 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 Silk screen stencil resistance - type IV only. Spray the enamel on a 4- by 12-inch solvent cleaned steel panel to deposit a dry film thickness of 0.0009 to 0.0011 inch. Air dry for 20 minutes under referee conditions and then stencil with a silk screen under moderate pressure of the squeegee using one back and forth motion along the length of the panel. Raise the screen and examine for compliance with 3.5.1.

4.3.12 Condition in container. Determine packaged condition on acceptance testing in accordance with method 3011 of Fed. Test Method Std. No. 141. On qualification testing, determine pigment settling or caking by proceeding as in method 3011, but do not stir. Reseal and agitate the can for 3 minutes on a paint shaker[4]. On re-examination of the contents, the disclosure of any gel bodies or undispersed pigment indicates unsatisfactory settling properties. Observe for compliance with 3.5.2.

4.3.13 Storage stability.

4.3.13.1 Partially full container. Determine 48 hour skinning in accordance with 3021 of Fed. Test Method Std. No. 141. Reseal and age 7 days at 60°C. and observe for compliance with 3.5.3.1.

4.3.13.2 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 six months and then examine the contents. Evaluate pigment settling or caking as in 4.3.12, but agitate the can for 5 minutes on the paint shaker prior to re-examination. Determine viscosity and make other applicable tests to determine compliance with 3.5.3.2.

4.3.14 Dilution stability.

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[4] 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.

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4.3.14.1 Types I, II, and III. Reduce 1 part by volume of enamel with one part by volume of mineral spirits conforming to TT-T-291, grade 1 except that the thinner used with composition L shall have a maximum of 8% aromatic content. Allow to stand 24 hours and observe for incompatibility in accordance with method 4203 of Fed. Test Method Std. No. 141. Then flow the enamel over a clear plate glass and examine in both the wet and dry condition. Examine for compliance with 3.5.4.

4.3.14.2 Type IV. Prepare and test the enamel as in 4.3.14.1, except using thinner conforming to TT-T-306 in place of the mineral spirits for composition G and thinner conforming to table V for composition L. Examine for compliance with 3.5.4.

4.3.15 Application properties.

4.3.15.1 Brushing properties.

4.3.15.1.1 Type II. The enamel as packaged or reduced with not more than 5 parts by volume of mineral spirits conforming to TT-T-291, grade 1 for composition G and thinner having a maximum of 8% aromatic for composition L to 95 parts by volume of enamel shall be observed for brushing properties in accordance with method 4321 of Fed. Test Method Std. No. 141 for compliance with 3.5.5.1.

4.3.15.1.2 Type IV. The enamel as packaged or reduced with not more than 10 parts by volume of thinner conforming to TT-T-306 for composition G and thinner conforming to table V for composition L to 90 parts by volume of enamel shall be applied over a 4- by 12-inch steel panel in accordance with method 4321 of Fed. Test Method Std. No. 141 for compliance with 3.5.5.1.

4.3.15.2 Spraying properties.

4.3.15.2.1 Type II. Reduce the enamel as in 4.3.6.1. Spray on a steel panel to 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 for compliance with 3.5.5.2. For referee test, use automatic application per method 2131 of Fed. Test Method Std. No. 141.

4.3.15.2.2 Type IV. Reduce the enamel as in 4.3.6.2. Spray on a steel panel to 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 for compliance with 3.5.5.2. For referee test, use automatic application per method 2131 of Fed. Test Method Std. No. 141.

4.3.15.3 Dipping properties.

4.3.15.3.1 Type I. Reduce the enamel, according to the recommendation of the manufacturer, with mineral spirits conforming to TT-T-291, grade 1 except that the thinner used with composition L shall have a maximum of 8% aromatic content. Observe for dipping properties as in method 4341 of Fed. Test Method Std. No. 141 for compliance with 3.5.5.3.

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4.3.15.3.2 Type IV. Reduce the enamel, according to the recommendation of the manufacturer, with thinner conforming to TT-T-306 for composition G and thinner conforming to table V for composition L. Observe for dipping properties as in method 4341 of Fed. Test Method Std. No. 141 for compliance with 3.5.5.3.

4.3.15.4 Roller coating - type III only. Prepare a phosphoric acid etched panel as in method 2011, procedure B of Fed. Test Method Std. No. 141. Apply, by roller coating machine or hand roller, a film of enamel as received or reduced with mineral spirits conforming to TT-T-291, grade 1 for composition G and thinner having a maximum of 8% aromatic for composition L according to the manufacturer's directions so as to yield a dry film thickness of 0.0006 to 0.0008 inch. A No. 4 Ford cup consistency of 45 to 100 seconds is usually required, the exact consistency depending on the material. Observe the application characteristics for compliance with 3.5.5.4. Air dry the panel in a horizontal position for 5 to 10 minutes; bake for 45 minutes at 250°F.; cool; measure the film thickness, and observe the panel for compliance with 3.5.5.4.

4.3.16 Odor. Test the enamel as in method 4401 of Fed. Test Method Std. No. 141 and observe for compliance with 3.5.6.

4.3.17 Flexibility. Determine flexibility as in method 6221 of Fed. Test Method Std. No. 141. Draw down a 2-inch wide film of enamel with a suitable film applicator that will deposit a dry film thickness of 0.0009 to 0.0011 inch on a flat tinplate panel prepared as in method 2012 of Fed. Test Method Std. No. 141 using the petroleum naphtha-ethylene glycol monoethyl ether mixture. Bake for 45 minutes at 250°F.; age for 24 hours at room temperature; and, bend sharply over a 1/8-inch mandrel. Examine the panel for compliance with 3.5.7.

4.3.18 Knife test. Solvent clean a steel panel of the type specified in method 2011 of Fed. Test Method Std. No. 141 using the petroleum naphtha-ethylene glycol monoethyl ether mixture. Draw down a 2-inch wide film of enamel with a suitable film applicator that will deposit a dry film thickness of 0.0009 to 0.0011 inch. Bake for 45 minutes at 250°F.; and age for 24 hours at room temperature. Perform the knife test in accordance with method 6304 of Fed. Test Method Std. No. 141 and observe for compliance with 3.5.8.

4.3.19 Recoating. Using a 0.0015 inch (0.0030 inch gap clearance) film applicator, draw down a 2-inch wide film of enamel on two clear plate glass panels. Air dry one panel for 6 hours under referee conditions; bake the other for 45 minutes at 250°F. or equivalent heat treatment and cool. At the end of each drying period, draw a 3-inch wide film of the enamel across the width of the enamel film with 0.0015 inch (0.0030 inch gap clearance) film applicator. Allow to dry and examine for compliance with 3.5.9.

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4.3.20 Water resistance. Using a 0.0015 inch (0.0030 inch gap clearance) film applicator, draw down a film of enamel on a steel panel, phosphoric acid etched, as in method 2011, procedure B of Fed. Test Method Std. No. 141 and air dry for 96 hours. Measure the 60° specular gloss and 45°, 0° luminous directional reflectance of the coating. Coat all exposed uncoated metal surfaces with wax or other suitable coating and immerse the panel for 18 hours in distilled water in accordance with method 6011 of Fed. Test Method Std. No. 141. Upon removal, examine for compliance with 3.5.10. Measure the 60° specular gloss and determine the loss in gloss. Measure the daylight 45°, 0° luminous directional reflectance and determine the lightness index difference by method 6122 of Fed. Test Method Std. No. 141.

4.3.21 Hydrocarbon fluid resistance. Prepare a film of enamel as in 4.3.20 except do not wax or coat the exposed metal surfaces. Immerse the panel for 4 hours in a hydrocarbon fluid conforming to TT-S-735, type III. Upon removal, test as in 4.3.20 and examine for compliance with 3.5.11.

4.3.22 Salt spray test. Apply a coat of enamel (0.0009 to 0.0011 inch dry film thickness) by brush, spray, dip, or roller coat, whichever method is applicable to the type of enamel being tested, to duplicate 4- by 12-inch steel panels, phosphoric acid etched, as in method 2011, procedure B of Fed. Test Method Std. No. 141. Air dry for 96 hours; score and expose to 5% salt spray for 192 hours for types I, II, and III, and 144 hours for type IV as in method 6061 of Fed. Test Method Std. No. 141. Observe for compliance with 3.5.12.

4.3.23 Accelerated weathering. Using a 0.0015 inch (0.0030 inch gap clearance) film applicator draw down a 2-inch wide film of the enamel on two flat tinplate panels and air dry for 96 hours. Measure the 60° specular gloss and 45°, 0° luminous directional reflectance of the coating. Subject the coated panels to 168 hours of accelerated weathering in accordance with method 6152 of Fed. Test Method Std. No. 141 using a twin arc apparatus. Examine the exposed coating for chalking. Wash the exposed panel under running water with a thoroughly degreased lamb's wool pad to remove any scum or dirt. Wipe off water with clean cheesecloth and let dry for 2 hours. Determine loss of gloss and the lightness index difference as in 4.3.20. Observe for compliance with 3.5.13.

4.3.24 Weather resistance. Apply films of enamel (0.0009 to 0.0011 inch dry film thickness) by brushing, spraying, dipping, or roller coating, whichever method is applicable to the type of material being tested, to duplicate 4- by 12-inch steel panels, which have been phosphoric acid etched as in method 2011, procedure B of Fed. Test Method Std. No. 141. Air dry for 96 hours. Measure 45°, 0° luminous directional reflectance. Score the panels along a line one inch from the edge of the long dimension and expose at an angle of 45° facing south in the vicinity of either Washington, D. C., for 1 year or Miami, Fla., for 6 months. At the end of exposure period, examine the panels for compliance with 3.5.14.

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4.3.25 Toxicity. The manufacturer shall certify that the enamel contains no benzene (benzol) or chlorinated solvents.

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 paint 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. This enamel is intended for use as a one or two coat painting system over properly cleaned and treated metal such as sheet metal, metal ammunition containers, landing mats, pipeline equipment, drums such as gasoline drums, vehicular equipment, and certain types of rail and Marine Corps tactical and combat equipment. When the enamel is used in a two-coat system, the first coat serves as a primer and may be supplied without the carbon black or tinted off-shade with chrome yellow in oil, so as to provide a color contrast between coats.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

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

(b) Type, color, and color number (see 1.2 and 3.2).

(c) Composition required (see 1.2.2).

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

(e) Levels of packing and packaging (see section 5).

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6.3 Qualification. Qualification testing is limited to types II and IV enamels. 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 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 U. S. Army Coating and Chemical Laboratory, Aberdeen Proving Ground, Maryland, and information pertaining to qualification of products may be obtained from that activity.

6.3.1 Types I and III enamels do not require qualification. Manufacturers supplying these types will furnish a certificate of conformance to the requirements of the specification.

6.4 Color standards for olive drab should be obtained from:

Commanding Officer
U. S. Army Coating and Chemical Laboratory
Aberdeen Proving Ground, Maryland 21005

Color standards for Marine Corps green should be obtained from:

Commandant of the Marine Corps (Code CSY)
Headquarters, U. S. Marine Corps
Washington, D. C. 20380

6.5 The requirements of tables I and III are based upon the use of a light stable medium chrome yellow containing 89 - 94 percent $PbCrO_4$; dry red lead conforming to type 1, grade 97 of TT-R-191; zinc oxide pigment conforming to type 1, grade A of TT-P-463, and appropriate extender pigments for natural color plus channel type carbon black and permanent tinting pigments in lieu of equivalent weight of extender pigments for olive drab, olive green, and Marine Corps green.

6.6 The nonvolatile vehicle in types I, II, and III is contemplated to be a medium oil length, oxidizing phthalic alkyd resin, nonreactive with pigments, and reducible with mineral spirits. The modification described in 3.3.2.5 is usually a 10 to 20 percent substitution with urea- or melamine-formaldehyde, the substitution being made on the complete resin, resulting in approximately the following description for types I, II, and III:

	Percent
Polyhydroxyl alcohol	12 to 16
Phthalic anhydride	24 to 36
Drying oil acids	36 to 49
Urea- or melamine-formaldehyde resin	10 to 20

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6.7 For production purposes, the specified baking schedule may be modified to permit shorter baking time, provided a sufficiently higher temperature is used so that equivalent results are obtained.

6.8 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.).

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

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

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