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TT-E-489J
7 March 1994
SUPERSEDING
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FEDERAL SPECIFICATION

ENAMEL, ALKYD, GLOSS, LOW VOC CONTENT

This specification was approved by the Assistant Administrator, Office of Federal Supply and Services, General Services Administration, for the use of all Federal Agencies.

1. SCOPE

1.1 Scope. This specification covers one type of an air drying, high gloss, alkyd enamel for use on primed exterior and interior metal and wood surfaces. The enamel is lead and chromate free and meets air pollution requirements for solvent emissions (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 Specifications and standards. The following documents in effect on date of invitation for bids or solicitation for offers, form a part of the specification to the extent specified herein.

Federal specifications:

QQ-A-250	- Aluminum and Aluminum Alloy Plate and Sheet, General Specification for.
QQ-A-250/2	- Aluminum Alloy 3003, Plate and Sheet.
TT-P-664	- Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC Compliant.
TT-T-291	- Thinner, Paint, Mineral Spirits.
TT-T-306	- Thinner, Synthetic Resin, Enamel.
CCC-C-419	- Cloth, Duck, Unbleached, Piled-Yarn (Army and Numbered).
PPP-P-1892	- Paint, Varnish, Lacquer and Related Materials; Packaging, Packing and Marking of.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US ARMY BELVOIR RDE CTR, ATTN SATBE TSE, FT BELVOIR VA 22060-5818 by using the Standardization Document Improvement Proposal (DD Form 1426 appearing at the end of this document or by letter.

AMSC N/A FSC 8010

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Federal standards:

FED-STD-141	- Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing.
FED-STD-313	- Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities.
FED-STD-595	- Colors Used in Government Procurement.

(Activities outside the Federal Government may obtain copies of Federal specification, standards, and commercial item descriptions, as outlined under General Information in the Index of Federal Specifications, and Standards, and Commercial Item Descriptions. The Index, which includes cumulative bimonthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

(Single copies of this specification, other Federal specifications, and commercial item descriptions required by activities outside Federal Government for bidding purposes are available without charge from General Services Administration Business Service Centers in Boston, MA; New York, NY; Philadelphia, PA; Washington, DC; Atlanta, GA; Chicago, IL; Kansas City, MO; Fort Worth, TX; Houston, TX; Denver, CO; San Francisco, CA; Los Angeles, CA; and Auburn, WA.)

(Federal Government activities may obtain copies of Federal standardization documents and the Index of Federal Specifications, Standards, and Commercial Item Descriptions from established distribution points in their agencies.)

Military specifications:

MIL-C-5541	- Chemical Conversion Coatings on Aluminum and Aluminum Alloys.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from: STDZN DCMNT ORDER DESK, BLDG 4D, 700 ROBBINS AVE, PHILADELPHIA, PA 19111-5094.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issue of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 185	- Coarse Particles in Pigments, Pastes and Paints.
D 476	- Titanium Dioxide Pigments.
D 523	- Specular Gloss.
D 562	- Consistency of Paints using the Stormer Viscometer.
D 1210	- Fineness of Dispersion of Pigment Vehicle Systems.
D 1364	- Water in Volatile Solvents (Fischer Reagent Titration Method).
D 1640	- Drying, Curing, or Film Formation of Organic Coatings at Room Temperature.
D 1729	- Visual Evaluation of Color Differences of Opaque Materials.

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D 2244	- Calculation of Color Differences from Instrumentally Measured Colored Coordinates.
D 2369	- Volatile Content of Coatings.
D 2371	- Pigment Content of Solvent Reducible Paints.
D 2805	- Hiding Power of Paints by Reflectometry.
D 3335	- Low Concentration of Lead, Cadmium and Cobalt in Paint by Atomic Absorption Spectroscopy.
D 3960	- Determining Volatile Organic Content (VOC) of Paints and Related Coatings.
E 97	- Directional Reflectance Factor of Opaque Specimens.
G 53	- Operating Light and Water Exposure Apparatus (Fluorescent UV - Condensation Type) for Exposure of Nonmetallic Materials.

(Application for copies should be addressed to: AMERCN SCTY & MTRLS, 1916 RACE STREET, PHILADELPHIA, PA 19103).

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

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. The coating furnished under this specification shall be a product which is qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.2.1 and 6.4). Any change in the formulation of a qualified product will necessitate its requalification. The material supplied under contract shall be identical, within manufacturing tolerances, to the product receiving qualification.

3.2 Materials. The materials used in the coating shall be as specified herein. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this specification.

3.2.1 Toxic products and formulations. The material shall have no adverse effect on the health of the personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the contracting activity to the appropriate departmental medical service which will act as an advisor to the contracting agency.

3.2.2 Hazardous material. The contractor shall comply with the hazardous material requirements of FED-STD-313 (see 6.5).

3.2.3 Prohibited material. The product shall not contain benzene, chlorinated solvents or ethylene based glycol ethers and their acetates. The lead content shall not exceed 0.06 percent of the nonvolatile content. Chromium (hexavalent) compounds shall not be used.

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3.3 Color. When tested as specified in 4.3.4, the color of the enamel shall match that of the standard color chip in FED-STD-595 (see 6.4.1). For color 17038, the color of the enamel may be darker or jetter than that of the actual standard color chip, and for color 17925, the enamel shall have a minimum directional reflectance of 86. Enamels meeting this specification shall be furnished in the following colors:

Color	FED-STD-595, Color No.
White	17875, 17877, 17925
Black	17038
Blue	15042, 15044, 15045, 15050, 15056, 15080, 15102, 15123, 15182
Green	14110
Yellow	13538, 13655
Orange	12197, 12199, 12246
Red	11105, 11136, 11140
Earth colors	10049, 10076, 10080, 10091, 14050, 14052, 14062, 14064, 14084
Other colors	10219, 10233, 10266, 10324, 10371, 13578, 13594, 13613, 13618, 13695, 13814, 14158, 14159, 24172, 14187, 14223, 14260, 14277, 14449, 14672, 15177, 15193, 15200, 16081, 16099, 16187, 16251, 16314, 16376, 16473, 16492, 17142

3.4 Composition. The material shall meet the requirements of table I.

TABLE I. Composition-percent by weight.

	WHITE	BLACK	ALL OTHER COLORS
Nonvolatile matter-minimum	70	60	60
Total pigment-% of nonvolatile-maximum	55	25	45
Extender pigment-% of total pigment-maximum	25	60	50

3.4.1 Pigments. The pigments listed in table II, in any combination, shall be the only ones used to match the colors. The titanium dioxide shall conform to ASTM D 476, type III or type IV. Lead or chromate (hexavalent) pigments shall not be used. If extender pigments are used, they shall be siliceous matter or barium sulfate and shall not exceed the amount specified in table I. The use of the specified pigments does not guarantee that a product will meet all the requirements of this specification, as the choice of vendors, amounts, methods of dispersion and incorporation can significantly affect the quality of the end product.

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TABLE II. Pigmentation.

Pigment	Color Index Name	Color Index Number
Titanium dioxide white	PW6	77891
Carbon black	PBk7	77266
Iron oxide black	PBk11	77499
Iron blue	PB27	77510
Phthalocyanine blue	PB15	74160
Phthalocyanine green	PG7	74260
Phthalocyanine green	PG36	74265
Arylide yellow	PY74	11741
Arylide yellow	PY65	11740
Diarylide yellow	PY83	21108
Benzimidazolone yellow	PY151	13980
Iron oxide yellow	PY42	77492
DNA orange	PO5	12075
Pyrazolone orange	PO34	21115
Benzimidazolone orange	PO36	11780
Naphthol red	PR170	12475
Quinacridone red	PR202	73905
Quinacridone red	PR122	73915
Quinacridone violet	PV19	46500
Iron oxide red	PR101	77491
Iron oxide brown	PBr6	77491, 77492, 77499
Iron oxide brown	PBr11	77495

3.4.1.1 Lead and chromate (hexavalent) content. When tested as specified, the lead content shall not exceed 0.06 percent by weight of the total nonvolatile content (see 4.3.7) and the test for hexavalent chromium shall be negative (see 4.3.8).

3.4.2 Vehicle. The vehicle shall be a drying oil alkyd resin solution, modified or unmodified, meeting the requirements of table III and 3.4.3.

TABLE III. Characteristics of alkyd resin.

Characteristic	Requirements	
	Minimum	Maximum
Drying oil (fatty acids), percent by weight of alkyd resin solids	39	-
Color (Gardner color scale)	-	12

3.4.3 Solvents. The coating shall not contain any benzene, chlorinated compounds or ethylene based glycol ethers and their acetates. Solvents used shall meet the requirements of 3.2.3.

3.4.4 Volatile organic compound (VOC) content. When tested according to 4.3.2, table VI, the volatile organic compound (VOC) content of the reduced enamel (see 4.3.11) shall not exceed 420 grams/liter.

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3.5 Quantitative requirements.

3.5.1 General quantitative requirements. When tested as specified in 4.3.2, table VI, the enamel shall comply with all requirements listed in table IV.

TABLE IV. General quantitative requirements.

Characteristic	Requirements	
	Minimum	Maximum
Specular gloss, 20 degree	70	
Fineness of grind	7	
Drying time:		
Set-to-touch, hours		2
Dry hard, hours		8
Dry through, hours		48
Viscosity, reduced as specified in 4.3.11, KU		70
Coarse particles and skins, percent by weight of pigment		0.5
Water, percent by weight of enamel		0.5

3.5.2 Specific quantitative requirements. When tested as specified in 4.3.12, the enamel shall comply with the requirements of table V.

TABLE V. Contrast ratio.

Color	Minimum Contrast Ratio
17925	0.94
12197	0.92
12199	0.88
13538	0.92
13655	0.88
11105	0.92
11136	0.92
11140	0.92
All Others	0.98

3.6 Qualitative requirements.

3.6.1 Condition in container. When tested as specified in 4.3.13, a freshly opened full container of enamel shall be free from grit, coarse particles, skins, lumps, seeds, livering or abnormal thickening and shall show no pigment settling or caking that can not be readily reincorporated to a smooth homogeneous state.

3.6.2 Storage stability.

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3.6.2.1 Full container. When tested as specified in 4.3.14.1, a full quart of the enamel shall be free from coarse particles, grit, skins, lumps, seeds, livering, hard caking and tough, gummy sediment. The enamel shall remix readily to a smooth homogeneous state, shall show a maximum viscosity increase of 15KU and shall meet all the requirements of this specification.

3.6.2.2 Partially filled container. When tested as specified in 4.3.14.2, the enamel shall show no skinning. After being aged as specified in 4.3.14.2, the enamel shall show no livering, curdling, seeding, hard caking or tough gummy sediment.

3.6.3 Dilution stability. When tested as specified in 4.3.15, the enamel shall be uniform and stable, showing no precipitation, curdling or separation. Slight pigment settling is permitted.

3.6.4 Brushing properties. When tested as specified in 4.3.16, the enamel shall dry to a smooth uniform film, free from sags, runs, streaks or gloss variations. It shall brush easily with minimum drag on the brush.

3.6.5 Spraying properties. When tested as specified in 4.3.17, the enamel shall show no running, sagging, streaking or orange peel. The dried film shall show no dusting, mottling, color separation, flooding or floating, and shall have a 20 degree specular gloss of not less than 70.

3.6.6 Flexibility. When tested as specified in 4.3.18, a film of the enamel shall withstand bending without cracking or flaking.

3.6.7 Knife test. When tested as specified in 4.3.19, the enamel shall adhere tightly to and not flake or crack from the metal surface. The film shall ribbon or curl from the metal or cutting and the cut shall show beveled edges.

3.6.8 Water resistance. When tested as specified in 4.3.20, a film of the enamel shall show no wrinkling or blistering when examined immediately after removal from distilled water. When examined two hours after removal, there shall be only a slight softening, whitening or dulling. After 24 hours air drying, the portion of the panel which was immersed shall be almost indistinguishable with regard to hardness, adhesion and general appearance from a panel prepared at the same time but not immersed.

3.6.9 Hydrocarbon resistance. When tested as specified in 4.3.21, a film of the enamel shall show no wrinkling or blistering when examined immediately after removal from the hydrocarbon solution. When examined two hours after removal, there shall be only a slight softening, whitening or dulling. After 24 hours air drying, the portion of the panel which was immersed shall be almost indistinguishable with regard to hardness, adhesion and general appearance from a panel prepared at the same time but not immersed.

3.6.10 Print resistance. When tested as specified in 4.3.22, the area that was under the fabric and weight shall show only a trace of an imprint. Two hours after the removal of the fabric and weight there shall be no visible imprint on the film.

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3.6.11 Wrinkling test. When tested as specified in 4.3.23, a film of the enamel shall be smooth, uniform and free from wrinkling, orange peel, and any irregularities.

3.6.12 Accelerated weathering. When tested as specified in 4.3.24, a film of the enamel shall show no more than slight chalking and shall have a minimum 60 degree specular gloss of 65. Color after exposure shall show a maximum change of 2 CIELAB units, using illuminant D65, ASTM D 2244.

3.6.13 Weather resistance. When tested, as specified in 4.3.25, a film of the enamel shall show no checking, cracking or appreciable film deterioration. There shall be no more than moderate chalking and the color shall remain a general match to that specified.

3.6.14 User instruction marking. In addition to the markings specified in 5.2, all containers shall be legibly marked or labeled with the following:

"CAUTION: The Surgeon General requires airline respirators to be used unless air sampling shows exposure to be below standards, then either chemical cartridge respirators or airline respirators are required. Avoid contact with skin and eyes. Use with adequate ventilation. For other safety recommendations refer to the Material Safety Data Sheet. Keep containers tightly closed."

4. QUALITY ASSURANCE PROVISIONS

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

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in this specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Hazardous material. Failure to meet the hazardous material requirements of FED-STD-313 shall be cause for rejection.

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

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4.2.1 Classification of inspection. Inspection under this specification shall be for the following:

a. Qualification (see 4.2.1.1 and 6.4).
b. Acceptance (see 4.2.1.2).

4.2.1.1 Qualification testing. Qualification testing shall be conducted by the qualifying activity (see 6.4). Qualification inspection shall consist of tests for all requirements in section 3. The results of each test shall be compared with the applicable requirement in section 3. Failure to conform to any requirement shall be counted as a defect, and the paint represented by the sample tested shall not be approved for inclusion on the Federal Qualified Products List (QPL) under this specification.

4.2.1.1.1 Extended qualification. Qualification, once established for the primary colors, is extended to related colors and shades as listed in table VII.

4.2.1.1.2 Plant qualification. Different plants of the same manufacturer must be qualified individually in order to be listed on the QPL.

4.2.1.2 Quality conformance inspection. Quality conformance inspection shall consist of the following: VOC, condition in container, total solids, viscosity, fineness of grind, gloss, contrast ratio, color, print resistance, and dry times as specified in sections 3 and 4.

4.2.2 Standard conditions. Unless otherwise specified, all test specimens shall be prepared and tested at a temperature of 21 to 27 degrees C and a relative humidity of 40-65 percent.

4.3 Test methods.

4.3.1 Test conditions. The testing conditions shall be in accordance with FED-STD-141, section 9 or in accordance with the appropriate ASTM method except as otherwise specified herein. Failure of any test result to fall within the range specified in section 3 as applicable, shall constitute failure of the applicable test.

4.3.2 Test procedures. The following tests (see table VI) shall be conducted in accordance with FED-STD-141, ASTM, or as specified herein. The right is reserved to make any additional tests deemed necessary to determine that the coating meets the requirements of this specification.

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TABLE VI. Index

Test	Test Paragraph	Requirement Paragraph	ASTM Method	FED-STD-141 Method
Color	4.3.4	3.3	D 1729	-
Nonvolatile matter	-	3.4	D 2369	-
Pigment content	-	3.4	D 2371	-
Pigment analysis	-	3.4.1	D 2371	-
Extender pigment	4.3.5	3.4	-	7281
Nonvolatile vehicle	4.3.6	3.4	-	-
Lead content	4.3.7	3.4.1.1	D 3335	-
Chromium content	4.3.8	3.4.1.1	-	-
Vehicle analysis	-	3.4.2	-	7014
Volatile Organic compound content	-	3.4.4	D 3960	-
Specular gloss	4.3.9	3.5.1	D 523	2021
Fineness of grind	-	3.5.1	D 1210	-
Drying time	4.3.10	3.5.1	D 1640	-
Viscosity, reduced	4.3.11	3.5.1	D 562	-
Coarse particles	-	3.5.1	D 185	-
Water	-	3.5.1	D 1364	-
Contrast ratio	4.3.12	3.5.2	D 2805	-
Condition in container	4.3.13	3.6.1	-	3011.2
Storage stability	4.3.14	3.6.2	-	-
Dilution stability	4.3.15	3.6.3	-	-
Brushing properties	4.3.16	3.6.4	-	4321.1
Spraying properties	4.3.17	3.6.5	-	4331.1
Flexibility	4.3.18	3.6.6	-	6221
Knife test	4.3.19	3.6.7	-	6304.1
Water resistance	4.3.20	3.6.8	-	-
Hydrocarbon resistance	4.3.21	3.6.9	-	-
Print resistance	4.3.22	3.6.10	-	-
Wrinkling test	4.2.23	3.6.11	-	-
Accelerated weathering	4.3.24	3.6.12	G 53	-
Color, instrumental	4.3.24	3.6.12	D 2244	-
Weather resistance	4.3.25	3.6.13	-	-
Directional Reflectance	4.3.26	3.3	E 97	-

4.3.3 Test panels. Except as otherwise specified, metal panels used for test purposes shall be of two types:

a. Aluminum alloy, 3003 H14, 0.025 inches thick, QQ-A-250/2, treated in accordance with MIL-C-5541.[1]
b. Steel, tinplated, 0.010 inches thick.[2]

4.3.4 Color. Determine the color in accordance with ASTM D 1729 by applying films with a 50.8 Micron (101.6 Micron gap clearance) film applicator on

[1] Q-Panel Company, Cleveland, Ohio, Alodine treated, AL-412, or equivalent.
[2] Q-Panel Company, Cleveland, Ohio, tinplated, DT-36, or equivalent.

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a black and white hiding chart [3] until complete hiding is obtained. Evaluate for compliance with 3.3. For colors 13538 and 13655, apply a single film using a 76.2 micron (152.4 micron gap clearance) film applicator, and use the area over the white for color comparison.

4.3.5 Extender pigment. Determine siliceous matter and barium sulfate by the applicable portions FED-STD-141, method 7281 of. Evaluate for compliance with table I.

4.3.6 Nonvolatile vehicle (NVV). Determine the NVV as the difference between the nonvolatile matter and the total pigment content. Evaluate for compliance with table I.

4.3.7 Lead content. Determine the percent of lead in accordance with ASTM D 3335 or by x-ray emission spectrometric analysis in accordance with the manufacturers's manual. Evaluate for compliance with 3.4.1.1.

4.3.8 Chromium (hexavalent) content.

a. Reagents:

(1) 25 percent aqueous KOH.

b. Procedure:

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

4.3.9 Specular gloss. Prepare a drawdown of the enamel using a 50.8 micron (101.6 micron gap clearance) film applicator on a glass panel according to FED-STD-141, method 2021 and air day for 7 days. Measure the 20 degree specular gloss in accordance with ASTM D 523 and evaluate for compliance with 3.5.1, table IV.

4.3.10 Drying time. Prepare a drawdown of the enamel using a 50.8 micron (101.6 micron gap clearance) film applicator on a glass panel and air dry for the specified time. Check the drying time in accordance with ASTM D 1640 and evaluate for compliance with table IV.

4.3.11 Viscosity (reduced). Reduce eight parts, by volume, for the enamel with one part, by volume, of thinner TT-T-306, type II. Measure the viscosity in accordance with ASTM D 562 and evaluate for compliance with table IV.

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[3] Leneta Company, Ho-Ho-Kus, NJ, Form 2A, or equivalent.

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4.3.12 Contrast ratio. Prepare a drawdown of the enamel using a 50.8 micron (101.6 micron gap clearance) film applicator and allow to air dry for 24 hours. Determine the contrast ratio in accordance with ASTM D 2805 and evaluate for compliance with table V.

4.3.13 Condition in container. Determine package condition of enamel in accordance with FED-STD-141, method 3011 and observe for compliance with 3.6.1. Determine pigment settling by proceeding as in FED-STD-141, method 3011, but do not stir. Reseal and then agitate the can for 3 minutes on a paint shaker [4]. On reexamination of the contents, the disclosure of any gel bodies or undispersed pigment indicates unsatisfactory settling properties. Observe for compliance with 3.6.1.

4.3.14 Storage stability.

4.3.14.1 Full container. Read and record the viscosity according to ASTM D 562. Momentarily invert a full standard quart can before storing for 12 months at standard conditions (see 4.2.2). After the aging period, evaluate for compliance with 3.6.2.1.

4.3.14.2 Partially filled container. Fill a 1-pint friction top can three fourths full with enamel. Secure the top tightly and invert the can momentarily. Store the can in an upright position for 48 hours and check for skinning. Reseal the can and age for 72 hours at 60 degrees C. After the aging period, evaluate for compliance with 3.6.2.2.

4.3.15 Dilution stability. Reduce by volume eight parts of enamel with one part of thinner TT-T-291, type I. Mix and allow to stand for one hour. Evaluate for compliance with 3.6.3.

4.3.16 Brushing properties. Reduce the enamel as specified in 4.3.11 and apply to a smooth metal panel according FED-STD-141, method of 4321. Allow to air dry for 24 hours and evaluate for compliance with 3.6.4.

4.3.17 Spraying properties. Reduce the enamel as specified in 4.3.11. Holding the spray gun 8-10 inches from a smooth metal panel, spray to a dry film thickness of 22.9 to 37.9 microns according to FED-STD-141, method 4331.1. Allow to air dry for 24 hours and evaluate for compliance to 3.6.5.

4.3.18 Flexibility. Using methyl ethyl ketone and a soft cloth, clean the steel tinplated panels and prepare drawdowns using a 50.8 micron film applicator (101.6 micron gap clearance). Air dry the panel for two days and force dry 24 hours at 60 +/- 2 degrees C. Condition the panel for 1 hour at standard conditions and bend over a 1/8 inch mandrel. Evaluate according to FED-STD-141, method 6221. Check for compliance with 3.6.6.

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[4] An apparatus of this type, powered by a 1/4 hp motor, operates at a rate of 61 cycles per minute and is manufactured by Red Devil Tools, Irvington, NJ.

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4.3.19 Knife test. Using the flat portion of the panel used for the flexibility test (see 4.3.18), perform this test in accordance with FED-STD-141, method 6304.1 and check for compliance with 3.6.7.

4.3.20 Water resistance. Prepare drawdowns on steel tinplated panels using a 50.8 micron film applicator (101.6 micron gap clearance). Air dry the panels for 7 days and immerse halfway in distilled water for 18 hours. Evaluate for compliance with 3.6.8.

4.3.21 Hydrocarbon resistance. Prepare drawdowns on steel tinplated panels using a 50.8 micron (101.6 micron gap clearance) film applicator. Air dry the panels for 7 days and immerse halfway in a hydrocarbon mixture consisting of 70 percent by volume of iso-octane and 30 percent by volume of toluene for 4 hours. Evaluate for compliance with 3.6.9.

4.3.22 Print resistance. Prepare the drawdown on a smooth glass panel using a 50.8 micron (101.6 micron gap clearance) film applicator and air dry the panel for 24 hours. Place a uniform piece of Army duck (8 cm X 8 cm) on the test film and carefully place a metal cylindrical weight end down on the cloth. Maintain the weight for 30 minutes. Remove the fabric and cylinder and examine immediately and after 2 hours for compliance with 3.6.10. The Army duck shall conform to CCC-C-419, type III, 8-10 ounces per square yard, scoured but not treated. The weight shall consist of a metal cylinder cut from stock 2 inches (51 mm) in diameter with plane ends perpendicular to the axis and of a length to give a pressure of 0.5 pounds per square inch.

4.2.23 Wrinkling test. Prepare a drawdown on a smooth glass panel using a 101.6 micron (203.2 micron gap clearance) film applicator. Air dry the panel for 48 hours and evaluate for compliance with 3.6.11.

4.3.24 Accelerated weathering. Prepare films on alodine treated aluminum panel (see 4.3.3) by applying the enamel to a dry film thickness of 35 to 41 microns and allowing to air dry for 7 days. Expose the panel for 200 hours according to ASTM G 53, using UV-A-351/302 lamps. Exposure cycle shall be 8 hours of ultraviolet at 60 deg. C followed by 4 hours of condensation only at 50 deg. C. Evaluate for compliance with 3.6.12.

4.3.25 Weather resistance. Reduce primer TT-P-664 as specified for spraying and apply to a dry film thickness for 23-28 microns on alodine treated aluminum panels (see 4.3.3). After air drying for 24 hours, spray enamel under test to a dry film thickness of 35-41 microns and allow to air dry for 7 days. Expose the panels in full sunlight at an angle of 45 degrees facing south in the vicinity of Washington, DC, for two years. At the end of the exposure, gently wash the panels with a mild non-abrasive detergent and determine compliance with 3.6.13.

4.3.26 Directional reflectance. For color 17925 only, prepare a panel according to ASTM E 97. Using the green filter, evaluate for compliance with 3.3.

4.4 Inspection of preparation for delivery. The packaging, packing and marking specified in 5.1 and 5.2 shall be examined for quality conformance in accordance with the applicable requirements for PPP-P-1892.

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5. PREPARATION FOR DELIVERY

5.1 Packaging and packing. The enamel shall be packaged and packed in accordance with PPP-P-1892. The level of packaging and of packing shall be level A, B, or C as specified (see 6.2). The enamel shall be furnished in 1 quart cans, 1 gallon cans, 5 gallon pails, or 55 gallon drums as specified (see 6.2).

5.2 Marking. Marking of each container, intermediate containers, shipping containers, and palletized loads shall be in accordance with PPP-P-1892. Special markings shall be as specified in the contract or purchase order (see 6.2).

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This specification covers a high gloss alkyd enamel that when reduced as specified shall have a maximum volatile organic compound (VOC) content of not more than 420 gram per liter. The intended use is on properly cleaned, pretreated and primed exterior and interior metal or wood surfaces. If it is to be used on previously painted surfaces, it must be reduced as specified in 4.3.11 and evaluated on a small area of the surface to be coated for any signs of lifting or other surface defects.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of the specification.
b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1 and 2.2).
c. Color required (see 3.3).
d. Size of container required (see 5.1).
e. Level of packing and packaging required (see 5.1).
f. Special marking required (see 5.2).

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

6.4 Qualification. With respect to product requiring qualification, awards will be made only for such products as have, prior to the time for opening of bid, been tested and approved for inclusion in qualified products list QPL-TT-E-489, whether or not such products have actually been listed by that date. The attention of the contractor 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: US ARMY BELVOIR RDE CTR, ATTN AMSRL MA E, FT BELVOIR VA 22060-5818, and information pertaining to qualification of products may be obtained from that activity. Application for qualification tests shall be made in accordance with

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"Provisions Governing Application by Manufacturers for inclusion of Federal Qualified Products Lists (QPL's)" (see 6.4.1). Material Safety Data Sheets prepared in accordance with FED-STD-313 are required for this product.

6.4.1 Qualification colors. Upon successful completion of qualification testing of colors shown in the left column of table VII, qualification will be extended to the respective colors listed in the right column (see 3.3).

TABLE VII. Colors approved by extension of qualification.

Color Qualified	Additional Colors to Which Approval is Extended
11136	11105, 11140
12197	12199, 12246
13538	13655
14084	10049, 10076, 10080, 10091, 14050, 14052, 14064, 14062
15045	15042, 15044, 15050, 15056, 15080, 15102, 15123, 15182
14110	----
17038	----
17925	10219, 10233, 10266, 10324, 10371, 13578, 13594, 13613, 13618, 13695, 13814, 14158, 14159, 14172, 14187, 14233, 14260, 14277, 14449, 14672, 15102, 15123, 15177, 15193, 15200, 16081, 16099, 16187, 16251, 16314, 16376, 16473, 16492, 17142, 17877

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

6.6 Subject term (key word) listing.

High gloss enamel
Low VOC coating
Topcoat
Volatile organic compounds (VOC)

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

MILITARY INTEREST:

Custodians

Army - ME
Navy - SH
Air Force - 99

Review activities

Army - AR
Navy - YD, AS
Air Force - 11, 84
Other - DS

User activities:

Army - MI
Navy - MC, OS

CIVIL AGENCY COORDINATING ACTIVITY:

GSA - FSS
VA - OSS

PREPARING ACTIVITY:

Army - ME

Project 8010-0503

Orders for this publication are to be placed with General Services Administration, acting as an agent for the Superintendent of Documents. See section 2 of this specification to obtain extra copies and other documents referenced herein.