

METRIC

MIL-E-24635A(SH)

19 June 1991

SUPERSEDING

DOD-E-24635(SH)

13 September 1984

(See 6.10)

MILITARY SPECIFICATION

ENAMEL, SILICONE ALKYD COPOLYMER (METRIC)

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers copolymerized silicone alkyd enamels for use on primed, smooth metal, GRP, wood and plastic/composite surfaces.

1.2 Classification. Enamel covered by this specification shall be an air-drying, silicone alkyd resin enamel furnished in the following types and classes as specified (see 6.1 and 6.2):

- Type I - Volatile organic content (VOC) not to exceed 420 grams per liter (g/L; 3.5 pounds per gallon [lb/gal]).
- Type II - VOC not to exceed 340 g/L (2.8 lb/gal).
- Type III - VOC not to exceed 275 g/L (2.3 lb/gal).

- Class 1 - High gloss, 85 percent minimum.
- Class 2 - Medium gloss, 45 to 60 percent.
- Class 3 - Low gloss, 15 to 30 percent.
- Class 4 - Flat gloss, 5 to 15 percent.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 8010

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

MIL-E-24635A(SH)

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

- TT-T-291 - Thinner, Paint, Mineral Spirits, Regular or Odorless.
- PPP-F-320 - Fiberboard, Corrugated and Solid, Sheet Stock (Container Grade), and Cut Sheets.
- PPP-P-1892 - Paint, Varnish, Lacquer, and Related Materials; Packaging, Packing and Marking of.
- PPP-T-60 - Tape; Packaging, Waterproof.

MILITARY

- MIL-L-19140 - Lumber and Plywood, Fire-Retardant Treated.

STANDARDS

FEDERAL

- 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.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, BLDG. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

PUBLICATIONS

ENVIRONMENTAL PROTECTION AGENCY (EPA)

- 40 Code of Federal Regulations (CFR) ch.1, part 60, appendix A, method 24 - Determination of Volatile Matter Content, Water Content, Density, Volume Solids and Weight Solids of Surface Coatings.

Federal Register (FR), Volume 55, paragraph 11798, March, 1990 (55 FR 11798), Toxicity Characteristic Leaching Procedure (TCLP).

MIL-E-24635A(SH)

DEPARTMENT OF LABOR
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

29 CFR Parts 1910, 1915, 1917, 1918, 1926 and 1928 - Hazard Communication Act, Final Rule.

(The Code of Federal Regulations (CFR) and the Federal Register (FR) are for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. When indicated, reprints of certain regulations may be obtained from the Federal agency responsible for issuance thereof.)

2.1.2 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 issues of the documents cited in the solicitation (see 6.2).

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents in the Work Environment and Biological Exposure Indices.

(Application for copies should be sent to the American Conference of Governmental Hygienists, 6500 Glenway Avenue, Bldg D7, Cincinnati, Ohio 45211).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- D 95 - Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation.
- D 523 - Standard Test Method for Specular Gloss. (DoD adopted)
- D 562 - Standard Test Method for Consistency of Paints Using the Stormer Viscometer. (DoD adopted)
- D 563 - Standard Test Method for Phthalic Anhydride Content of Alkyd Resins and Resin Solutions. (DoD adopted)
- D 659 - Standard Method of Evaluating Degree of Chalking of Exterior Paints. (DoD adopted)
- D 823 - Standard Test Methods for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels. (DoD adopted)
- D 1210 - Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems. (DoD adopted)
- D 1296 - Standard Test Method for Odor of Volatile Solvents and Diluents. (DoD adopted)
- D 1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes. (DoD adopted)
- D 1364 - Standard Test Method for Water in Volatile Solvents (Fischer Reagent Titration Method).

MIL-E-24635A(SH)

- D 1398 - Standard Test Method for Fatty Acid Content of Alkyd Resins and Alkyd Resin Solutions. (DoD adopted)
- D 1542 - Standard Test Method for Qualitative Detection of Rosin in Varnishes. (DoD adopted)
- D 1849 - Standard Test Method for Package Stability of Paint. (DoD adopted)
- D 1983 - Standard Test Method for Fatty Acid Composition by Gas-Liquid Chromatography of Methyl Esters. (DoD adopted)
- D 2244 - Standard Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates. (DoD adopted)
- D 2245 - Standard Method for Identification of Oils and Oil Acids in Solvent-Reducible Paints. (DoD adopted)
- D 2698 - Standard Method for Determination of the Pigment Content of Solvent-Reducible Paints by High-Speed Centrifuging. (DoD adopted)
- D 2800 - Standard Test Method for Preparation of Methyl Esters from Oils for Determination of Fatty Acid Composition by Gas-Liquid Chromatography. (DoD adopted)
- D 2805 - Standard Test Method for Hiding Power of Paints by Reflectometry.
- D 3278 - Standard Test Method for Flash Point of Liquids by Setaflash Closed-Cup Apparatus (DoD Adopted).
- G 53 - Standard Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials. (DoD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 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 document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. The enamels furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list (QPL) at the time of award of contract (see 4.2 and 6.4).

3.2 Composition. The manufacturer is given his choice of ingredients used in the formulation of the enamels described in this document. However, enamel shall conform to all the requirements of this specification. Soluble metals content and total metal content of the enamel shall not exceed the values listed in tables I and II when tested in accordance with 4.6.20.

MIL-E-24635A(SH)

TABLE I. Soluble metals content.

Requirement	Maximum
Metals content (soluble), mg/L	
Antimony and/or its compounds	15
Arsenic and/or its compounds	5
Barium and/or its compounds (excluding barite)	100
Beryllium and/or its compounds	0.75
Cadmium and/or its compounds	1
Chromium (VI) compounds	5
Chromium and/or chromium (III) compounds	560
Cobalt and/or its compounds	80
Copper and/or its compounds	25
Fluoride salts	180
Lead and/or its compounds	5
Mercury and/or its compounds	0.2
Molybdenum and/or its compounds	350
Nickel and/or its compounds	20
Selenium and/or its compounds	1
Silver and/or its compounds	5
Thallium and/or its compounds	7
Vanadium and/or its compounds	24
Zinc and/or its compounds	250

TABLE II. Total metals content.

Requirement	Maximum
Metals content (total), weight percent	
Antimony and/or its compounds	0.05
Arsenic and/or its compounds	0.05
Barium and/or its compounds (excluding barite)	1.00
Beryllium and/or its compounds	0.0075
Cadmium and/or its compounds	0.01
Chromium (VI) compounds	0.05
Chromium and/or chromium (III) compounds	0.25
Cobalt and/or its compounds	0.80
Copper and/or its compounds	0.25
Fluoride salts	1.80
Lead and/or its compounds	0.10
Mercury and/or its compounds	0.002
Molybdenum and/or its compounds	0.35
Nickel and/or its compounds	0.20
Selenium and/or its compounds	0.01
Silver and/or its compounds	0.05
Thallium and/or its compounds	0.07
Vanadium and/or its compounds	0.24
Zinc and/or its compounds	0.50

MIL-E-24635A(SH)

3.3 Color. The color shall be characteristic of the pigments used and shall match the FED-STD-595 number specified (see table VI and 4.6.7).

3.3.1 Color deviation. The color deviation of the paint shall be obtained as specified in 4.6.7. The measured color deviation from FED-STD-595 color number shall not exceed: $\Delta E = 0.5$ Commission Internationale de l'Eclairage (International Commission on Illumination) (CIE) Lab units, $\Delta A = \pm 0.3$ CIE Lab units, $\Delta B = \pm 0.3$ CIE Lab units and $\Delta L = \pm 0.3$ CIE Lab units.

3.4 Vehicle resin. The vehicle shall consist of a copolymerized, air-drying, silicone modified long oil soya alkyd conforming to the requirements of table III (see table V).

TABLE III. Characteristics of vehicle. 1/

Characteristics	Requirements	
	Minimum	Maximum
Silica (SiO ₂) percent by weight of nonvolatile vehicle	14.7	--
Phthalic anhydride, percent by weight of nonvolatile vehicle	14	17
Drying oil acids, percent by weight of nonvolatile vehicle	41	47
Soya oil	Positive	
Rosin	Negative	
Phenolic resin	Negative	

1/ Tests shall be as specified in table V.

3.4.1 Identification. The copolymer shall give two similar spectra, both of which shall have the significant bands of both the alkyd and silicone resins as shown on figure 1. Neither spectra shall show an absorption band in the 13.9 - to 14.0 micrometer (μm) region and both shall show a sharp narrow band at 7.0 μm (see 4.6.15.2).

3.5 Qualitative requirements.

3.5.1 Condition in container. The enamel shall be free of grit, seeds, skins, lumps or livering, and shall show no more pigment settling or caking than can be readily re-incorporated to a smooth uniform state with a paddle or mechanical mixer within 5 minutes (see 4.6.1).

3.5.2 Storage stability.

3.5.2.1 Partially-full container. The enamel shall show no skinning (see 4.6.2.1). After aging as specified in 4.6.2.1, the enamel shall show no livering, curdling, hard caking or gummy sediment. The enamel shall mix readily to a smooth uniform state within 5 minutes when mixed with a paddle or mechanical mixer and shall have a consistency not greater than 5 units from the original Krebs unit consistency before testing (see table V). Enamel shall meet all other requirements of this specification.

MIL-E-24635A(SH)

3.5.2.2 Full container. The enamel shall show no skinning, livering, curdling, hard caking or gummy sediment (see 4.6.2.2). The enamel shall remix readily to a smooth uniform state within 5 minutes when mixed with a paddle or mechanical mixer and shall have a consistency not greater than 5 units from the original Krebs unit consistency before testing (see table V). Enamel shall meet all other requirements of this specification.

3.5.3 Dilution stability. When thinned as specified in 4.6.3, the enamel shall remain stable and uniform, showing no precipitation or curdling. Slight pigment settling shall be permitted. Thinning shall not cause the VOC of any type to be exceeded.

3.5.4 Brushing properties. The enamel shall brush satisfactorily and shall dry to a uniform film, free from seeds, runs, sags or streaks (see 4.6.4).

3.5.5 Rolling properties. The enamel shall roll satisfactorily and shall dry to a uniform film, free from seeds, runs, sags or streaks. The dried film shall show an even, smooth finish (see 4.6.5).

3.5.6 Spraying properties. The enamel shall spray satisfactorily and shall show no running, sagging, streaking or orange peel. The air-dried film shall show no seeding, dusting, floating, fogging, mottling, hazing, or other film defects (see 4.6.6).

3.5.7 Odor. The odor of the wet enamel and the film at any interval of drying shall not be obnoxious or objectionable (see 4.6.8).

3.5.8 Anchorage. A film of the enamel shall show no removal or loosening of the enamel beyond 1.6 millimeters (mm) (0.063 inch) on either side of the score line (see 4.6.9).

3.5.9 Flexibility. A film of enamel shall bend without cracking or flaking (see 4.6.10).

3.5.10 Flake and crack resistance. A film of enamel shall adhere tightly to the metal and shall not flake or crack. The film shall ribbon or curl from the metal on cutting, and the cut shall show beveled edges (see 4.6.11).

3.5.11 Recoating. Recoating of a dried film shall produce no film irregularities. The enamel shall not wrinkle or lift the first coat and shall dry to a smooth, uniform finish (see 4.6.12).

3.5.12 Water resistance. A film of enamel shall show no blistering or wrinkling when examined immediately after removal from distilled water. When examined, 2 hours after removal, there shall be no softening, whitening or dulling. After 24 hours of air-drying, the portion of the panel which was immersed shall be indistinguishable with regard to hardness, adhesion and general appearance from a panel prepared at the same time but not immersed, and shall retain at least 90 percent of the 60-degree specular gloss of the comparison panel (see 4.6.13).

MIL-E-24635A(SH)

3.5.13 Accelerated weathering. Films of the enamel shall show no evidence of chalking and a loss of not more than 35 percent of the gloss measured prior to exposure (see 4.6.18). The color difference (8E) shall not exceed a value of 1.0 CIE Lab units from the original pre-test standard value. After testing, 8 L, 8 a and 8 b, respectively, shall not exceed plus or minus 1.0 CIE Lab unit from the original pre-test standard value when measured as specified in 4.6.7.

3.6 Quantitative requirements. The enamels shall conform to the requirements of table IV (see table V).

TABLE IV. Quantitative requirements of the enamel. 1/

Characteristics	Requirements	
	Minimum	Maximum
Flash point, Setaflash, closed cup, degrees Celsius (#C) (degrees Fahrenheit (#F))	38(100)	--
Water, percent by weight of enamel	--	0.5
Coarse particles and skins (retained on number 325 mesh) percent by weight of pigment	--	0.5
Consistency, Krebs-Stormer, shearing rate, equivalent Krebs units	--	100
Fineness of grind	6	--
Drying time:		
Set-to-touch, hours	--	2
Dry hard, hours	--	8
Asbestos	None	
Lead content (as metal), percent	--	0.06
VOC, g/L		
Type I	--	420
Type II	--	340
Type III	--	275
Gloss (60 degrees specular)		
Class 1	85	--
Class 2	45	60
Class 3	15	30
Class 4	5	15
Contrast ratio		
Gray and black colors	0.90	--
White colors	0.90	--
Red, yellow and orange colors	0.75	--

1/ Tests shall be as specified in table V.

MIL-E-24635A(SH)

3.7 Label. Manufacturer shall prepare container label instructions for the enamel in accordance with the requirements of 29 CFR Parts 1910, 1915, 1917, 1918, 1926 and 1928 - Hazard Communication Act, Final Rule (see 5.1).

3.8 Toxicity. The manufacturer shall certify that the enamel does not contain the following materials in excess of 0.06% by weight of the dry paint: asbestos or asbestos-form pigments, benzene, toluene, chlorinated solvents, hydrolyzable chlorine derivatives, coal tar or coal tar derivatives, any ACGIH carcinogenic or ACGIH suspected carcinogenic compounds (see 3.5 and 3.7). The enamel shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this toxic effect shall be referred by contracting activity to the qualifying activity. The qualifying activity will act as advisor to the contracting activity. The qualifying activity will arrange for review of questions by the appropriate departmental medical service.

3.9 Material safety data sheet (MSDS). The contracting activity shall be provided a material safety data sheet at the time of contract award. The MSDS shall be provided in accordance with the requirements of FED-STD-313. The MSDS shall be included with each shipment of the material covered by this specification (see 6.7).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall 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 the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- (a) Qualification inspection (see 4.3).
- (b) Quality conformance inspection (see 4.4).

MIL-E-24635A(SH)

4.3 Qualification inspection. Qualification inspection shall be conducted at a laboratory satisfactory to NAVSEA. Qualification inspection shall consist of all tests specified in table V and paragraph 4.7. The enamel tested shall be drawn from regular production stocks. A test report detailing the results of any required testing performed by the manufacturer shall be provided.

4.3.1 Extension of qualification. Approval of qualification for Navy haze gray to match color 26270 of FED-STD-595 shall constitute approval for other colors of the same type and class. Approval of qualification for a type III class enamel shall also constitute approval of qualification of that enamel for types I and II of the same class. Approval of qualification for a type II class enamel shall also constitute approval of qualification of that enamel for type I of the same class. Enamel submitted for qualification for a type III, but passes the VOC requirement for type I and or II shall be qualified for the same type I and/or II class provided that the enamel passes all other requirements for that type and class. Enamel submitted for qualification for a type II class, but that does not pass the VOC requirement for type II, but passes the VOC requirement for type I, shall be qualified for the same type I class provided that the enamel passes all other requirements for that type and class.

TABLE V. Tests

	Requirements paragraph	Applicable test method FED-STD-141	ASTM test method	Test paragraph
Condition in container	3.5.1	3011.2	---	4.6.1
Storage stability	3.5.2	3021.1	D 1849	4.6.2
Dilution stability	3.5.3	4203.1	--	4.6.3
Brushing properties	3.5.4	4321.2	--	4.6.4
Rolling properties	3.5.5	---	D 823	4.6.5
Spraying properties	3.5.6	4.331.1	---	4.6.6
Color	3.3	---	D 2244	4.6.7
Odor	3.5.7	---	D 1296	4.6.8
Anchorage	3.5.8	---	---	4.6.9
Flexibility	3.5.9	6221	---	4.6.10
Flake and crack resistance	3.5.10	6304.1	---	4.6.11
Recoating	3.5.11	4061.2	---	4.6.12
Water resistance	3.5.12	---	---	4.6.13
Silica content	Table III	---	---	4.6.15.1
Copolymer	3.4.1	---	---	4.6.15.2
Phthalic anhydride	Table III	---	D 563	4.6.14.1
Drying oil acids	Table III	---	D 1398	4.6.14.1

TABLE V. Tests - Continued.

	Requirements paragraph	Applicable test method FED-STD-141	ASTM test method	Test paragraph
Gloss 60-degree specular	Table IV	---	D 523	4.6.16
Drying time	Table IV	4061.2	---	4.6.17
Accelerated weathering	3.5.13	---	G 53, D 659	4.6.18
Soya oil	Table III	---	D 2800	---
	---	---	D 2245	---
	---	---	D 1983	---
Phenolic resin	Table III	5141.1	---	---
Rosin	Table III	---	D 1542	---
Vehicle extraction	Table I	---	D 1398, D 563	4.6.14
Flash point	Table IV	---	D 3278	---
Water	Table IV		D 95 or D 1364	---
Coarse particles	Table IV	4092.1	---	---
Consistency	Table IV	---	D 562	---
Fineness of grind	Table IV	---	D 1210	---
VOC	Table IV	---	---	4.6.19
Contrast ratio	Table IV	---	D 2805	---
Soluble and total metal content	3.2	---	---	4.6.20

4.4 Quality conformance inspection. Quality conformance inspection shall consist of all tests specified in table V with the exception of storage stability (see 4.6.2), water resistance (see 4.6.13), and accelerated weathering (see 4.6.18). Sampling and inspection shall be in accordance with methods 1022 and 1031 of FED-STD-141. Failure to pass any test and noncompliance with the requirements of section 3 shall be cause for rejection of the lot (see 6.3).

4.5 Test conditions. Unless otherwise specified, the routine and referee testing conditions shall be in accordance with Section 9 of FED-STD-141. The term referee condition shall mean a temperature of $23 \pm 1^{\circ}\text{C}$ ($73 \pm 2^{\circ}\text{F}$) and a relative humidity of 50 ± 4 percent. A dry film thickness of 3.8 to 5.1 μm (0.0015 to 0.002 inches) shall be used whenever film thickness is requested in any test, unless otherwise required by the test.

MIL-E-24635A(SH)

4.6 Tests.

4.6.1 Condition in container. The package condition on acceptance testing shall be determined in accordance with method 3011.2 of FED-STD-141 and observed for compliance with 3.5.1.

4.6.2 Storage stability.

4.6.2.1 Partially-full containers. Skinning shall be determined after 48 hours in accordance with method 3021.1 of FED-STD-141, except that a 3/4 filled 1/2 pint multiple friction top can shall be used. The can shall be resealed and aged for 30 days at 60°C (140°F) and examined for compliance with 3.5.2.1.

4.6.2.2 Full container. A full quart can of enamel shall be allowed to stand undisturbed for 12 months and then the contents tested in accordance with ASTM D 1849. The contents shall be evaluated for pigment settling or caking as specified in 3.5.1, then agitate the can for 5 minutes on the paint shaker prior to re-examination. The viscosity shall be determined and other applicable tests made for compliance with 3.5.2.2.

4.6.3 Dilution stability. One part by volume of enamel as packaged shall be reduced with one part by volume of thinner in accordance with TT-T-291, type I or III and tested in accordance with method 4203.1 of FED-STD-141 for compliance with 3.5.3.

4.6.4 Brushing properties. Brushing properties of the packaged enamel shall be determined in accordance with method 4321.2 of FED-STD-141 for compliance with 3.5.4. Method 4494.1 of FED-STD-141 shall be used as a referee test except that the drawdown shall be made a minimum of 25 centimeters (cm) (10 inches) long on a clear glass plate. Contact of the 102 μm (4 mil) strip with the next thicker strip at any point within the 14 cm (5.5 inch) central portion of the blade path shall be an indication of sagging.

4.6.5 Rolling properties. Rolling properties of the enamel shall be determined in accordance with ASTM D 823 for compliance with 3.5.5.

4.6.6 Spraying properties. The enamel shall be sprayed on a steel panel to a dry film thickness of 23 to 28 μm (0.0009 to 0.0011 inch). The panel shall be observed for spraying properties in accordance with method 4331.1 of FED-STD-141 to determine compliance with 3.5.6.

4.6.7 Color. The color deviation (ΔE) and the color factors (ΔL , Δa and Δb) shall be determined in accordance with ASTM D 2244 using a D65 light source, 45 degree illumination angle and a 0 degree viewing angle. Check for compliance with 3.3, or table VI as applicable.

4.6.8 Odor. The enamel shall be tested for odor in accordance with ASTM D 1296 for compliance with 3.5.7.

4.6.9 Anchorage. A panel shall be prepared in accordance with method 4061.2 of FED-STD-141 and air-dried for 18 hours. The panel shall then be baked for 2 hours at $105 \pm 2^\circ\text{C}$ ($221 \pm 4^\circ\text{F}$). After baking, the panel shall be conditioned for 1 hour under referee testing conditions in accordance with Section 9 of FED-STD-

MIL-E-24635A(SH)

141, and a line scored 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 19 mm (0.750 inch) wide tape in accordance with PPP-T-60. The tape shall be pressed in firm contact with the test area, and approximately 10 seconds allowed for the test area to return to room temperature. The force end of the tape shall be grasped and stripped from the film by pulling it back at a rapid speed from the panel at an angle of approximately 180 degrees to determine compliance with 3.5.8.

4.6.10 Flexibility. The flexibility shall be determined in accordance with method 6221 of FED-STD-141. A 51 mm (2 inches) wide film applicator that will give a dry film thickness of 23 to 28 μm (0.0009 to 0.0011 inch) on a smooth finish steel plate shall be prepared in accordance with method 2011.2 of FED-STD-141 using the aliphatic naphtha/propylene glycol monomethyl ether mixture. The panel shall be prepared from new cold rolled rust-free carbon steel $25.4 \pm 2.5 \mu\text{m}$ (0.010 ± 0.001 inch) thick with a Rockwell 15-T maximum hardness of 82 and shall be finished with a surface roughness of 8 to 12 microinches. The panel shall be air dried in a horizontal position for 18 hours and then baked for 168 hours at $105 \pm 2^\circ\text{C}$ ($221 \pm 4^\circ\text{F}$). The panel shall be conditioned for 1/2 hour under referee conditions and then bent over a 6.35 mm (0.250 inch) mandrel. The coating shall be examined for cracks over the area of the bend in a strong light at a 7-diameter magnification to determine compliance with 3.5.9.

4.6.11 Flake and crack resistance test. The knife test shall be performed in accordance with method 6304.1 of FED-STD-141 using the flat portion of the panel from the flexibility test (see 4.6.10) to determine compliance with 3.5.10.

4.6.12 Recoating. The enamel shall be prepared in accordance with method 4061.2 of FED-STD-141 and allowed to air-dry for 24 hours under referee testing conditions. A second coat of enamel shall be applied crosswise to the first coat and allowed to air-dry for an additional 24 hours. The enamel shall show no film irregularities in compliance with 3.5.11.

4.6.13 Water resistance. A film of enamel shall be prepared by drawing down with a 51 μm (0.002 inch) to 102 μm (0.004 inch) gap clearance film applicator on a steel panel which has been solvent cleaned and phosphate coated in accordance with method 2011.2, procedure B of FED-STD-141, and shall be air dried for 7 days. Exposed uncoated metal surfaces shall be coated with wax or other suitable coating. The panel shall then be immersed in distilled water at $23 \pm 1^\circ\text{C}$ ($73 \pm 2^\circ\text{F}$) for 18 hours in accordance with ASTM D 1308. At the end of the test period, the panel shall be removed and examined for compliance with 3.5.12.

4.6.14 Vehicle extraction. The vehicle shall be extracted in accordance with ASTM D 2698.

4.6.14.1 Phthalic anhydride and drying oil acids. The unsaponifiable, drying oil acids and phthalic anhydride shall be determined on the isolated vehicle in accordance with ASTM D 1398 and D 563 respectively, except that the drying oil acids shall be extracted with the petroleum ether in place of chloroform and shall conform to table III.

MIL-E-24635A(SH)

4.6.15 Silicone-alkyd copolymer resin.

4.6.15.1 Silica content of vehicle. From a stoppered bottle or weighing pipet, the mass shall be accurately determined by difference, weigh approximately 3 grams of vehicle into a previously ignited and weighed 7.6 cm (3-inch) porcelain evaporating dish. The sample shall be dried at 110°C (230°F) in an oven for 1 hour. Add 1 milliliter (mL) American Chemical Society concentrated sulfuric acid. Heat sample with bunsen burner flame until ignition occurs. Allow sample to burn to self-extinguishment. Dry sample in a convection oven at 110°C (230°F) for 3 hours. The dried sample shall be placed in a cold muffle furnace and the temperature shall be gradually increased over a period of 3 hours to 800°C (1472°F). This temperature shall be maintained for an additional hour. After cooling in a desiccator, the mass of the dish and the contents shall be determined and the percent of silica shall be calculated as follows:

$$\text{Percent silica} = \frac{\text{Mass of ash} \times 100}{\text{Mass of sample} \times \text{nonvolatile fraction}}$$

The mass shall be in compliance with table III.

4.6.15.2 Qualitative test for copolymer. The copolymer shall be tested qualitatively by agitating a 0.5 gram sample of the extracted vehicle with three successive 20 mL portions of isopropanol, decanting of the alcohol and saving each portion. The infrared spectrum shall be scanned from 2 to 15 μm of a solvent-free film of both the isopropanol insoluble portion and the soluble portion after evaporation of the alcohol. The sample shall be checked for compliance with 3.4.1.

4.6.16 60-degree specular gloss. When tested as specified in table V, gloss shall conform to requirements of table IV as applicable, for class specified.

4.6.17 Drying time. A film of enamel shall be prepared by drawing down a 0.075 mm (0.003 inch) film by using a 0.15 mm (0.006 inch) gap clearance with a film applicator, and the drying time shall be determined in accordance with method 4061.2 of FED-STD-141 under referee conditions for compliance with table IV.

4.6.18 Accelerated weathering. The duplicate flat tin panels shall be prepared by drawing down films of enamel with a 0.15 mm (0.006 inch) gap clearance film applicator and allowing 7 days for complete cure. Air-dry for 168 hours. Measure the initial color of the test panel in accordance with ASTM E97 on any suitable instrument. Measure the initial 60° gloss of the test panel in accordance with ASTM D523. Expose the panels for 300 hours to accelerated weathering using Fluorescent UV-Condensation type apparatus in accordance with ASTM G 53. The cycle shall be 4 hours UV exposure using a UVB-313 bulb at 60°C (140°F) and 4 hours condensation exposure at 40°C (104°F). After exposure, remeasure color and gloss in accordance with ASTM E97 and D523. Calculate color difference in accordance with ASTM D2244 and calculate gloss change. The chalking shall be evaluated in accordance with ASTM D 659 and 60-degree gloss determined in accordance with ASTM D 523. The results shall be checked for compliance with 3.3 and 3.5.13.

MIL-E-24635A(SH)

4.6.19 VOC. VOC tests shall be conducted on enamel prepared for application in accordance with the manufacturer's ASTM F718 data sheet. The VOC test shall be conducted in accordance with 40 CFR CH.1, part 60, appendix A, (EPA) method 24 and checked for compliance with 1.2 and table IV (see 6.3 and appendix).

4.6.20 Soluble and total metal content. Soluble and total metal content shall be determined on a dry paint film of the enamels in accordance with the Federal Register (FR), Volume 55, paragraph 11798, March 19, 1990 (55 FR 11798), Toxicity Characteristic Leaching Procedure (TCLP).

4.7 Toxicological product formulations. The contractor shall have the toxicological product formulations and associated information available for review by the contracting activity to evaluate the safety of the material for the proposed use.

4.8 Inspection of packaging. Sample packs, and the inspection of the preservation, packing and marking for shipment, stowage and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition.)

5.1 Packaging requirements. The enamel shall be package level A, B, or C packed as specified (see 6.7) and marked in accordance with PPP-P-1892, herein, and shall include bar codes, hazardous warnings (see 3.7) and applicable packaging acquisition options therein specified (see 6.2). The enamel shall be furnished in 3.78-liter (1-gallon) cans or 19-liter (5-gallon) pails as specified (see 6.2). In addition, for Navy acquisitions, the following Navy fire-retardant requirements apply:

- (a) Treated lumber and plywood. Unless otherwise specified (see 6.2), all lumber and plywood, including laminated veneer materials, used in shipping container and pallet construction, member, blocking, bracing, and reinforcing shall be fire-retardant treated material in accordance with MIL-L-19140 as follows:

Levels A and B: MIL-L-19140, type II (weather resistant), Category I (general use).

Level C: MIL-L-19140, type I (non-weather resistant), Category I (general use).

- (b) Fiberboard. Fiberboard used in the construction of interior (unit and intermediate) and exterior containers, including interior packaging forms, shall conform to the PPP-F-320. PPP-F-320 classes shall be domestic fire-retardant or weather resistant fire-retardant as specified (see 6.2).

MIL-E-24635A(SH)

5.1.1 Special marking. In addition to other markings required on the containers, enamels shall be marked as follows: "Contains (Insert VOC level for type here) grams per liter of volatile organic content per 40 CFR CH.1, part 60, appendix A (EPA) method 24."

5.1.2 Shelf life marking. In addition to markings specified in 5.1 and 5.1.1, each unit container, intermediate container where applicable, and shipping container shall be marked as follows: "Date of first reinspection (insert date 1 year after date of manufacture)".

5.1.3 Precautionary markings. In addition to the markings in accordance with 29 CFR Parts 1910, 1915, 1917, 1918, 1926 and 1928, as well as PPP-P-1892, all individual containers shall have the following markings:

"CAUTION: This enamel contains volatile solvents, with probable hazardous vapors. Use with adequate ventilation. Avoid prolonged breathing of vapors or spray mists. The solvents are highly flammable, avoid open flame and smoking."

5.2 Material safety data sheets (MSDS). A copy of the MSDS shall be attached to the shipping document for each destination (see 3.8).

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 high grade, air-drying enamels made from a copolymer of long-oil soya alkyd and silicone resins and is intended for use on primed metal, particularly on smooth, exterior metal. It is highly weather-resistant and is characterized by excellent color and gloss retention, good drying, freedom from aftertack and good flexibility. The enamel may be applied with brush, roller or spray.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- (a) Title, number, and date of this specification.
- (b) Type and class required (see 1.2).
- (c) Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
- (d) When first article inspection is required (see 3.1).
- (e) Color, class, and number of enamels recommended (see table VI).
- (f) Level of packaging, level of packing and packaging acquisition option(s) required (see 5.1).
- (g) When fire retardant treated lumber and plywood is not required (see 5.1a)
- (h) Class of fire retardant fiberboard required (see 5.1b)
- (i) Size of container required (see 5.1).
- (j) Required marking (see 5.1.1, 5.1.2 and 5.1.3).

MIL-E-24635A(SH)

TABLE VI. Color numbers and descriptions. 1/ 2/

Gloss	Semigloss	Low gloss lusterless	Word Description
---	*20109	30109	Brown (20109 for replacement of DOD-E-18210 formula 23)
---	20117	30117	Brown
10371	---	---	Spar (U.S. Coast Guard)
11136	21136	31136	Red (Insignia red)
12197	---	---	International orange
12199	---	---	Red (U.S. Coast Guard)
13655	23655	33655	Yellow
14097	24097	*34097	Dark green (34092 for replacement of DOD-E-18214 formula 19)
15042	25042	35042	Blue (Sea blue)
15048	25048	35048	Blue (Insignia blue)
15102	25102	---	Blue (Light blue)
15182	---	---	Blue (U.S. Coast Guard)
---	*26008	---	Gray (26008 for replacement of DOD-E-699 formula 20)
16099	---	---	Deckgray (U.S. Coast Guard)
---	26118	*36118	Gray # 11 (36118 for replacement of DOD-P-15183 formula 109)
---	*26173	36173	Gray # 17 (Ocean gray)
---	26231	*36231	Gray # 23 (36231 for replacement of DOD-E-700 formula 20L)
---	*26270	36270	Gray # 27 (Haze gray; 26270 for Navy semigloss requirements)
16307	*26307	36307	Gray # 30 (Bulkhead gray)
---	*26373	36273	Gray # 37
16492	*26492	36492	Gray # 49 (Gull or Pearl Gray)
17038	*27038	37038	Black (27038 for replacement of DOD-E-698 formula 24; 37038 for replacement of DOD-P-15146 formula 104; 17038-U.S. Coast Guard)
17875	*27875	37875	White (Insignia white - 27875 matches color of DOD-E-1115 formula 30)
17886	27886	37886	White (bone white)

1/ See FED-STD-595 for color cards.

2/ * mark Navy colors.

MIL-E-24635A(SH)

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DoD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

<u>Reference Paragraph</u>	<u>DID Number</u>	<u>DID Title</u>	<u>Suggested Tailoring</u>
4.6.19 and appendix 4.4	DI-MISC-80678	Certification/data report	-----

The above DID's were those cleared as of the date of this specification. The current issue of DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. 24635 whether or not such products have actually been listed by that date. The attention of contractors is called to these requirements, 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 purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Sea Systems Command, SEA 5122P, Washington, D.C. 20362-5101 and information pertaining to qualification of products may be obtained from that activity.

6.5 The paint covered by this specification should be purchased by volume, the unit being 1 liter or 1 U.S. liquid gallon at 15.5°C (60°F).

6.6 Volatile content. Although the container marking specifically refers to Federal regulations, the paint may be used anywhere else a product complying with 1.2 is allowed. This includes other air pollution control districts or similar areas controlling the emission of solvents into the atmosphere.

6.7 Material Safety Data Sheets. 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 FED-STD-313.

MIL-E-24635A(SH)

6.8 Directions for use. The manufacturer must provide written directions for the mixing and applying of the enamel supplied and this direction shall include all information necessary to comply with OSHA Hazard Communication Act and FED-STD-313. In addition, the manufacturer must prepare an ASTM F 718 data sheet which separately details requirements for small unit (pint, quart, gallon) and large unit (5 gallon) containers.

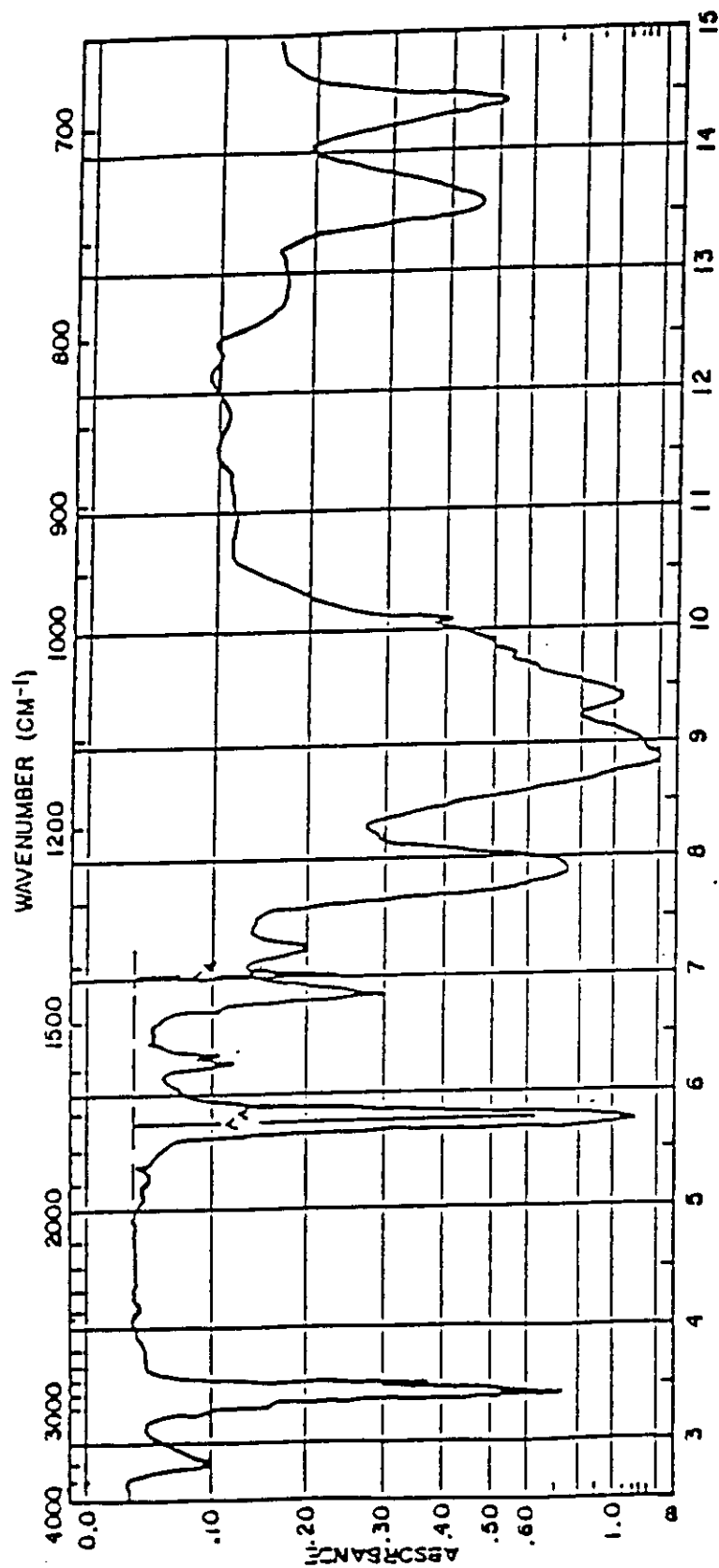
6.9 Subject term (key word) listing.

Alkyd
Flat
Gloss
Low-gloss
Non-lead
Paint
Semi-gloss
Topcoat
Volatile organic content

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

Preparing activity:
Navy - SH
(Project 8010-N262)

MIL-E-24635A(SH)

FIGURE 1. Wavelength (micrometers).

MIL-E-24635A(SH)

APPENDIX

CERTIFICATION/DATA REPORT TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers the content requirements of the certification to accompany each lot of enamel submitted for Government acceptance. This appendix is mandatory only when data item description DI-MISC-80678 is cited on the DD Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. TECHNICAL CONTENT REQUIREMENTS

30.1 Certificate of compliance. The certificate of compliance shall include separate and specific statements by the contractor that:

- (a) The VOC shall conform to the requirements of the enamel as specified in table IV.
- (b) The lead and asbestos content shall conform to the requirements of the enamel as specified in table IV.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

1. RECOMMEND A CHANGE:		1. DOCUMENT NUMBER MIL-E-24635A	2. DOCUMENT DATE (YYMMDD) 91 JUNE 19
3. DOCUMENT TITLE ENAMEL, SILICONE ALKYD COPOLYMER (METRIC)			
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)			
5. REASON FOR RECOMMENDATION			
6. SUBMITTER			
a. NAME (Last, First, Middle Initial)		b. ORGANIZATION	
c. ADDRESS (Include Zip Code)		d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)
8. PREPARING ACTIVITY			
a. NAME Technical Point of Contact (TPOC) Dr. Brenda S. Holmes		b. TELEPHONE (Include Area Code) (1) Commercial (703) 602-0213	(2) AUTOVON 332-0213
c. ADDRESS (Include Zip Code) Commander Naval Sea Systems Command, Code 5523 Washington, DC 20362-5101		IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	