

METRIC

MIL-DTL-24441C(SH)

19 May 1999

SUPERSEDING

MIL-P-24441B(SH)

23 July 1991

DETAIL SPECIFICATION

PAINT, EPOXY-POLYAMIDE, GENERAL SPECIFICATION FOR

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 a series of two component epoxy-polyamide paints designed to protect metal and plastic surfaces from environmental attack.

1.2 Classification. Paints covered by this specification will be of the following types, as specified (see 6.2):

Type III - Three coat system, for use where air pollution regulations restrict volatile organic content (VOC) to 340 grams per liter (2.8 pounds per gallon).

Type IV - Two coat system, for use where air pollution regulations restrict volatile organic content (VOC) to 340 grams per liter (2.8 pounds per gallon).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 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).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, SEA 03Q, Naval Sea Systems Command, 2531 Jefferson Davis Hwy, Arlington, VA 22242-5160 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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SPECIFICATIONS

FEDERAL

QQ-S-698 - Steel Sheet and Strip, Low Carbon.

DEPARTMENT OF DEFENSE

(See supplement 1 for list of specification sheets.)

STANDARDS

FEDERAL

FED-STD-141 - Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling and Testing.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Defense Automated Printing Service (DAPS), 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 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.

DEPARTMENT OF LABOR

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

29 CFR Part 1910.1000 - Subpart Z, Toxic and Hazardous Substances
 29 CFR 1910.1001J, Validated Analytical Method ID-191 - Polarized Light Microscopy of Asbestos.
 29 CFR Part 1990 - Identification, Classification, and Regulation of Potential Occupational Carcinogens

ENVIRONMENTAL PROTECTION AGENCY (EPA)

40 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.
 40 CFR Part 82 - Protection of Stratospheric Ozone.
 40 CFR part 261, appendix II, method 1311 - Toxicity Characteristic Leaching Procedure (TCLP).
 EPA SW-846 - Test Methods for Evaluating Solid Waste - Physical/Chemical Methods (NSN 955-001-00000-1).
 EPA 600/4-020 - Methods for Chemical Analysis of Water and Waste (USEPA, 1979).
 40 CFR 355 Appendixes A and B - The List of Extremely Hazardous Substances and Their Threshold Planning Quantities.
 40 CFR Part 372.65 - Specific Toxic Chemical Listings.

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49 Code of Federal Regulations (CFR) Part 171-178 -
Hazardous Materials Regulations

(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.)

2.3 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 Department of Defense Index of Specifications and Standards (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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM D 185 - Standard Test Methods for Coarse Particles in Pigments, Pastes, and Paints. (DoD adopted)
- ASTM D 523 - Standard Test Method for Specular Gloss. (DoD adopted)
- ASTM D 562 - Standard Test Method for Consistency of Paints Using the Stormer Viscometer. (DoD adopted)
- ASTM D 714 - Standard Test Method for Evaluating Degree of Blistering of Paints. (DoD adopted)
- ASTM D 1141 - Standard Specification for Substitute Ocean Water. (DoD adopted)
- ASTM D 1210 - Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman Type Gage. (DoD adopted)
- ASTM D 1296 - Standard Test Method for Odor of Volatile Solvents and Diluents. (DoD adopted)
- ASTM D 1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes. (DoD adopted)
- ASTM D 1364 - Standard Test Method for Water in Volatile Solvents (Karl Fischer Reagent Titration Method). (DoD adopted)
- ASTM D 1394 - Standard Test Methods for Chemical Analysis of White Titanium Pigments. (DoD adopted)
- ASTM D 1475 - Standard Test Method for Density of Paint, Varnish, Lacquer, and Related Products. (DoD adopted)
- ASTM D 1640 - Standard Test Methods for Drying, Curling, or Film Formation of Organic Coatings at Room Temperature. (DoD adopted)
- ASTM D 1652 - Standard Test Methods for Epoxy Content of Epoxy Resins. (DoD adopted)
- ASTM D 1729 - Standard Practice for Visual Appraisal of Color Differences of Diffusely-Illuminated Opaque Materials. (DoD adopted)
- ASTM D 2244 - Standard Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates. (DoD adopted)
- ASTM D 2369 - Standard Test Method for Volatile Content of Coatings. (DoD adopted)
- ASTM D 2698 - Standard Test Method for Determination of the Pigment Content Of Solvent-Reducible Paints by High-Speed Centrifuging. (DoD adopted)

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- ASTM D 2805 - Standard Test Method for Hiding Power of Paints by Reflectometry. (DoD adopted)
- ASTM D 3272 - Standard Practice for Vacuum Distillation of Solvents from Solvent-Reducible Paints for Analysis. (DoD adopted)
- ASTM D 3278 - Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus. (DoD adopted)
- ASTM D 3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings. (DoD adopted)
- ASTM D 4417 - Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel. (DoD adopted)
- ASTM D 4541 - Standard Test Method for Pull-Off Strength of Coatings Using portable Adhesion Testers.
- ASTM E 260 - Standard Practice for Packed Column Gas Chromatography.
- ASTM E 1252 - Standard Practice for General Techniques for Qualitative Infrared Analysis.

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC)

International Agency for Research on Cancer (IARC) Monographs

(Application for copies should be addressed to the WHO Publication Center, 49 Sheridan Avenue, Albany, NY 12210.)

NATIONAL TOXICOLOGY PROGRAM (NTP)

Latest Annual Report on Carcinogens, Summary, National Toxicology Program

(Application for copies should be addressed to the U.S. Department of Health and Human Services, National Institute of Environmental Health Sciences, Public Information Office, P.O. Box 12233, MD B2-04, Research Triangle Park, NC 27709.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), 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 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. The paints furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.3 Manufacturer. The paint shall be manufactured (see 6.5) and

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supplied as a two component system formulated in accordance with the applicable specification sheet to produce a uniform, high quality product capable of meeting all requirements.

3.4 Composition. The components shall be manufactured using the material specified, and in the proportions as specified in the individual specification sheets. The components shall be completely compatible so, when components A and B are mixed as specified by volume, the paint shall be suitable for spray applications above 4.4 degrees Celsius (°C) (40 degrees Fahrenheit(°F)), and shall meet all other specified requirements. To achieve specified colors, pigments dispersed in polyamide may be used for tinting provided all requirements of the specification are met. Added pigment shall not exceed 120 grams for 100 liters (1 pound for 100 gallons).

3.4.1 Solvent. Types III and IV materials shall have solvents conforming to the applicable specification sheets.

3.4.2 Use of alternate ("or equal") ingredients. Specification sheets allow manufacturers to use alternate ("or equal") ingredients for named ingredients. When such alternate ingredients are used, manufactures shall conduct the following qualification tests.

3.4.2.1 Alternate solvents. When tested as specified in 4.5.20, the content of hazardous air pollutant solvents (HAPs) in the each individual liquid coating shall not exceed the weight percent (%WT) values specified in table I. Within these limitations and the requirement that the finished coating meet all requirements of this specification, coating system solvent selection is the responsibility of the manufacturer.

TABLE I. Hazardous air pollutant (HAPs) solvent content limits of coatings using alternate solvents.

Hazardous solvent in each individual total paint	Maximum, %WT
Benzene	0.05
Chlorine or Fluorine containing solvents, total	0.05
Class I or class II ozone-depleting chemicals as defined in 40 CFR 82	0.01
Ethyl benzene	0.05
Methyl, Ethyl and Butyl mono-ethers of Ethylene glycol or the acetates thereof, total (Methyl, Ethyl and Butyl cellosolves and Methyl, Ethyl, and Butyl cellosolve acetates)	0.05
Methyl ethyl ketone (MEK)	0.05
Methyl isobutyl ketone (MIBK)	0.05
Toluene	0.05
Xylene (all forms), total	0.1

3.4.2.2 Alternate pigments and additives. When tested as specified in 4.5.21, the content of each soluble metal and total content of each metal in the coating, shall be not greater than the values specified in table II. In addition, asbestos and asbestos form pigments shall not exceed 5 milligrams per liter (mg/L). Crystalline silica shall not exceed 100 mg/L.

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TABLE II. Metals content for coatings using alternate pigments.

Soluble metal and its compound in each individual dry paint	Soluble content, maximum, mg/L	Total content, maximum, %Weight
Antimony	15	0.015
Arsenic	0.001	0.001
Barium (excluding barite)	100	0.10
Beryllium	0.75	0.0002
Cadmium	1	0.0005
Chromium (VI)	5	0.0005
Chromium and chromium (III)	560	0.56
Cobalt	80	0.005
Copper	25	0.01
Fluoride salts	180	0.18
Lead	5	0.005
Mercury	0.2	0.0002
Molybdenum	350	0.35
Nickel	20	0.02
Selenium	1	0.001
Silver	5	0.001
Tantalum	100	0.100
Tungsten	100	0.100
Vanadium	24	0.01
Zinc	250	0.25

3.4.3 Toxicity. The materials used in the coating compound, unless specific material maximum levels are cited herein (see 3.3.2, and 3.3.3), shall have no known carcinogenic or potentially carcinogenic materials identified by OSHA (29 CFR 1990) as regulated carcinogens, or IARC latest monographs, or the latest annual report of the NTP; and shall have no extremely hazardous substances (EHS) or toxic chemicals identified in 29 CFR 1910.1000, 40 CFR 355 and 372, respectively. The manufacturer is responsible for maintaining carcinogenic free, extremely hazardous substance free, and toxic chemical free, materials. The manufacturer shall not, unless specific material maximum levels are cited herein, allow the addition of any of these prohibited materials to the formulation; and when any of these prohibited materials are/may be present, as a result of being present as a trace or impurity in another ingredient(s), the concentration of the prohibited material shall not equal or exceed 0.01 percent by weight of the coating compound. Questions pertinent to this toxic effect shall be referred by the contracting activity to the qualifying activity. The qualifying activity will act as advisor to the contracting activity. The qualifying will arrange for review of questions by the appropriate departmental medical service.

3.4.4 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.5 Conformance requirements. The paint shall conform to all qualitative requirements specified in 3.6 and all quantitative requirements tabulated in the applicable specification sheet when tested as specified in section 4.

3.6 Qualitative requirements. Qualitative requirements shall be as specified in 3.6.1 through 3.6.10:

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3.6.1 Brushing properties. When prepared for application as specified in 4.5.1 and tested as specified in 4.5, the paint shall be capable of being brushed out and laid off without excess drag on the brush. When dry, the brushed surface shall be free from sags or runs, and shall show a minimum of brush marks.

3.6.2 Spraying properties. When prepared for application as specified in 4.5.1 and tested as specified in 4.5 and 4.5.9, the paint, shall spray satisfactorily in all respects, and shall show no running, sagging or streaking. The film shall show no dusting, mottling, or color separation and shall be smooth and uniform.

3.6.3 Flexibility. When prepared as specified in 4.5.1 and tested as specified in 4.5.10, a film of paint shall withstand bending without visible cracking or flaking.

3.6.4 Stability in partially full container. When tested as specified in 4.5.12, a three-quarter filled, closed 0.1-Liter (L) (8-ounce) glass jars of part A and part B shall show no skinning, livering, curdling, seeding, hard caking, loss of thixotropy, or gummy sediment. After this aging, each component shall remix readily to a smooth uniform mixture with a consistency not greater than 625 grams to produce a 200 revolutions per minute (r/min) Krebs-Stormer shear rate (121 Krebs units [KU]).

3.6.5 Dilution stability. When thinned as specified in 4.5.13 and mixed as specified in 4.5.1, paint shall remain stable and uniform showing no precipitation, separation, or curdling.

3.6.6 Odor. The odor shall be characteristic of the volatiles permitted.

3.6.7 Condition in container.

3.6.7.1 Components. When tested as specified in 4.5.14, each component shall be readily broken up with a paddle to a smooth, uniform consistency and shall not liver, gel, or show any other objectionable properties for at least 1 year after date of acceptance.

3.6.7.2 Paint. When tested as specified in 4.5.14, components which have been stored for at least 1 year in their original containers, shall, when mixed as specified in 4.5.1 and shall produce a paint which meets all requirements of this specification and the applicable specification sheet, except that the consistency of the mixed paint reported in grams shall be ~~no~~ ~~more~~ not greater than 625 grams (121 KU).

3.6.7.3 Accelerated storage stability. When mixed as specified in 4.5 and tested as specified in table III, components shall meet the requirements of this specification and the applicable specification sheet for consistency, fineness of grind, and condition in container. Mixed paints from these components shall have a consistency of not more than 625 grams when tested in accordance with ASTM D 562, and, when tested as specified in table III, shall meet the requirements of the applicable specification sheet for dust-free time, dry-hard time, fineness of grind, pot life, sag, gloss, sprayability, and condition in container.

3.6.8 Immersion tests. When tested as specified in 4.5.15, qualification paint test panels shall perform at least as well as the reference panels for blistering resistance and the average adhesion, both to the substrate and the original paint in the recoated area, shall be not less

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than 95 percent of average adhesion values measured for the reference panels in the same areas.

3.6.9 Solvent resistance. When prepared and tested as specified in 4.5.11, paint films, shall show no wrinkling, softening, tackiness, swelling, blistering, loss of adhesion, or other signs of solvent attack when examined.

3.6.10 Cathodic protection (formula 159 only). When formula 159 is tested as specified in 4.5.19, the coating shall prevent corrosion in the bare metal area for not less than 48 hours. No corrosion of bare circle or any other surface shall occur.

4. VERIFICATION

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

- (a) Qualification inspection (see 4.2).
- (b) Conformance inspection (see 4.3)

4.2 Qualification inspection. Qualification inspection for paint ingredients and for finished paints shall be conducted at a laboratory satisfactory to the Naval Sea Systems Command. Qualification inspection for paint ingredients shall consist of the appropriate ingredient specification tests and performance testing of paints made using the candidate ingredients. These performance tests shall be run comparing paints made with the candidate raw material to paints made exclusively from reference materials. Qualification inspections for paints made with candidate raw materials, and qualification inspections for a manufacturer's paint, shall consist of all tests specified in 4.5.

4.2.1 Qualification application. The contractor shall apply at least three coatings comprising one of the coating systems listed (see 4.5.15.1) for qualification inspection.

4.2.2 Toxicological product formulations. The contractor shall have the toxicological product formulations and associated information, including the material safety data sheet (MSDS), available for review by the contracting activity to evaluate the safety of the material for the proposed use.

4.3 Conformance inspection.

4.3.1 Lot. For purposes of conformance inspection, a lot shall consist of all epoxy-polyamide paint of the same formula number from a single uniform batch or single uniform blend of batches (for each component) offered for delivery at one time. Two representative samples of component A and of component B from each lot of paint (total of 4 samples per lot) shall be forwarded to a designated Government laboratory for verification tests. The 4 samples per lot shall be packaged in separate containers. Minimum size for each sample shall be 1 liter (1 quart).

4.3.2 Conformance tests. Conformance tests for acceptance of individual lots shall consist of all tests identified by footnote 1/ in table III. As a minimum, the contractor shall select representative samples from the first and last containers from each lot of each component, and subject the samples to all conformance tests. Results shall meet the applicable requirements in section 3 (see 6.7).

4.4 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in 4.

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4.5 Test methods. The paint shall be tested in accordance with the applicable methods specified in table III and other methods as described herein.

TABLE III. Verification requirements.

Item	Applicable method in FED-STD-141	Applicable ASTM test method	Test	Requirement
Pigment content <u>1/</u>	4021.1	----	----	<u>2/</u>
Volatile percent <u>1/</u>	----	D 2369	4.5.2	<u>2/</u>
Nonvolatile vehicle content <u>1/</u>	4053.1	----	----	<u>2/</u>
Water	----	D 1364	----	<u>2/</u>
Coarse particles <u>1/</u>	----	D 185	----	<u>2/</u>
Consistency <u>1/</u>	----	D 562	----	<u>2/</u>
Weight per liter (kilograms/Liter [Kg/L]) [pounds/gallon [lb/gal]] <u>1/</u>	----	D 1475	----	<u>2/</u>
Alternate solvents	7356 7360	D 3272 E 260 E 1252		<u>2/</u> 3.4.2.1
Alternate pigments and additives	----	----		<u>2/</u> 3.4.2.2
Dust-free drying time <u>1/</u>	----	D 1640	4.5.3	<u>2/</u>
Dry-hard time <u>1/</u>	----	D 1640	4.5.3	<u>2/</u>
Fineness of grind <u>1/</u>	----	D 1210	----	<u>2/</u>
Flash point <u>1/</u>	----	D 3278	----	<u>2/</u>
Adhesion	----	D 4541	4.5.15.4	<u>2/</u>
Titanium dioxide	----	D 1394	----	<u>2/</u>
Pot life <u>1/</u>	----	----	4.5.4	<u>2/</u>
Gloss <u>1/</u>	----	D 523	4.5.5	<u>2/</u>
Contrast ratio <u>1/</u>		D 2805	----	<u>2/</u>
Sag <u>1/</u> <u>3/</u>	4494.1	----	4.5.6	<u>2/</u>
Epoxy equivalent weight	----	D 1652	4.5.17	<u>2/</u>
Color (wetted film) <u>1/</u>	----	D 2244	4.5.7.1	<u>2/</u>
Color (dry film) <u>1/</u>	----	D 1729	4.5.7.2	<u>2/</u>
Brushing properties <u>1/</u>	4321.2	----	4.5.8	3.6.1
Spraying properties <u>1/</u>	4331.1	----	4.5.9	3.6.2
Flexibility	6221	----	4.5.10	3.6.3
Stability in partially full container	3021.1	----	4.5.12	3.6.4
Dilution stability	4203.1	----	4.5.13	3.6.5
Odor <u>1/</u>	----	D 1296	4.5.16	3.6.6
Condition in container <u>1/</u>	3011.2	----	4.5.14	3.6.7
Immersion tests	----	----	4.5.15	3.6.8
Solvent resistance	----	D 1308	4.5.11	3.6.9
Volatile organic content	----	D 3960	4.5.18	<u>2/</u>
Cathodic protection	----	----	4.5.19	3.6.10

1/ See 4.3.2.

2/ See applicable specification sheet.

3/ In accordance with FED-STD-141.

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4.5.1 Preparation of paint for testing.

4.5.1.1 Conditioning of paint. Each component, prior to testing, shall be mixed on a paint shaker. One-liter (L) (1-quart) samples shall be shaken not less than 5 minutes and 4-L (1-gallon) containers shall be shaken not less than 10 minutes until all ingredients are uniformly distributed.

4.5.1.2 Storage. Components shall be maintained at ambient laboratory conditions (nominal 23°C [73°F]) and any other further mixing shall be by spatula or paddle.

4.5.1.3 Mixed paints. Prepare 844 ml (13.5 ounces) of paint. Thoroughly mix by hand stirring with a spatula or paint paddle. Allow the thoroughly mixed paint to condition for 1 hour in a bath maintained at 23°C ± 1°C (73°F ± 2°F) prior to testing.

4.5.1.4 Reference paints. When reference paints are referred to in this document, paints of any type having the equivalent formula number from a vendor qualified to this specification shall be used. Reference paints constituting the equivalent system to that being qualified shall be from the same qualified source. Preparation of panels using the reference paints shall be in accordance with this specification.

4.5.2 Volatile percent. Determine volatiles in accordance with ASTM D 2369. Test result shall be in accordance with the requirements of the appropriate specification sheet.

4.5.3 Dust-free and dry-hard times. Prepare duplicate test panels by drawing down material prepared as specified in 4.5.1 to a 75 µm (3-mil) wet film thickness on a ground glass panel. Cure one panel in a dust-free location at 4.4°C ± 1°C (40°F ± 2°F). Determine the dry-hard time on each panel in accordance with ASTM D 1640. Dust-free and dry-hard time shall be in accordance with the requirements of the appropriate specification sheet.

4.5.4 Pot life. Mix paint 1-L (1-quart) as specified in 4.5.1.3 from materials conditioned to 23°C ± 1°C (73°F ± 2°F). Remove mixed paint from the water bath at the following intervals from initial mixing and determine consistency: 1 hour before the specified pot life and every half-hour for the remaining hour. Test may be terminated whenever the consistency exceeds 625 grams or at the end of the specified pot life, whichever comes first. Pot life shall be in accordance with the requirements of the appropriate specification sheet.

4.5.5 Gloss. Prepare a test panel by spraying out a 100 µm (4-mil) (nominal) wet film thickness of material prepared as specified in 4.5.1, except allow a maximum of 2 hours conditioning prior to spray out on plain opaque white glass or other suitable substrate using a suitable spray apparatus. Dry the film in a dust-free area for 24 hours at 23°C (73°F) (nominal) and determine gloss in accordance with ASTM D 523. Gloss shall be in accordance with the requirements of the appropriate specification sheet.

4.5.6 Sag test. Test the paint mixed, as specified in 4.5.1, in accordance with method 4494.1 of FED-STD-141. Determine the greatest value at which sag does not occur. Sag shall be in accordance with the requirements of the appropriate specification sheet.

4.5.7 Color. Determine color in accordance with one of the following, depending on whether wet film or dry film is specified.

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4.5.7.1 Camouflage coatings. Wetted film for camouflage coatings (camouflage coatings are identified as formulas 153, 154, and 155). Prepare the test panel by spraying on smooth steel a 100 μm (4-mil) (nominal) wet film thickness of material prepared as specified in 4.5.1. Dry the panel for 16 hours at ambient laboratory conditions, then 15 minutes at $52^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($125^{\circ}\text{F} \pm 5^{\circ}\text{F}$). The color shall be measured using ASTM D 2244. Color shall be in accordance with the requirements of the appropriate specification sheet.

4.5.7.1.1 Reflectometer. The reflectometer shall have a geometry conforming to method 6123 of FED-STD-141 with an illumination angle of 45 degrees from the perpendicular, and a viewing angle of 0 degrees from the perpendicular. The reflectometer shall measure green reflectance in the range 0.80 ± 0.01 to 4.00 ± 0.01 percent. Any instrument with the required precision and accuracy is suitable for use (see 4.5.7.1.4).

4.5.7.1.2 Wetting solution. Distilled water containing approximately 1/10 percent of a clear wetting agent (detergent) shall be used for wetting the specimens. Solution shall wet the paint film in a sheet without foam.

4.5.7.1.3 Procedure. Cover the specimen to be tested with a thin film of the wetting solution mixture (see 4.5.7.1.2) and immediately obtain a green reflectance reading. Check specimen after obtaining reading for intact water film. If water film is not intact, repeat procedure until a satisfactory reading is obtained on a fully wetted test area.

4.5.7.1.4 Alternative color measuring equipment. Manufacturers can qualify alternative color measuring equipment to the Naval Sea Systems Command (NAVSEA) or the General Services Administration (GSA) by demonstrating that the particular instrumentation to be used to measure the green color parameter with the accuracy specified in 4.5.7.1.1. The manufacturer shall demonstrate that the alternate instrumentation can provide green color parameters that result in the colors defined in the appropriate specification sheet.

4.5.7.2 Color of dry film of non-camouflage paints. Prepare a panel for test by spraying or draw down, on smooth steel or other suitable substrate, a 100 μm (4-mil) (nominal) wet film thickness of material prepared as specified in 4.5.1. Dry for 16 hours at ambient laboratory conditions, then 15 minutes at $52^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($125^{\circ}\text{F} \pm 5^{\circ}\text{F}$). Compare the test panel with the standard color chip in accordance with ASTM D 1729. If doubt exists as to whether the match is satisfactory, determine the color difference by instrument as specified in ASTM D 2244. An acceptable color match shall be as specified in the individual specification sheets.

4.5.8 Brushing properties. Prepare the paint as specified in 4.5.1. Without further reduction, apply the paint in accordance with method 4321.2 of FED-STD-141. Brushing properties shall be as specified in 3.6.1.

4.5.9 Spraying properties. Prepare the paint as specified in 4.5.1. Without further reduction, spray on a sandblasted steel panel to a 150 μm (6-mil) (nominal) wet film thickness. Observe for spraying properties in accordance with method 4331.1 of FED-STD-141. Spraying properties shall be as specified in 3.6.2. For referee test, use automatic application of method 2131.1 of FED-STD-141.

4.5.10 Flexibility. Determine flexibility in accordance with method 6221 of FED-STD-141 and as follows.

4.5.10.1 Panel preparation. Prepare a flat tin panel in accordance

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with method 2012.2 of FED-STD-141 using the petroleum naphtha-ethylene glycol monoethyl ether mixture. Apply a 50 mm (2-inch) (nominal) wide film of mixed paint (see 4.5.1) with a suitable film applicator that will give a dry film thickness of $38 \pm 8 \mu\text{m}$ (1.5 ± 0.3 mils). Air dry paint in a horizontal position for 24 hours at ambient laboratory conditions.

4.5.10.2 Procedure. Bend 180 degrees over a 3-millimeter (mm) (1/8-inch) (nominal) mandrel and examine the coating for cracks over the area of the bend in a strong light at a 2-diameter magnification. Flexibility shall be as specified in 3.6.3.

4.5.11 Solvent resistance. Determine solvent resistance by immersion in xylene, methyl isobutyl ketone (MIBK), and a 1:1 by volume mixture of methyl isobutyl ketone and xylene.

4.5.11.1 Panel preparation. Prepare three tin panels in accordance with method 2011.2 of FED-STD-141 using the petroleum naphtha 2-ethoxy ethanol mixture. Draw down a film of mixed paint (see 4.5.1) to give a dry film thickness of $38 \pm 8 \mu\text{m}$ (1.5 ± 0.3 mils). Air dry the film at $23^\circ\text{C} \pm 0.3^\circ\text{C}$ ($73^\circ\text{F} \pm 5^\circ\text{F}$) for 24 hours.

4.5.11.2 Procedure. Immerse a panel in each solvent system listed in 4.5.11 at $23^\circ\text{C} \pm 3^\circ\text{C}$ ($73^\circ\text{F} \pm 5^\circ\text{F}$) for 18 hours in accordance with ASTM D 1308. Examine for wrinkling, softening, tackiness, swelling, blistering, loss of adhesion, or other signs of solvent attack at removal, 2 hours and at 24 hours after removal from the solvent. Solvent resistance shall be as specified in 3.6.9.

4.5.12 Stability in partially full container. Determine stability and consistency of a three-quarter filled, closed 0.5-L (8-ounce) glass jar of each component after aging for 7 days at 60°C (140°F) in accordance with method 3021.1 of FED-STD-141. Results shall be as specified in 3.6.4.

4.5.13 Dilution stability. Prepare thinner by mixing one volume of thinner prepared from the solvents specified by the formula being tested in the amounts specified. Reduce one part by volume of mixed component from 4.5.1 with one part by volume thinner. Then test in accordance with method 4203.1 of FED-STD-141. Results shall be as specified in 3.6.5.

4.5.14 Condition in container. When tested in accordance with method 3011.2 of FED-STD-141, the individual components shall be readily broken up with a paddle to a smooth, uniform consistency. When tested as specified in table III, paint, mixed from the components aged for one year at ambient laboratory conditions, shall be as specified in 3.6.7.2. When tested in accordance with ASTM D 562, the consistency of the paint, mixed from the aged components, shall be as specified in 3.6.7.2.

4.5.15 Hot distilled water test. Determine resistance to hot distilled water. Six qualification paint and six reference test panels (see 4.5.1.4) are required from each system. Three qualification paint and three reference panels are used as test controls for the 82°C (180°F) immersion test and the remaining three panels of each paint system are used as test controls from the 93°C (200°F) immersion test.

4.5.15.1 Preparation of panels. Panels shall be mild steel in accordance with QQ-S-698, cold rolled, 90 mm by 150 mm by 3.0 mm (6 inches by 10 inches by 1/8-inch) (nominal) blasted using aluminum abrasive blasting media to a uniform white appearance with a minimum surface profile of $25 \mu\text{m}$ (1 mil) (nominal), but not greater than $75 \mu\text{m}$ (3 mils) (nominal) peak to valley

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when measured in accordance with ASTM D 4417. Panels shall be vapor degreased before blasting and care shall be taken to prevent recontamination (especially by fingerprints) before painting. Panels shall be cleaned after blasting using clean, dry compressed air or vacuum.

- (a) Type III paints. Prepare six test panels for each of the following systems:

	System A	System B	System C	System D
Coat no. 1	<u>1</u> / F.150	F.150	F.150	F.162
Coat no. 2	F.151	F.151	F.151	F.161
Coat no. 3	F.152	F.156	F.153, 154, 155	F.160

1/ F. indicates formula number.

- (b) Type IV paints. Prepare six test panels for each of the following systems:

	System A	System B	System C	System D
Coat no. 1	<u>1</u> / F.150	F.150	F.150	F.162
Coat no. 2	F.151	F.152	F.153, 154, 155	F.156

1/ F. indicates formula number.

The total dry film thickness, 200 to 250 μm (8 to 10 mils) (nominal), for type III and type IV paints, shall be applied to both sides of panel. Apply paint using standard spray equipment allowing 16 to 24 hours drying time between coats at ambient laboratory conditions (nominal 23°C (73 °F)). Condition coated panels for 1 week after application of final coat at ambient laboratory conditions (nominal 23°C (73°F)). Measure and report the dry film thickness for each side of each panel.

4.5.15.2 Testing of panels. Immerse three panels in 82°C (180°F) distilled water and three panels in 93°C (200°F) distilled water. Remove the panels from the 93°C (200°F) tank at the end of 2 weeks, wash, dry, and sand one side of each panel to a dull finish with no. 100 emery cloth. Wash, dry, and recoat the sanded side with an additional 50 to 75 μm (2 to 3 mils) (nominal) coat of coat no. 3 for type III paints or coat no. 2 of type IV paints. Cure for 1 week and reimmerse in 93°C (200°F) distilled water for two weeks. Remove the panels and examine for appearance, blistering, and adhesion. Repeat the preceding for the panels immersed in 82°C (180°F) distilled water after 10 weeks immersion.

4.5.15.3 Blistering. Determine degree of blistering in accordance with ASTM D 714. Blisters appearing within 6 mm (1/4-inch) (nominal) from the edge of the panel and that are less than 1.6 mm (1/16-inch) in diameter shall be disregarded. Qualification test panels shall perform at least as well as the reference panels for blistering both the substrate and to the original paint in the recoated area.

4.5.15.4 Adhesion. Determine adhesion of both sides of each panel using a tensile adhesion tester in accordance with ASTM D 4541 to determine any loss of adhesion. Adhesion shall be as specified in 3.6.8.

4.5.16 Odor. Test in accordance with ASTM D 1296. Odor shall be as specified in 3.6.6.

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4.5.17 Epoxy equivalent. Determine the epoxy equivalent weight of the nonvolatile from component B. Separate the pigments from component B in accordance with ASTM D 2698. Remove solvents from the resinous portion by evaporating on a steam bath. Determine epoxy equivalent weight of the nonvolatile vehicle in accordance with ASTM D 1652. Epoxy equivalent weight shall be as specified in the appropriate specification sheet.

4.5.18 Volatile organic content (VOC) determination. VOC shall be determined in accordance with EPA Method 24 (40 CFR ch.1, part 60, appendix A, method 24) as follows:

- (a) The paint test sample shall be drawn from material prepared as specified in 4.5.1.3.
- (b) Nonvolatile matter content shall be determined in accordance with EPA Method 24 and ASTM D 2369. Between steps 7.2 and 7.3 of ASTM D 2369, in the EPA Method 24, the aluminum foil dish containing the solvent-paint test sample mixture shall be allowed to set in a desiccator for 24 hours to cure resin fractions not volatile under use conditions, but volatile at 105°C (221°F). After 24 hours, proceed to step 7.3 of ASTM D 2369 and complete all testing required by ASTM D 3960. [Note: Since neither ASTM D 2369 nor EPA Method 24 contain a time interval requirement between steps 7.2 and 7.3, this modification does not violate the test procedure.]

4.5.19 Cathodic protection.

4.5.19.1 Panel preparation. Test panels shall be prepared from cold rolled sheet steel in accordance with QQ-S-698, shall be 150 mm by 300 mm by 3 mm (6 inches by 8 inches by 1/8-inches) (nominal) and blasted using aluminum oxide abrasive blasting media to a uniform white appearance (no more than 0.01 percent remaining rust) with a minimum surface profile of 75 µm (3mils)(nominal) peak to valley when measured in accordance with ASTM D 4417. Panels shall be vapor degreased before blasting, and care shall be taken to prevent recontamination (especially by fingerprints) before painting. Panels shall be cleaned after blasting with clean, dry compressed air or vacuum. After blasting, mask off a 60 mm (2-1/2 inch) (nominal) circle in the center of the panel with a non residue tape or other non residue impervious mask. Apply by spraying 75 to 125 µm (3 to 5 mils) of formula 159 to all exposed metal surfaces. Cure 24 hours at ambient laboratory conditions.

4.5.19.2 Immersion. After removing circle mask, wash bare metal with appropriate solvent to remove all tape residue and allow to dry. Fully immerse panel in a container of substitute ocean water in accordance with ASTM D 1141 for 48 hours at ambient laboratory conditions. Cathodic protection results shall be as specified in 3.6.10.

4.5.20 HAP content of coatings. Hazardous solvent content of each individual coating shall be determined in accordance with ASTM D 3272, ASTM E 260, or methods 7356 and 7360 of FED-STD-141, as applicable. Solvent fractions shall be identified in accordance with ASTM E 1252. Accuracy of the analysis shall be 0.25%WT absolute and the reproducibility shall be 0.25%WT over a minimum of three runs. Test results shall be reported as %WT of the total paint. The test results for each solvent shall be as specified in 3.4.2.1.

4.5.21 Hazardous pigments and additives. Soluble and total metal content, except tantalum and tungsten, shall be determined on a dry paint film of the coatings in accordance with 40 CFR part 261, appendix II, method 1311

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and the appropriate test specified in tables IV and V. Asbestos shall be determined on a dry paint film of each individual coating of the coating system in accordance with OSHA Validated Analytical Method ID-191 reported as %WT of the dry paint film. Soluble metal content shall be reported as mg/L. Total metal content shall be reported as %WT of the dry paint film. The test results shall be as specified in 3.4.2.2. Tantalum and tungsten soluble metal content and total metal content shall be analyzed as specified in 4.5.21.1.

TABLE IV. EPA SW-846 - Test Methods for Evaluating Solid Waste - Physical/Chemical Methods.

Metal/material	Digestion test method
All metals, except chromium (VI)	3050
Chromium (VI)	3060

Metal/material	Analysis test method
Antimony	7040 or 7041
Arsenic	7060 or 7061
Barium	7080 or 7081
Cadmium	7131
Total chromium	7190

Metal/material	Analysis test method
Chromium (VI)	7195, 7196, or 7197
Lead	7421
Mercury	7470 or 7471
Nickel	7520 or 7521
Selenium	7740 or 7741
Silver	7760 or 7761

TABLE V. EPA 600/4-020 - Methods for Chemical Analysis of Water and Waste (USEPA 1979).

Metal/material	Test method
Beryllium	10.1 or 210.2
Cobalt	219.1 or 219.2
Copper	220.1 or 220.2
Fluoride	340.1, 340.2, or 340.3
Molybdenum	246.1 or 246.2
Thallium	279.1 or 279.2
Vanadium	286.1 or 286.2
Zinc	289.1 or 289.2

4.5.21.1 Tantalum and tungsten content. Determine the tantalum and tungsten content of the paint using any appropriate spectroscopy test method. Conduct the tests in accordance with the instrument manufacturer's directions for the use of the instrument. Manufacturer is responsible for establishing data supporting the test method choice and analytical accuracy. The test results for tantalum or tungsten shall be as specified in 3.4.2.2.

4.6 Weighing. Unit containers or groups of unit containers shall be weighed to verify that they contain the required amount of materials. Any container weighing less than the amount corresponding to the required quantity of material shall be rejected. When containers are weighed in groups, the average weight shall be not less than the weight corresponding to the required quantity of material plus the average weight of the empty containers times the number of containers.

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5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

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

6.1 Intended use. Paints covered by this specification are intended for use on sandblasted steel, aluminum, or fiberglass where a hard, durable, chemically resistant non-porous coating is desired. Formulations suitable for priming, interior, or exterior coats are provided. Form painting particular areas aboard ship, such as bilges, tanks, and exterior underwater hull, coating system and instructions are covered in applicable Navy directives or technical manuals. Types III and IV are for use in air quality management and air pollution control districts where volatile organic content (VOC) regulations apply.

6.1.2 The paints covered by this specification are used in Navy nuclear power engineering plants and are exempt from conversion to performance or non-government documents.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- (a) Title, number, and date of the specification.
- (b) Type of material required and applicable specification sheet (see 1.2 and 3.1).
- (c) Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
- (d) Packaging requirements (see 5.1 and 6.8).
- (e) Whether an MSDS and ASTM F 718 are required (see 6.4).

6.3 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. 24441 whether or not such products have actually been so listed by that date. The attention of the 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. Information pertaining to qualification of products may be obtained from Naval Sea Systems Command, 03R4, 2531 Jefferson Davis Highway, Arlington, VA 22242-5160.

6.4 Material Safety Data Sheets and product use data sheets (ASTM F 718). Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with

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FED-STD-313 and product use data sheets (ASTM F 718). The pertinent Government mailing addresses for submission of data are listed in FED-STD-313.

6.5 Manufacturing note. Manufacturing procedure determines the thixotropy of the components. Manufacturers should follow instructions issued by the manufacturer of the thixotroping agent to ensure development of proper consistency and sag resistance (see 3.3).

6.6 Material disposal. Disposal of the material components or the reacted compound should conform to applicable Federal, state, and local regulations.

6.7 Lot acceptance and rejection criteria. Acceptance of individual lots is based on compliance of paint with conformance tests specified in 4.3.2. Detection of one or more defective characteristics in any combined component sample is cause for rejection of the lot. The contractor has the option of screening 100 percent of the rejected lot and correcting all defective characteristics, or providing a new lot. In the event of a rejected lot the corrected lot or new lot being offered to the Government should be tested in accordance with all requirements specified herein.

6.8 Packaging. Recommended packaging requirements are provided in table VI.

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TABLE VI. Packaging.

Packaging	Recommended requirements for direct Government acquisitions
Containers	<p>(1) The components should be furnished in cans appropriate to kit requirements capable of holding 0.47L (1 pint), 0.945L (1 quart), 3.78L (1 gallon), and 18.9L (5 gallons). Kits should consist of two containers.</p> <p>(2) Multiple friction plug containers should be in accordance with PPP-C-96, type V, class 2. Interior coatings should be as specified therein. Exterior coatings, including side seam stripping, should be as specified therein for plan B. Wire handles as specified therein, should be provided for the 3.78-L (1-gallon) container. Closure of the properly filled and sealed cans should be as specified in the appendix thereto.</p> <p>(3) Containers should comply with the requirements of the Uniform Freight Classifications (UFC), the National Motor Freight Classification (NMFC), and the applicable requirements of the Code of Federal Regulations 49CFR, Department of Transportation (DOT).</p> <p>(4) Unit of procurement: The paints covered by this specification should be purchased by volume. The unit of procurement should be in multiples of 1 L or 1 U.S. liquid gallon at 15.5°C (60°F).</p>
Commercial packaging	<p>(1) Commercial packaging should be in accordance with ASTM D 3951.</p> <p>(2) Containers should comply with the requirements of the Uniform Freight Classifications (UFC), the National Motor Freight Classification (NMFC), and the applicable requirements of the Code of Federal Regulations 49CFR, Department of Transportation (DOT).</p>
Packing	<p>Packing should be specified as follows:</p> <p>(1) Overseas delivery (level A) packing. Intermediate containers of like size kits of paint should be packed in close-fitting wood boxes in accordance with PPP-B-601, overseas type, or PPP-B-621, class 2. Box closure and strapping should be as specified in the applicable box specification or the appendix thereto except that strapping should be flat and the finish B.</p> <p>(2) Domestic delivery (level B) packing. Level B packing should be as for level A, except that boxes should be domestic type or class and the strapping should be finish A or B.</p> <p>(3) Commercial packing. The paint, in the unit kit and intermediate containers should, as applicable, be packed in multiples of like sizes in accordance with UFC, NMFC, and 49CFR requirements.</p>
Palletization	Intermediate containers should be palletized in accordance with MIL-STD-147. Only one size unit or intermediate container should be placed on a pallet.

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TABLE VI. Packaging - Continued.

Packaging	Recommended requirements for direct Government acquisitions
Unit kits	The paints covered by this specification should be packed and packaged as kits.
Material safety data sheets (MSDS) and Product/procedure data sheets	A copy of the MSDS and company product data/procedure sheets (ASTM F 718) should be attached to the shipping document for each destination.
Intermediate containers	Paints should be packaged in intermediate containers as kits. Intermediate containers should be close-fitting corrugated fiberboard boxes in accordance with UFC, NMFC, and 49CFR requirements. Fiberboard used in the construction of interior (unit and intermediate) and exterior containers, including interior packaging forms, should be in accordance with PPP-F-320. PPP-F-320 classes should be domestic fire-retardant or weather resistant fire-retardant.
Packing for acquisitions involving direct delivery to Navy ships or installations	Treated lumber and plywood. Lumber and plywood, including laminated veneer materials, used in shipping container and pallet construction, member, blocking, bracing, and reinforcing must be fire-retardant treated material in accordance with MIL-L-19140 as follows: (a) General use, weather resistant: MIL-L-19140, type II, Category I. (b) General use, non-weather resistant: MIL-L-19140, type I, Category I.
Marking type	Recommend marking
Bar codes	Marking should include bar codes.
Hazardous warnings	(a) Labels should be in accordance with 29 CFR Parts 1910, 1915, 1917, 1918, 1926 and 1928, as well as PPP-P-1892. (b) Individual containers should have the following marking: "CAUTION: This paint 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." (c) Each component container, shipping container, and palletized load should be marked with the appropriate hazardous symbol in accordance with 29 CFR Parts 1910, 1915, 1917, 1918, 1926 and 1928 (Hazard Communication Act). (d) Unit containers should be marked: "This product is Asbestos, Lead, Chromium, Cadmium free." Type III containers should also be marked: "This product is free of volatile organic hazardous air pollutants (VOHAPs/HAPs)."
Volatile organic content (VOC)	"Contains (insert VOC content) grams per liter of volatile organic content per 40 CFR CH.1, Part 60, Appendix A (EPA) Method 24."
Shelf life	Each unit container, intermediate container where applicable, and shipping container should be marked as follows: "Date of first re-inspection (insert here date 4 years after date of manufacture)."

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6.9 Subject term (key word) listing.

Asbestos free
Cargo tank coating
Chromate free
Coating
HAP
Hazardous air pollutant free
Lead free
Marine paint
Protective coating
Ship paint
VOC
VOC compliant

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 extent of the changes.

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CONCLUDING MATERIAL

Preparing activity:
Navy - SH
(Project 8010-N006)

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 and send to preparing activity.
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.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
MIL-DTL-24441C

2. DOCUMENT DATE (YYYYMMDD)
1999/05/19

3. DOCUMENT TITLE
PAINT, EPOXY-POLYAMIDE, GENERAL SPECIFICATION FOR

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)*

7. DATE SUBMITTED
(YYYYMMDD)

(1) Commercial
(2) DSN
(if applicable)

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(2) DSN

c. ADDRESS *(Include Zip Code)*
Commander, Naval Sea Systems Command
ATTN: SEA 03Q, 2531 Jefferson Davis Hwy
Arlington, VA 22242-5160

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Defense Standardization Program Office (DLSC-LM)
8725 John J. Kingman Road, Suite 2533,
Fort Belvoir, VA 22060-6221
Telephone (703) 767-6888 DSN 427-6888