INCH-POUND
MIL-P-24441B(SH)
23 July 1991
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15 July 1980
(See 6.12)

MILITARY 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 surfaces from environmental attack.

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

Type I - For use where air pollution regulations for solvents in marine coatings do not apply.
Type II - For use where SCAQMD Rule 102 type air pollution regulations for solvents in marine coatings apply.
Type III - Three coat system, for use where air pollution regulations restrict volatile organic content (VOC) to 2.8 pounds per gallon (340 grams per liter).
Type IV - Two coat system, for use where air pollution regulations restrict volatile organic content (VOC) to 2.8 pounds per gallon (340 grams per liter).

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 55Z3, 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

2. APPLICABLE DOCUMENTS

2.1 Government documents.

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

QQ-S-698 - Steel Sheet and Strip, Low Carbon.
PPP-B-585 - Boxes, Wood, Wirebound.
PPP-B-636 - Boxes, Shipping, Fiberboard.
PPP-C-96 - Cans, Metal, 28 Gage and Lighter.
PPP-P-704 - Pails, Metal; (Shipping, Steel, 1 Through 12 Gallons).

MILITARY

MIL-C-11133 - Crates, Shipping, Wood, Open, Wirebound.

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.

MILITARY

MIL-STD-129 - Marking for Shipment and Storage.

(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.

DEPARTMENT OF LABOR (OSHA)

Code of Federal Regulations (CFR) 29, Parts 1910, 1915, 1916, 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.)

ENVIRONMENTAL PROTECTION AGENCY (EPA)

Code of Federal Regulations (CFR) 40, Chapter 1, Part 60, Appendix A, Method 24 - Determination of volatile matter content, water content, density, volume solids and weight solids of surface coatings.

(Application for copies should be addressed to the United States Environmental Protection Agency, 401 M Street Southwest, Washington, D.C. 20460)

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 185 - Standard Test Methods for Coarse Particles in Pigments, Pastes, and Paints. (DoD adopted)

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 714 - Standard Test Method for Evaluating Degree of Blistering of Paints. (DoD adopted)

D 1141 - Standard Specification for Substitute Ocean Water. (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). (DoD adopted)

D 1394 - Standard Test Methods for Chemical Analysis of White Titanium Pigments. (DoD adopted)

D 1475 - Standard Test Method for Density of Paint, Varnish, Lacquer, and Related Products. (DoD adopted)

D 1640 - Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature.

D 1729 - Standard Practice for Visual Evaluation of Color Differences of Opaque Materials. (DoD adopted)

D 2244 - Standard Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates. (DoD adopted)

D 2269 - Standard Test Method for Evaluation of White Mineral Oils by Ultraviolet Absorption.

D 2369 - Standard Test Method for Volatile Content of Coatings. (DoD adopted)

D 2698 - Standard Method for Determination of the Pigment Content of Solvent - Reducible Paints by High-Speed Centrifuging. (DoD adopted)

ASTM - Continued

D 2805 - Standard Test Method for Hiding Power of Paints by Reflectometry.

D 3278 - Standard Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus. (DoD adopted)

D 3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.

E 260 - Standard Practice for Packed Column Gas Chromatography.

F 718 - Standard for Shipbuilders and Marine Paints and Coatings Product/Procedure Data Sheet. (DoD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)
Rules and Regulations, Rule 102

(Application for copies should be addressed to South Coast Air Quality Management District, 9150 East Flair Drive, El Monte, CA 91731.)

(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 (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 which are authorized by the qualifying activity for listing on the applicable qualified products list at the time of award of contract (see 4.3 and 6.4).

3.3 Manufacturer. The paint shall be manufactured (see 6.6) and 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 shown on the individual specification sheets (see 6.8). The components shall be completely compatible so that, when components A and B are mixed as specified by volume, the paint shall be suitable for spray

applications above 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 1-pound for 100 gallons.

3.4.1 Solvent. Types I, III and IV materials shall have solvents conforming to the applicable specification sheets. The solvent portion for the type II product shall conform to requirements specified as follows:

(a) A combination of hydrocarbons, alcohols, aldehydes, ethers, esters, or ketones having an olefinic or cycloolefinic type of unsaturation except perchloroethylene: 5 volume percent maximum.
(b) A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethylbenzene, methyl benzoate, and phenyl acetate: 8 volume percent maximum.
(c) A combination of ethylbenzene, ketones having branched hydrocarbon structures, trichloroethylene, or toluene: 20 volume percent maximum.

The contractor shall provide certification to this effect.

3.4.2 Toxicity. The material shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the contracting activity to the appropriate departmental medical service who will act as an advisor to the contracting activity.

3.4.3 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.4.4 Material safety data sheet (MSDS). The contracting activity shall be provided a material safety data sheet, which shall include a product data sheet in accordance with ASTM F 718, 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 6.5).

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

3.5.1 Asbestos. The paint shall be asbestos free (see 6.3).

3.6 Qualitative requirements. Qualitative requirements shall be as follows:

3.6.1 Brushing properties. The paint, when prepared for application in accordance with 4.6.1 and tested as specified in 4.6, 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. The paint, when prepared for application in accordance with 4.6.1 and tested as specified in 4.6 and 4.6.9, 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. A film of paint, prepared and tested as specified in 4.6.1 and 4.6.10, shall withstand bending without visible cracking or flaking.

3.6.4 Stability in partially full container. Three-quarter filled, closed 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 aging for 7 days at 140°F. After this aging, each component shall remix readily to a smooth uniform mixture with a consistency not exceeding 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 4.6.13, paint mixed in accordance with 4.6.1 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. 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. Components which have been stored for at least 1 year in their original containers, shall, when mixed in accordance with 4.6.1 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 than 625 grams (121 KU) to produce the 200 r/min pattern as specified in ASTM D 562.

3.6.8 Immersion tests. Panels tested for resistance to hot distilled water immersion (see 4.6.15) shall perform at least as well as the reference panels.

3.6.9 Solvent resistance. Paint films, prepared and cured in accordance with 4.6.11, shall show no wrinkling, softening, tackiness, swelling, or other signs of solvent attack when examined.

3.6.10 Cathodic protection (formula 159 only). When Formula 159 is tested in accordance with 4.6.19, the coating shall prevent corrosion in the bare metal area for a minimum of 48 hours. No corrosion of bare circle or any other surface shall occur.

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).
(c) Verification inspection (see 4.4.3).

4.3 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 ingredient. 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 4.6.

4.3.1 Ingredient samples. The ingredient samples submitted shall be 1-pint of the following ingredients: Polyamide resin, polyamide adduct, and epoxy-resin; also 4 containers of "Component A" and 4 containers of "Component B". Each component shall be packaged in a separate container not to exceed 1 quart in volume. The volume of total samples shall be sufficient to prepare 2 gallons of mixed paint.

4.3.2 Qualification application. The contractor shall apply at least three coatings comprising one of the coating systems listed (see 4.6.15.1) for qualification inspection.

4.3.3 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.

4.4 Quality conformance inspection.

4.4.1 Lot. For purposes of quality conformance inspection, a lot shall consist of all epoxy 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 quart.

4.4.2 Quality conformance tests. Quality conformance tests for acceptance of individual lots shall consist of all tests identified by footnote 1/ in table I (see 6.3 and appendix). 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 quality conformance tests identified by footnote 1/ in table I. Results shall meet the applicable requirements in section 3.

4.4.3 Verification tests. Verification tests shall consist of any test determined by the Naval Sea Systems Command to be necessary for conformance to this specification.

4.5 Acceptance of individual lots. Acceptance of individual lots shall be based on compliance of paint with quality conformance tests specified in 4.4.2 (see 6.3 and appendix). Detection of one or more defective characteristics in any sample shall 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 shall be tested in accordance with all requirement specified herein.

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

TABLE I. Test methods.

Item	Applicable method in FED-STD-141	Applicable ASTM test method	Test method	Requirements
Pigment content 1/	4021.1	----	-----	2/
Volatiles content 1/	----	E260	4.6.1.4	2/
Volatile percent	----	D2369	4.6.1.4.1	2/
Nonvolatile vehicle content	4053.1	----	-----	2/
Water	----	D1364	-----	2/
Coarse particles	----	D185	-----	2/
Consistency 1/	----	D562	-----	2/

See footnotes at end of table.

TABLE I. Test methods - Continued.

Item	Applicable method in FED-STD-141	Applicable ASTM test method	Test method	Requirements
Weight per gallon (pounds) 1/	----	D1475	-----	2/
Dust-free drying time 1/	----	D1640	4.6.2	2/
Dry-hard time 1/	----	D1640	4.6.3	2/
Fineness of grind 1/	----	D1210	-----	2/
Flash point 1/	----	D3278	-----	2/
Adhesion	6301	----	4.6.15.4	2/
Titanium dioxide	----	D1394	-----	2/
Pot life	----	----	4.6.4	2/
Gloss 1/	----	D523	4.6.5	2/
Contrast ratio 1/	----	D2805	-----	2/
Sag 1/ 3/	4494.1	----	4.6.6	2/
Amine nitrogen content of non-volatile vehicle	7391	----	4.6.17	2/
Color (wetted film) 1/	----	D2244	4.6.7.1	2/
Color (dry film) 2/	----	D1729	4.6.7.2	2/
Brushing properties 1/	4321.2	----	4.6.8	3.6.1
Spraying properties 1/	4331.1	----	4.6.9	3.6.2
Flexibility	6221	----	4.6.10	3.6.3
Stability in partially full container	3021.1	----	4.6.12	3.6.4
Dilution stability	4203.1	----	4.6.13	3.6.5
Odor 1/	----	D1296	----	3.6.6
Condition in container 1/	3011.2	----	4.6.14	3.6.7
Immersion tests	----	----	4.6.15	3.6.8
Solvent resistance	----	D1308	4.6.11	3.6.9
Volatile organic content	----	D3960	4.6.18	2/
Cathodic protection	----	----	4.6.19	3.6.10

1/ See 4.4.2.
2/ See applicable specification sheet.
3/ Per FED-STD-141.

4.6.1 Preparation of paint for testing.

4.6.1.1 Conditioning of paint. Each component, prior to testing, shall be mixed on a paint shaker. One quart samples shall be shaken at least 5 minutes and 1-gallon containers shall be shaken at least 10 minutes until all ingredients are uniformly distributed.

4.6.1.2 Storage. Components shall be maintained at 73.4 ± 5°F and any other further mixing shall be by spatula or paddle.

4.6.1.3 Mixed paints. Prepare 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 73.4 ± 2°F prior to testing.

4.6.1.4 Volatile. To determine compliance with the composition requirements specified in 3.4.1, analyze the paint by gas chromatography in accordance with ASTM E 260, using such apparatus, columns, operating conditions, and allowable options as are necessary to accommodate the various specified chemical components. The accuracy of the analysis shall be 0.25 percent or less absolute by weight for each component, and the reproducibility shall be 0.25 percent or less absolute by weight over three or more runs. All peaks 0.5 percent of the sample or greater shall be identified and quantified. Depending on the equipment available, the volatile may be distilled from the paint solids and tested in the gas chromatograph, or the whole paint may be injected into the instrument and the volatile tested. In either case, calibrate the instrument with known ingredients before testing for the unknown volatiles.

4.6.1.4.1 Volatile percent. Percent volatile shall conform to the applicable specification sheet when tested in accordance with ASTM D 2369.

4.6.2 Dust-free drying time. Prepare duplicate test panels by drawing down material prepared as specified in 4.6.1 to a 3 mil wet film thickness on a ground glass panel. Cure one panel in a dust-free location at 40 ± 2°F and the second panel at 73.4 ± 2°F. Determine the set-to-touch drying time (time from the drawdown) in accordance with ASTM D 1640.

4.6.3 Dry-hard time. Prepare duplicate test panels by drawing down material prepared as specified in 4.5 to a 3-mil wet film thickness on a glass plate. Cure one panel at 41 ± 2°F. Cure the second panel at 73.4 ± 2°F. Determine the dry-hard time on each panel in accordance with ASTM D 1640.

4.6.4 Pot life. Mix 13.5 ounces of paint in a 1-pint can as specified in 4.6.1 from materials conditioned to 73.4 ± 2°F. Condition mixed paint in a water bath maintained at 73.4 ± 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.

4.6.5 Gloss. Prepare a test panel by spraying out a 4-mil wet film thickness of material prepared as specified in 4.6.1, 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 73.4 ± 5°F and determine gloss in accordance with ASTM D 523.

4.6.6 Sag test. Test the paint mixed, as specified in 4.6.1, in accordance with method 4494.1 of FED-STD-141. Determine the greatest value at which sag does not occur. This value shall be numerically equal to or greater than the value specified.

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

4.6.7.1 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 4-mil wet film thickness of material prepared

as specified in 4.6.1. Dry the panel for 16 hours at room temperature, then 15 minutes at 125 ± 5°F. The color measured using ASTM D 2244 shall be within the limits specified in the specification sheets.

4.6.7.1.1 Apparatus.

4.6.7.1.1.1 Reflectometer. The reflectometer shall have a geometry conforming to method 6123 of FED-STD-141 with an illumination angle of 45° from the perpendicular, and a viewing angle of 0 degrees from the perpendicular. The reflectometer shall be capable of measuring green reflectance in the range 0.8 to 4.0 percent to plus or minus 0.05 percent. The procedure of 4.6.7.1.3 shall be used for the Gardner (Hunter) multipurpose reflectometer which is the referee instrument for this test. Any instrument with the required precision and accuracy is suitable for use.

4.6.7.1.2 Reagents. Distilled water containing 0.009 ± 0.001 percent of a clear anionic surfactant shall be used for wetting the specimens. A suitable anionic detergent shall be used.

4.6.7.1.3 Procedure.

4.6.7.1.3.1 Obtaining reflectance.

4.6.7.1.3.1.1 General. Operate the reflectometer according to the operating manual. Zero the galvanometer with the reflectometer scale set at mid-range, the light on, the light control window closed, green filter in place, and a dry zero percent reflectance standard in the sample window.

4.6.7.1.3.1.2 Procedure to be used for formula no. 153, (Rw 0.8 to 1.02 percent). Standardize the instrument with the green filter using the G = 2.2 percent standard (see 4.6.7.1.4.1) in a dry condition, set on the instrument scale at 0.88. Cover the specimen to be tested with a thin film of the water/surfactance mixture (see 4.6.7.1.2) and immediately obtain the 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. Calculate the wet reflectance in percent:

$$Rw = 1/4 \text{ reading} \times 10$$

4.6.7.1.3.1.3 Procedure to be used for formula no. 154, (Rw 1.74 to 2.06 percent). Standardize the instrument with the green filter using the G = 2.2 percent standard (see 4.6.7.1.4.1), in a dry condition, set on the instrument scale at 0.66. Cover the specimen to be tested with a thin film of the water/surfactant mixture (see 4.6.7.1.2), and immediately obtain the 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. Calculate the wet reflectance in percent:

$$Rw = 1/3 \text{ reading} \times 10$$

4.6.7.1.3.1.4 Procedure to be used for formula no. 155 (Rw 2.65 to 3.00 percent). Standardize the instrument with the green filter using the G = 2.2 percent standard (see 4.6.7.1.4.1) in a dry condition, set on the instrument scale at 0.44. Cover the specimen with a thin film of the water/surfactant mixture (see 4.6.7.1.2) and immediately obtain the green reflectance reading. Check the specimen immediately after obtaining reading for intact water film. If the water film is not intact, repeat procedure until a satisfactory reading is obtained. Calculate the wet green reflectance in percent:

$$Rw = 1/2 \text{ reading} \times 10$$

4.6.7.1.3.2 Reflectance values. Report wet green reflectance values.

4.6.7.1.4 Notes to procedure.

4.6.7.1.4.1 If other than 2.2 percent green reflectance standard is used, use the indicated multiplication factor to obtain the instrument scale reading to use with the standard.

4.6.7.1.4.2 The expanded scale is used so that readings are obtained near the center of the scale. This eliminates the large error introduced when the sensor is close to the specimen at the low end of the scale.

4.6.7.2 Dry film. Prepare a panel for test by spraying on smooth steel a 4-mil wet film thickness of material prepared as specified in 4.6.1. Dry for 16 hours at room temperature, then 15 minutes at 125 ± 5°F. Compare the test panel with the standard color chip in accordance with ASTM D 1729. If doubt exists as to the satisfactoriness of the match, 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.

4.6.8 Brushing properties. Prepare the paint as specified in 4.6.1. Without further reduction, apply the paint in accordance with method 4321.2 of FED-STD-141 and observe for compliance with 3.6.1.

4.6.9 Spraying properties. Prepare the paint as specified in 4.6.1. Without further reduction, spray on a sandblasted steel panel to a 6-mil wet film thickness. Observe for spraying properties in accordance with method 4331.1 of FED-STD-141 for compliance with 3.6.2. For referee test, use automatic application of method 2131.1 of FED-STD-141.

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

4.6.10.1 Panel preparation. Prepare a flat tin panel in accordance with method 2012.2 of FED-STD-141 using the petroleum naphtha-ethylene glycol monoethyl ether mixture. Apply a 2-inch wide film of mixed paint (see 4.6.1) with a suitable film applicator that will give a dry film thickness of 1.5 ± 0.3 mil. Air dry paint in a horizontal position for 24 hours at 73.4 ± 5°F.

4.6.10.2 Procedure. Bend 180 degrees over a 1/8-inch mandrel and examine the coating for cracks over the area of the bend in a strong light at a 7-diameter magnification for compliance with 3.6.3.

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

4.6.11.1 Panel preparation. Prepare three tin panels in accordance with method 2012.2 of FED-STD-141 using the petroleum naphtha 2-ethoxy ethanol mixture. Draw down a film of mixed paint (see 4.6.1) to give a dry film thickness of 1.5 ± 0.3 mil. Air dry the film at 73.4 ± 5°F for 24 hours.

4.6.11.2 Procedure. Immerse a panel in each solvent system listed in 4.6.11 at 73.4 ± 2°F for 18 hours in accordance with ASTM D 1308. Examine for compliance with 3.6.9 at 2 hours and at 24 hours after removal from the solvent.

4.6.12 Stability in partially full container. Determine stability of each component after 48 hours in accordance with method 3021.1 of FED-STD-141. Reseal and age for 7 days at 140°F and observe for compliance with 3.6.4.

4.6.13 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 4.6.1 with one part by volume thinner. Then test in accordance with method 4203.1 of FED-STD-141 for compliance with 3.6.5.

4.6.14 Condition in container. The contractor shall determine package condition at time of acceptance testing in accordance with method 3011.2 of FED-STD-141 and observe for compliance with 3.6.7.1. The Government, at its option, may test components stored in their original containers for compliance with 3.6.7.2.

4.6.15 Hot distilled water test. Determine resistance to hot distilled water. Six reference test panels are required for each system. Three reference panels are used as test controls for the 180°F immersion test and the remaining three are used as test controls for the 200°F immersion test.

4.6.15.1 Preparation of panels. Panels shall be mild steel conforming to QQ-S-698, cold rolled, 6 inches by 10 inches by 1/8-inch blasted using aluminum abrasive blasting media to a uniform white appearance with a minimum surface profile of 1.0 but no more than 3.0 mils peak to valley. 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. Prepare six test panels for each of the following systems:

	System A	System B	System C	System D
Coat No. 1 0.076 - 3 to 4 mils	F.1/150	F.150	F.150	F.162
Coat No. 2 0.05 - 2 to 3 mils	F.151	F.151	F.151	F.161
Coat No. 3 0.05 - 2 to 3 mils	F.152	F.156	F.153, 154, 155	F.160

1/ F. indicates formula number.

Total film thickness, 7 to 9 mils dry film shall be applied to both sides of panel. Apply paint using standard spray equipment allowing 16 to 24 hours drying time between coats at 73.4 ± 5°F. Condition coated panels for 1 week after application of final coat at 73.4 ± 5°F. Measure and report the dry film thickness for each side of each panel.

4.6.15.2 Testing of panels. Immerse three panels in 180°F distilled water and three panels in 200°F distilled water. Remove the panels from the 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 2 to 3 mil coat of Coat No. 3. Cure for 1 week and reimmerse in 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 180°F distilled water after 10 weeks immersion.

4.6.15.3 Blistering. Determine degree of blistering in accordance with ASTM D 714. Blister appearing within 1/4-inch from the edge of the panel shall be disregarded. Panels shall perform at least as well as the reference panels.

4.6.15.4 Adhesion. Determine adhesion of both sides of each panel using a tensile adhesion tester to determine any loss of adhesion. Panels shall perform at least as well as the reference panels.

4.6.16 Odor. When tested in accordance with ASTM D 1296, check for compliance with 3.6.6.

4.6.17 Amine nitrogen content. Determine the amine nitrogen content of the nonvolatile from Component A. Separate the pigments from Component A using ASTM D 2698. Remove solvents from the resinous portion by evaporating on a steam bath. Determine amine nitrogen content of the nonvolatile by method 7391 of FED-STD-141.

4.6.18 Volatile organic content (VOC) determination. VOC shall be determined in accordance with EPA method 24 (40 CFR CH.1, appendix A, method 24) as follows:

(a) The paint test sample shall be drawn from material prepared as specified in 4.6.1.3.
(b) Nonvolatile matter content shall be in accordance with EPA method 24, ASTM D 2269. 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. After 24 hours, proceed to step 7.3 of D 2369 and complete all testing required by 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.]

4.6.19 Cathodic protection.

4.6.19.1 Panel preparation. Test panels shall be prepared from cold rolled sheet steel conforming to QQ-S-698, shall be 6 inches by 8 inches by 1/8-inch 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 1.0 mils, but not more than 3.0 mils, peak to valley. 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 2-1/2-inch circle in the center of the panel with a non residue tape or other non residue impervious mask. Apply by spraying 3 to 5 mils of formula 159 to all exposed metal surfaces. Cure 24 hours.

4.6.19.2 Immersion. After removing circle mask, wash bare metal with super high flash naphtha (see applicable specification sheet for source) and allow to dry. Fully immerse panel in container of ASTM D 1141 substitute ocean water for 48 hours. Check for compliance with 3.6.10.

4.7 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.

4.8 Inspection of packaging. Sample packages and packs, and the inspection of the preservation, packing and marking for shipment 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. For the extent of applicability of the packaging requirements of referenced documents listed in section 2, see 6.7.)

5.1 Preservation.

5.1.1 Level A and C. The epoxy-polyamide coating shall be supplied as a kit consisting of polyamide marked component A and epoxy marked component B (see 6.2).

5.1.1.1 Navy formulas 150, 151, 152, 153, 154, 155, 156, 157, 158, 160, 161, 162, and 163. The quantity of each component in the kit shall be in the proportions 1:1 by volume. Navy formula 159 shall be in the proportions of 1:4 by volume. Each component in each kit shall be furnished in 1-quart, or 1-gallon, or 5-gallons as specified (see 6.2). Containers shall be as follows:

5.1.1.1.1 One-quart and 1-gallon cans. One-quart and 1-gallon cans shall conform to type V, class 2 of PPP-C-96. Interior of cans may be unlined; exterior plan B coating and side seam stripping is required. Wire handles are required for 1-gallon cans.

5.1.1.1.2 Five-gallon pails. Five-gallon pails shall conform to type II, class 3 of PPP-P-704. Interior coating is not required. Wire handles or bails shall be treated to resist corrosion.

5.2 Packing. Packing shall be level A, B, or C as specified (see 6.2).

5.2.1 Levels A and B.

5.2.1.1 Cans. Each kit shall be packed in a fiberboard box conforming to PPP-B-636, class weather resistant for level A, and class domestic for level B. Other options, variety, grade, and style shall be at the suppliers option. Each box shall be provided with fiberboard separators and pads, as necessary, to provide support to all panels of the shipping containers. Fiberboard separators and pads shall be of the same material as the box. Class weather resistant boxes shall be closed, waterproofed, and reinforced in accordance with method V of the appendix to the box specification. Class domestic boxes shall be closed in accordance with method I of the appendix to the box specification.

5.2.1.2 Pails. Five-gallon pails require no further packing for level A and B. The two 5-gallon pails, one each of the compatible components A and B (see 3.4 and 5.3.1(h)), shall be packed in a snug fitting box or crate conforming to one of the following, as applicable: A box conforming to PPP-B-585, class 2, style optional; a box conforming to PPP-B-636, type CF, class weather resistant, grade V1lc, with the option that the maximum weight shall be increased to 225 pounds, if applicable; a crate conforming to MIL-C-11133, type II, class and style optional, grade A, process 2.

5.2.2 Level C. Epoxy-polyamide coating, packaged as specified in 5.1, shall be packed in containers acceptable to the common carrier which will insure safe delivery at destination in a satisfactory condition at the lowest applicable rate. Container packing or method of shipment shall comply with carrier rules as applicable to the mode of transportation.

5.3 Marking. In addition to any special marking required herein, or by the contract or order (see 6.2), interior packages and shipping containers shall be marked in accordance with MIL-STD-129.

5.3.1 Special marking. Each container of component shall have the following additional information:

(a) Specification number including specification sheet numbers.
(b) Type as specified.
(c) Color designation and number (if applicable).
(d) Formula number, where applicable.
(e) Manufacturer's designation.
(f) Manufacturer's name and address.
(g) Manufacturer's batch number and date of manufacture.
(h) Component B container shall be marked with the same formula number as component A container in the kit.
(i) The volatile content of this container is not photochemically reactive as defined by rule 102 of the South Coast Air Quality Management District. (Type II paints only.)
(j) The two compatible components (see 3.4 and 5.2.1.2) shall be marked with the same batch or lot number.
(k) Types I, III and IV shall be labeled with VOC content.

5.3.1.1 Mixing and use instructions.

5.3.1.1.1 Each component container shall be marked with the following:

"CAUTION

This is one component of a two component paint system which WILL NOT HARDEN unless both components are mixed together."

5.3.1.1.2 The containers for Navy formulas 150, 151, 152, 153, 154, 155, 156, 157, 158, 160, 161, 162, and 163 shall be marked with the following:

"INSTRUCTIONS FOR USE

Stir component A and component B thoroughly.
Mix component A and component B together 1:1 by volume.
Mix amount for no more than 5-hours work.
Allow mixed paint to stand for 1 hour at 60 to 70°F before application.
DO NOT THIN"

5.3.1.1.3 The containers of Navy formula 159 shall be marked with the following:

"INSTRUCTIONS FOR USE

Stir component A and component B thoroughly.
Mix one (1) volume of component A together with four (4) volumes of component B.
Mix amount for no more than 5-hours work.
Allow mixed paint to stand one hour at 60 to 90°F before application.
DO NOT THIN MORE THAN 3 OUNCES (0.3 LBS) F.159 THINNER PER GALLON OF MIXED PAINT"

5.3.2 Material safety data sheet. A copy of the material safety data sheet shall be attached to the shipping document for each destination (see 3.4.4).

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. For 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 I, III, and IV is for use where VOC air pollution regulations for solvents in marine coatings are in effect. Type II is for use where SCAQMD Rule 102 type air pollution regulations for solvents in marine coatings apply.

6.2 Acquisition requirements. Acquisition documents must specify the following:

(a) Title, number, and date of the specification.
(b) Title, number, and date of the applicable specification sheet.
(c) Formula number and color of material (see applicable specification sheets).
(d) Type of material required (see 1.2).
(e) 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).
(f) Quantity of kits and size of component containers (see 5.1).
(g) Levels of preservation and packing and marking required (see 5.1.1 and 5.2).
(h) Special marking required (see 5.3.1).

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 contractural 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.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
3.5.1, 4.4.2, 4.5, and appendix	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 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. The activity responsible for the Qualified Products List is the Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 and information pertaining to qualification of products may be obtained from that activity. Application for qualification tests must be made in accordance with "Provisions Governing Qualification SD-6" (see 6.4.1).

6.4.1 Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

6.5 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.

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

6.7 Sub-contracted material and parts. The preparation for delivery requirements of referenced documents listed in Section 2 do not apply when material and parts are procured by the supplier for incorporation into the coating and lose their separate identity when the coating is shipped.

6.8 Composition variation. The manufacturer will have the choice or (1) the amount and type of thixotrope required for long term storage stability; (2) specification consistency requirements and (3) acceptable application properties consistent with the specification requirements.

6.9 Volatile content. Although the container marking specifically refers to the SCAQMD of Southern California, the paint may be used anywhere a paint complying with 3.4.2 is allowed. This includes nearly all other air pollution control districts or similar areas controlling the emission of solvents into the atmosphere.

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

6.11 Subject term (key word) listing.

Camouflage coatings
Component A
Component B
Material disposal
MSDS

6.12 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-N229)

APPENDIX

CERTIFICATION/DATA REPORT TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers information that shall be included in the certification/data report when specified in the contract or order. 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. CERTIFICATION CONTENT

30.1 Certification/data report. The contractor shall furnish certification data/reports for each lot of paint. The certification data/report shall include the following information:

(a) Certification of conformance of each lot of ingredient material, stating test results and source, as applicable.
(b) Certification of conformance and test results as specified in 4.4.2, for finished paint as specified.
(c) Certification that paint contains no asbestos.

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.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
	MIL-P-24441B(SH)	23 July 1991

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) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (Include Area Code)
Technical Point of Contact (TPOC): Mr. John Tock (SEA 05M1) PLEASE ADDRESS ALL CORRESPONDENCE AS FOLLOWS:	(1) Commercial (2) AUTOVON TPOC: 703-602-0215
c. ADDRESS (Include Zip Code) Commander, Naval Sea Systems Command Department of the Navy (SEA 55Z3) 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