METRIC
MIL-DTL-700B
30 June 1998
SUPERSEDING
DOD-E-700A
12 January 1978
(See 6.12)

DETAIL SPECIFICATION

ENAMEL, DECK, INTERIOR, GRAY, (FORMULA NO. 20L) (METRIC)

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers a 340 grams per liter (g/L) (maximum) [2.8 pounds per gallon (lb/gal) (maximum)] volatile organic content (VOC) gray, interior deck enamel (Formula No. 20L) for shipboard use as a general purpose interior deck enamel for application to either primed steel or aluminum (see 6.1). Product is supplied in a single can and used as supplied.

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, 03R42, Naval Sea Systems Command, 2531 Jefferson Davis Highway, Arlington, VA 22242-5160 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

SPECIFICATIONS

FEDERAL

TT-P-645 - Primer, Paint, Zinc-Molybdate, Alkyd Resin Type.
A-A-2904 - Thinner, Paint, Mineral Spirits.

DEPARTMENT OF DEFENSE

MIL-A-22262 - Abrasive Blasting Media Ship Hull Blast Cleaning.
MIL-P-24441 - Paint, Epoxy-Polyamide General Specification for.
MIL-E-24635 - Enamel, Silicone Alkyd Copolymer. (Metric)
MIL-E-24763 - Enamel, Emulsion Type, for Shipboard Use.

STANDARDS

FEDERAL

FED-STD-141 - Paint, Varnish, Lacquer and Related Materials: Materials: Methods of Inspection, Sampling Sampling and Testing.
FED-STD-595 - Colors Used In Government Procurement.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 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.

PUBLICATIONS

CODE OF FEDERAL REGULATIONS (CFR)

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

29 CFR 1910, 1000 - Toxic and Hazardous Substances.

29 CFR 1910, 1200 - Hazard Communication Standard.

29 CFR 1915, 1001, Appendix K - Polarized Light Microscopy of Asbestos, Method ID-191.

29 CFR 1990 - Identification, Classification, and Regulation of Potential Occupational Carcinogens.

40 CFR 60, Appendix A, Method 24 - Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings.

40 CFR 82 - Protection of Stratospheric Ozone.

CFR (Continued)

40 CFR 261, Appendix III, Method 1311 - Toxicity Characteristic Leaching Procedure (TCLP).

40 CFR 355, Appendixes A and B - The List of Extremely Hazardous Hazardous Substances and Their Threshold Planning Quantities.

40 CFR 372.65 - Specific Toxic Chemical Listings.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (EPA)

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

EPA 600/4-020 - Methods for Chemical Analysis of Water and Wastes.

(The Code of Federal Regulations (CFR) and EPA documents 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 documents 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)

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

ASTM D 476 - Standard Specification for Titanium Dioxide Pigments. (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 869 - Standard Test Method for Evaluating Degree of Settling of Paint. (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 1364 - Standard Test Method for Water in Volatile Solvents (Karl Fischer Reagent Titration Method. (DoD adopted)

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

ASTM D 1542 - Standard Test Method for Qualitative Detection of Rosin in Varnishes. (DoD adopted)

ASTM's (Continued)

ASTM D 1729 - Standard Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials. (DoD adopted)

ASTM D 1849 - Standard Test Method for Package Stability of Paint. (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)

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 3363 - Standard Test Method for Film Hardness by Pencil Test.

ASTM D 4400 - Standard Test Method for Sag Resistance of Paints Using a Multinotch Applicator.

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.)

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 10 - Surface Preparation Specification No. 10 Near-White Blast Cleaning.

(Application for copies should be addressed to the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, PA 15213.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.2 Formula. The enamel shall consist of an alkyd resin, pigments, extender pigments, and solvent which, when combined, shall result in a paint conforming to the requirements of the applicable paragraphs of this specification. The maximum VOC limit is 340 g/L (2.8 lb/gal) of paint.

3.2.1 Formula Number 20L. The formula shown in table I is designated Navy Formula Number 20L. When Formula Number 20L is specified, or when this specification is referenced without reference to formula number, the enamel shall conform to the requirements of this specification. Manufacturers may use alternate ingredients as long as the alternate ingredients are

specifically approved and the enamel is shown to meet all the requirements of this specification by first article testing and conformance testing (see 6.3). Conformance testing may be conducted by the Government at any time to verify that the product being acquired meets the requirements of this specification.

TABLE I. Formula Number 20L.

Ingredients	Kilograms 16/ (kg)	Pounds 16/ (lb)	Weight percent (%wt)
Sunflower alkyd resin solution 1/	151.9	334.9	29.20
Titanium dioxide 2/	45.8	100.9	8.78
Yellow iron oxide 3/	1.41	3.1	0.27
Carbon black 4/	0.41	0.91	0.08
Calcium carbonate 5/	151.7	334.5	29.12
Magnesium silicate 6/	64.1	141.4	12.32
Paint thinner 7/	89.9	198.2	17.25
Dispersant 8/	2.45	5.4	0.47
Suspending agent 9/	4.85	10.7	0.93
Antiskinning agent 10/	2.08	4.58	0.40
Anti-float agent 11/	1.22	2.7	0.24
Calcium drier (6%) 12/	2.13	4.7	0.41
Cobalt drier (12%) 13/	0.23	0.51	0.04
Neodymium drier (12%) 14/	2.27	5.0	0.44
Bipyridal drier 15/	0.27	0.61	0.05
TOTALS	520.7	1148.1	100.0

1/ McWhorter Technologies, Inc., Resin 57-5816, 90% solids sunflower oil alkyd resin.
2/ ASTM D 476, Types III or IV, Trioxide America, Inc., TR-63.
3/ Harcross Pigments, Inc., YLO-3288D.
4/ Cabot Corp., “Black Pearls L”.
5/ Omycarb-5, from OMYA, Inc., Proctor, VT.
6/ R.T.Vanderbilt Co., “Nytal 300”.
7/ Mineral Spirits, Ashland Chemicals, Columbus, OH 189.7 pounds, NiPar 640, 8.5 pounds, Angus Chemical Co., Northbrook, IL 9.2 pounds.
8/ Nuosperse 657, Huls America, Piscataway, NJ.
9/ Bentone 38 Gel, Niles Chemical Paint Co.
10/ Skino #2, Methyl Ethyl Ketoxime, OMG Mooney Chemicals, Cleveland, OH.
11/ Troysol AFL, Troy Chemical Co.
12/ Chem-All, Calcium Carboxylate, OMG Mooney Chemicals, Cleveland, OH.
13/ Chem-All, Cobalt Carboxylate, OMG Mooney Chemicals, Cleveland, OH.
14/ Neo-Chem 250, OMG Mooney Chemicals, Cleveland, OH.
15/ DRI-Rx, OMG Mooney Chemicals, Cleveland, OH.
16/ This formula makes approximately 100 gallons.

3.2.2 Manufacture. The component raw materials shall be mixed, ground, and blended as required to produce a product which is uniform, free from grit, lumps, skins, and floating pigment. The enamel shall be entirely suitable for the purpose intended and shall be in full conformance to the requirements of this specification.

3.2.3 Composition. The paint shall consist of the ingredients listed in table I footnotes in the proportions shown in table I, except that the amount of carbon black may be varied as necessary to meet color requirements. In addition, to assist in meeting drying times, brushing, condition in container, and storage stability requirements, driers, antisettling, antisagging, and antiskinning agents may be varied as necessary to meet the other requirements of the specification are met.

3.2.4 Safety. The materials used in the enamel, unless specific material maximum levels are cited herein (see 3.2 and 3.3), shall have no known carcinogenic or potentially carcinogenic materials identified by Occupational Safety and Health Administration (OSHA) as regulated carcinogens, or International Agency for Research on Cancer (IARC) latest monographs, or the latest annual report of the National Toxicology Program (NTP); and shall have no extremely hazardous substances (EHS) or toxic chemicals identified in 40 CFR 355 and 372, respectively. The enamel shall not contain more than 5 percent cobalt compounds and 5 percent manganese compounds by weight in its formulation. 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 or 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 0.1 percent by weight of the enamel. The enamel shall have no adverse effect on the health of personnel when used for its intended purpose (see 6.7).

3.3 Quantitative requirements. The enamel shall conform to the quantitative requirements as specified in table II.

TABLE II. Quantitative requirements.

Characteristics	Requirements	
	Minimum	Maximum
Pigment, percent by weight (%wt) of enamel	49.4	52.4
Volatile, %wt of enamel	20.4	23.4
Nonvolatile vehicle, %wt of enamel (calculated by difference)	25.7	29.1
Water, %wt of enamel	---	0.5
Coarse particles and skins (as residue on No. 325 sieve), %wt of enamel	---	0.2
Viscosity, Krebs units	---	95
Weight per gallon, kg/liter (lb/gallon)	4.99 (11.0)	5.44 (12.0)
Time of drying to touch, hours	---	2.0
Time of dry hard, hours	---	7.0
Fineness of grind	5	---
Flashpoint, °C (°F)	38 (100)	---
Gloss, 60-degree specular	25	50
Sag resistance, mm (mils)	0.092 (4)	---
VOC, g/L (lb/gal) of paint minus water	---	340 (2.8)
Asbestos content, %wt of dry film	---	0.05
Crystalline silica	---	0.05

3.3.1 Metal content. When tested as specified in 4.6.2, the content of each soluble metal and total content of each metal of the enamel shall be not greater than the values as specified in tables III and IV.

TABLE III. Soluble metals content.

Soluble metal and its compounds	Maximum, mg/L
Antimony and its compounds	15.0
Arsenic and its compounds	5.0
Barium and its compounds (excluding barite)	100.0
Beryllium and its compounds	0.75
Cadmium and its compounds	1.0
Chromium (IV) compounds	5.0
Chromium and its chromium (III) compounds	560.0
Cobalt and its compounds	80.0
Copper and its compounds	25.0
Fluoride salts	180.0
Lead and its compounds	5.0
Mercury and its compounds	0.2
Molybdenum and its compounds	350.0
Nickel and its compounds	20.0
Selenium and its compounds	1.0
Silver and its compounds	5.0
Tantalum and its compounds	100.0
Thallium and its compounds	7.0
Tungsten and its compounds	100.0
Vanadium and its compounds	24.0
Zinc and its compounds	250.0

TABLE IV. Total metals content.

Metal and its compounds	Maximum, %wt
Antimony and its compounds	0.015
Arsenic and its compounds	0.001
Barium and its compounds (excluding barite)	0.10
Beryllium and its compounds	0.0002
Cadmium and its compounds	0.0005
Chromium (IV) compounds	0.0005
Chromium and its chromium (III) compounds	0.56
Cobalt and its compounds	0.005
Copper and its compounds	0.01
Fluoride salts	0.18
Lead and its compounds	0.005
Mercury and its compounds	0.0002
Molybdenum and its compounds	0.035
Nickel and its compounds	0.02
Selenium and its compounds	0.001
Silver and its compounds	0.001
Tantalum and its compounds	0.100
Thallium and its compounds	0.007
Tungsten and its compounds	0.100
Vanadium and its compounds	0.01
Zinc and its compounds	0.25

3.3.2 Hazardous air pollutants (HAPs). When tested as specified in 4.6.3, the content of HAP solvents in the total enamel shall be not greater than the weight percent (%wt) values as specified in table V.

TABLE V. Hazardous solvent contents.

Hazardous solvent in total enamel	Maximum, %wt
Benzene	0.05
Chlorinated solvent(s), total Carbon tetrachloride Chloroform (trichloromethane) Methylene chloride (dichloromethane) Tetrachloroethylene (perchloroethylene) 1,1,1-Trichloroethylene (methyl chloroform) Trichloroethylene	0.05
Ethyl benzene	0.05
Methyl, ethyl, and butyl mono-ethers of ethylene glycol or the acetates, total (also known as: Methyl, ethyl, and butyl cellosolves and cellosolve acetates)	0.05
Methyl ethyl kettle (MEK)	0.05
Methyl isobutyl kettle (MIBK)	0.05
Toluene	0.05
Xylene (all forms), total	0.1

3.4 Qualitative requirements. The enamel shall conform to the qualitative requirements as specified in 3.4.1 through 3.4.12.

3.4.1 Odor. When tested as specified in table VI, the odor shall be characteristic of the volatiles permitted and used.

3.4.2 Color. When tested as specified in table VI, the color shall be a general match to color no. 36231 in accordance with FED-STD-595.

3.4.3 Flexibility. When tested as specified in 4.6.6, a film of the enamel shall show no evidence of cracking or flaking.

3.4.4 Rosin and rosin derivatives. When tested as specified in 4.6.7, rosin and rosin derivative shall give a negative test for the presence of rosin and rosin derivatives.

3.4.5 Condition in container. When tested as specified in 4.6.9, a freshly opened, full container of enamel shall be free from lumps, abnormal thickening, or livering and shall show no more pigment settling or caking than can be readily reincorporated to a smooth, uniform state.

3.4.5.1 Storage stability.

3.4.5.1.1 Full container. When tested as specified in 4.6.10.1, the product shall be capable of being readily broken up with a paddle to a smooth uniform consistency. It shall be free from livering, curdling, gelling, pigment float, hard caking, gummy sediment, or other objectionable properties for at least 1 year after date of manufacture. The enamel shall conform in all respects to this specification.

3.4.5.1.2 Partially full container. When tested as specified in 4.6.10.2, enamel shall show no skinning at the end of 48 hours. In addition, the enamel shall show no livering, curdling, hard caking, or gummy sediment after being in a partially filled container at an elevated temperature. The enamel shall mix readily to a smooth uniform state and any skin formed shall be continuous and easily removed.

3.4.6 Dilution stability. When tested as specified in 4.6.8, the enamel shall remain stable and uniform, showing no precipitation, curdling, or separation. Slight pigment settling is permitted. Any thinning shall not cause the enamel to exceed the maximum allowed VOC limits.

3.4.7 Brushing properties. When tested as specified in table VI, the enamel shall be capable of being brushed out and laid off without excess drag on the brush. When dry, the brushed surface shall be free of sags and runs and shall show a minimum of brush marks.

3.4.8 Spraying properties. When tested as specified in table VI, the enamel shall spray satisfactorily in all respects and shall show no running, sagging, streaking, or pronounced orange peel. The film shall air dry and show no seeding, dusting, floating, fogging, mottling, hazing, or other film defects.

3.4.9 Knife test. When tested as specified in 4.6.11 and 4.6.12, a 0.023 mm (nominal) [0.001 inch (nominal)] dry film of enamel shall adhere tightly to and shall not flake or crack from the primers or topcoats. The cut shall show beveled edges.

3.4.10 Water resistance and film hardness. When tested as specified in 4.6.11, a film of enamel shall show no wrinkling or blistering immediately after removal of the panel from water. The enamel shall be only slightly affected with regard to hardness and adhesion when observed 2 hours after removal from the water. The enamel shall have a hardness of 4H. After 24 hours air drying, the portion of the panel which was immersed shall be almost indistinguishable, with regard to hardness, adhesion, and general appearance, from the portion of the panel that was not immersed and shall have a hardness of 4H when tested as specified in 4.6.11.

3.4.11 Compatibility.

3.4.11.1 Compatibility with topcoats. When tested as specified in 4.6.12, the enamel shall show no signs of incompatibility such as blistering, wrinkling or peeling when topcoated with coatings manufactured in accordance with MIL-E-24635 and MIL-E-24763. Examine for incompatibility immediately after topcoat application and after 48 hours.

3.4.11.2 Compatibility with primers and undercoats. When tested as specified in 4.6.12, the enamel shall show no signs of incompatibility such as blistering, wrinkling or peeling when applied over fully cured or dried films of coatings manufactured in accordance with TT-P-645 or MIL-P-24441, type III and type IV Formula 150 primer. Examine for incompatibility immediately after topcoat application and after 48 hours.

3.4.12 Surface appearance. When tested as specified in 4.6.13, a flow-out film on glass of the mixed enamel, after drying for 24 hours, shall exhibit a surface smooth in appearance and free of defects, such as loss of dry, color drift, seeding, pinholes, coarse particles, skins, or agglomerates of any kind.

3.5 Directions for use. The manufacturer shall provide directions for the mixing and application of the enamel. The direction shall comply with 29 CFR OSHA Hazard Communication Act.

3.6 Label. Manufacturer shall prepare label instructions in accordance with 29 CFR 1910. Each container must be affixed with a hazardous chemical warning label in accordance with 29 CFR 1910.1200.

3.7 Ozone-depleting chemicals. The materials used in the enamel shall not contain class I or class II ozone-depleting chemicals as defined in 40 CFR 82.

4. VERIFICATION

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

(a) First article inspection (see 4.2).
(b) Conformance inspection (see 4.3).

4.2 First article inspection. First article inspection shall be performed on a random unit sample drawn from the first production batch of enamel. First article testing shall include all tests specified in table VI and 4.6.

4.3 Conformance inspection. Conformance inspection shall be conducted in accordance with methods 1011, 1022, and 1031 of FED-STD-141 and shall consist of the conformance tests as specified in table VI.

4.4 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in table VI and 4.6.

4.5 Acceptance. Acceptance of the enamel shall be based upon compliance of the enamel with the requirements of this specification (see 6.10).

4.5.1 Definition of lot. A lot shall consist of all material manufactured at one time (batch) or all material produced by mixing multiple batches into one uniform unit of material.

TABLE VI. Test procedures.

Test	Require-ment	Test	FED-STD-141 test method	ASTM test method	Conformance inspection
Pigment content	table II	table VI	4021.1	D 2698	Yes
Volatiles content	table II	table VI	---	D 2369	Yes
Nonvolatile vehicle content	table II	table VI	4053.1	---	Yes
Water content	table II	table VI	---	D 1364	No
Coarse particles/skins	table II	table VI	4092.1	D 185, section 6	Yes
Viscosity	table II	table VI	---	D 562	Yes
Weight per liter (gallon)	table II	table VI	---	D 1475	Yes
Drying time	table II	4.6.5	4061.2	---	Yes
Fineness of grind	table II	table VI	4411.1	D 1210	Yes
Flash point	table II	table VI	---	D 3278	Yes
Gloss	table II	table VI	---	D 523	Yes
Sag resistance	table II	table VI	---	D 4400	Yes
VOC g/L	table II	4.6.4	---	---	Yes
Asbestos content	table II	4.6.2	---	---	No
Metal content	3.3.1	4.6.2	---	---	No
Hazardous air pollutants	3.3.2	4.6.3	7356 7360	E 1252 D 3272	No
Odor	3.4.1	table VI	---	D 1296	Yes
Color	3.4.2	table VI	4250	D 1729	Yes
Flexibility	3.4.3	4.6.6	6221	---	No
Rosin/rosin derivatives	3.4.4	4.6.7	---	D 1542, section 4	No
Condition in container	3.4.5	4.6.9	3011.2	D 869	No
Storage stability					
Full container	3.4.5.1.1	4.6.10.1	3011.1	D 869 D 1849 F 718	No
Partially full container	3.4.5.1.2	4.6.10.2	3021.1	---	No
Dilution stability	3.4.6	4.6.8	4203.1	---	No
Brushing properties	3.4.7	table VI	4321.2	---	Yes
Spraying properties	3.4.8	table VI	2131.1 4331.1	---	Yes
Knife test	3.4.9	4.6.11 4.6.12	6304.1	---	No
Water resistance and hardness	3.4.10	4.6.11	6304.1	D 3363	
Compatibility with other coatings	3.4.11	4.6.12	6304.1	---	No
Surface appearance	3.4.12	4.6.13	3011.1	---	Yes

4.6 Test procedures.

4.6.1 Panel preparation. Steel panels [minimum size 60 mm by 90 mm by 3 mm (2.4 inches by 3.6 inches by 0.12 inch) thick (nominal)] shall be prepared for testing by abrasive blasting to a near white metal surface in accordance with SSPC SP 10 to achieve a minimum 0.051 mm (0.002 inch; 2.0 mil) surface profile. The blasted panels shall be solvent wiped to remove any traces of oil or residue, blown dry with dry air, wrapped in plastic and stored in a desiccator, oven, air-tight storage bag or use other means to prevent rusting prior to coating. The abrasive used for blasting shall be in accordance with MIL-A-22262 and be listed on the current qualified products list. Unless otherwise specified, the test panels shall be coated with TT-P-645 primer applied in one coat at a wet film thickness that will yield a dry film thickness 50 percent greater than the blast profile. Unless otherwise specified, dry time shall be 48 hours at 21 degrees Celsius (˚C) [70 degrees Fahrenheit (˚F)].

4.6.2 Soluble and total metal content. Asbestos, soluble and total metal content, except tantalum and tungsten, shall be determined on a dry film of the enamel in accordance with the 40 CFR, Part 261, Appendix II and the appropriate test listed below. Asbestos shall be analyzed in accordance with 29 CFR 1915.1001, Appendix K and the results shall be recorded as percent by weight of the dry enamel film. Soluble metal content shall be analyzed as milligrams per liter (mg/L). Total metal content shall be analyzed as percent by weight of the dry enamel film. The test results for asbestos, each individual soluble metal, and total metal shall be as specified in 3.3.1, table III, and table IV. Tantalum and tungsten soluble metal content and total metal content shall be analyzed as specified in 4.6.2.1.

Test Methods for Evaluating Solid Waste
Physical/Chemical Methods, EPA SW-846

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

Metal/material	SW-846 analysis test method
Antimony	7040 or 7041
Arsenic	7060 or 7061
Barium	7080 or 7081
Cadmium	7131
Total chromium	7190
Lead	7421
Mercury	7471 or 7471
Nickel	7520 or 7521
Selenium	7740 or 7741
Silver	7760 or 7761

Methods for Chemical Analysis of Water
and Waste, EPA 600/4-020

Metal/material	Test method
Beryllium	210.1 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

4.6.2.1 Tantalum and tungsten content. Determine the tantalum and tungsten content of the enamel using any appropriate spectroscopy test method. Conduct the tests in accordance with the equipment manufacturer's directions for the use of the instrument. Paint manufacturer is responsible for justifying the test method choice and analytical accuracy. Test results for tantalum and tungsten shall be as specified in table III and table IV.

4.6.3 Hazardous solvent content. Hazardous solvent content shall be determined in accordance with methods 7356 and 7360 of FED-STD-141 or ASTM D 3272. Solvent fractions shall be identified in accordance with ASTM E 1252. Test results shall be recorded as percent by weight of the total enamel. The test results for each solvent shall be as specified in 3.3.2 and table V.

4.6.3.1 Alternate analysis methods. Manufacturer may use other analysis methods if such methods are shown to identify and quantify the hazardous air pollutants with the accuracy required (see 6.3).

4.6.4 Volatile organic content (VOC). VOC shall be determined in accordance with 40 CFR 60, Appendix A, Method 24. VOC shall be as specified in table II.

4.6.5 Drying time. Drying time shall be determined in accordance with method 4061.2 of FED-STD-141, except that the specified conditions of temperature and humidity shall apply only for referee tests in case of dispute. All other tests shall be conducted under prevailing laboratory conditions. Time of drying to touch and time of drying to recoat in hours shall be as specified in table II.

4.6.6 Flexibility. Flexibility shall be determined in accordance with method 6221 of FED-STD-141. The enamel shall be applied to a flat metal plate of approximately 31 gauge coated with a dry film thickness of 0.025 mm (0.001 inch + 0.0003 inch) of TT-P-645 primer by means of a doctor blade capable of yielding a dry film thickness of 0.025 mm (0.001 inch + 0.0003 inch). The panel shall be allowed to air-dry for 2 hours then baked for 24 hours at 100 to 105°C (212 to 221°F). The panel shall then be removed from the oven and allowed to stand for 30 minutes at laboratory temperature [nominal 23°C (73°F)]. The panel shall then be bent over a 3.2-mm (1/8-inch) mandrel and the film examined at the bent under a magnification of five diameters. Flexibility shall be as specified in 3.4.3.

4.6.7 Rosin and rosin derivatives. The test for rosin and rosin derivatives shall be in accordance with ASTM D 1542. A portion of the separated nonvolatile vehicle shall be used for the test. Rosin and rosin derivatives shall be as specified in 3.4.4.

4.6.8 Dilution stability. Dilution stability with thinner shall be determined in accordance with method 4203.1 of FED-STD-141. Fifty milliliters (mL) of enamel and 50 mL of paint thinner conforming to type I of A-A-2904 shall be used. Observations shall be made immediately after mixing and 30 minutes after mixing. Compatibility with thinner shall be as specified in 3.4.6.

4.6.9 Condition in container. A container of the product in the size ordered shall be inspected. The product shall be equilibrated to test laboratory conditions [nominal 23°C (73°F)]. Evidence of pressure or vacuum in the unopened container shall be noted. The container shall then be opened and examined in accordance with method 3011.1 of FED-STD-141 for evidence of skinning, corrosion of container interior, odor of putrefaction, rancidity or souring, gell bodies, and hard settling. If the sample is in a 1-liter (1-quart) or smaller container, the character of the lower (or settled) layer shall be determined with a spatula as specified in ASTM D 869. If the sample is larger than 1 liter (1 quart), this step shall be omitted. The enamel shall be hand-stirred 300 stirs in 2 minutes with a spatula appropriate to the container, stirring so as to ensure uniform distribution of any settled material. Immediately after stirring, the consistency of the enamel shall be measured using the Krebs-Stormer viscometer. The enamel shall be applied to a test panel and after it has dried the enamel film shall be examined for grains 0.8 mm (1/32 inch) in diameter, even larger gelatinous lumps, and streaks caused by such grains or lumps. The condition of the product shall be as specified in 3.4.5.

4.6.10 Storage stability.

4.6.10.1 Full container. Storage stability shall be tested in accordance with ASTM D 1849. A container of the product of the size ordered shall be stored at the temperature recommended in the manufacturer's data sheet or ASTM F 718 for a period of 1 year. After completion of 1 year, the stored sample shall be equilibrated to test laboratory conditions [nominal 23°C (73°F)]. Evidence of pressure or vacuum in the unopened container shall be noted. The container shall then be opened and examined in accordance with method 3011.1 of FED-STD-141 for evidence of skinning, corrosion of container interior, odor of putrefaction, rancidity, or souring. If the sample is in a 1-liter (1-quart) or smaller container, the character of the lower (or settled) layer shall be determined with a spatula as specified in ASTM D 869. If the sample is larger than 1 liter (1 quart), this step shall be omitted. The enamel shall be hand-stirred 300 stirs in 2 minutes with a spatula appropriate to the container, stirring so as to ensure uniform distribution of any settled material. Immediately after stirring, the consistency of the enamel shall be measured using the Krebs-Stormer viscometer. The enamel shall be applied to a test panel and after it has dried the enamel film shall be examined for grains 0.8 mm (1/32 inch) in diameter, even larger gelatinous lumps, and streaks caused by such grains or lumps. The condition of the product shall be as specified in 3.4.5.1.1.

4.6.10.2 Partially filled container. A sample of enamel shall be prepared and tested in accordance with method 3021.1 of FED-STD-141. After 48 hours inspect for skinning, livering, curdling, hard caking, or gummy sediment. Examine for ease of mixing. The enamel shall be as specified in 3.4.5.1.2.

4.6.11 Water resistance and film hardness. Spray apply a 0.076 ± 0.025 mm (0.003 ± 0.001 inch) film of the enamel on a panel prepared as specified in 4.6.1. Cure at room temperature [approximately 22°C (72°F)] for 48 hours. Immerse 50 percent of the panel in room temperature distilled water for 24 hours. Test for pencil hardness in accordance with ASTM D 3363. The coated panel shall be placed on a firm horizontal surface. A set of calibrated drawing leads or equivalent calibrated wood pencils meeting the two end points, the pencil that will not cut into or gouge the film (pencil hardness) following hardness scale (6B-5B-4B-3B-B-HB-F-H-2H-3H-4H-5H-6H) shall be used in the test. Whichever pencil is used, it shall be held firmly against the film at a 45-degree angle (point away from the operator) and pushed away from the operator in a 6.5 mm (1/4 inch) stroke. The process shall be started with the hardest pencil and continued down the scale of hardness to the pencil that will not scratch the film (scratch hardness). The condition and hardness shall be as specified in 3.4.10.

4.6.12 Compatibility with topcoats. Prepare and prime three panels as specified in 4.6.1. To the first panel apply a 0.046 to 0.076 mm (0.002 to 0.003 inch; 2 to 3 mil) coating (topcoat) of paint manufactured to MIL-E-24635; to the second panel apply a 0.046 to 0.076 mm (0.002 to 0.003 inch; 2 to 3 mil) topcoat of paint qualified to MIL-E-24763, to the third panel apply a 0.046 to 0.076 mm (0.002 to 0.003 inch; 2 to 3 mil) topcoat of the MIL-DTL-700 test enamel produced to this specification. After drying (curing the three panels for 48 hours at 50°C (122°F), cool to ambient laboratory conditions and apply a 0.046 to 0.076 mm (0.002 to 0.003 inch; 2 to 3 mil) topcoat of the test enamel. Examine for blistering, wrinkling or peeling of the enamel. Check adhesion by method 6304.1 of FED-STD-141 except that the knife used may be an ordinary pocket knife or utility knife. Enamel condition shall be as specified in 3.4.9 and 3.4.11.1.

4.6.13 Surface appearance. Prepare a flow out test panel and inspect in accordance with method 3011.1 of FED-STD-141. Enamel shall be as specified in 3.4.12.

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 which may be helpful, but is not mandatory.)

6.1 Intended use. The enamel covered by this specification is intended for use as a finish or topcoat on ship decks in marine service. This enamel is a non-lead, non-chromate, non-asbestos material. The dried paint film has been tested to USEPA standards and the paint debris is, as of the time of this specification, a non-hazardous waste. It may be applied by brush or spray and is suitable for any metal or wood structure. During development, this enamel was easily sprayed with a Binks #7 HTES (high transfer efficiency special) gun. Spraying with a high volume, low pressure gun was successful using an AIRVERTER® HVLP Sprayer available from Smith Eastern Corporation. The basic formulation provides an enamel of a gray color. This enamel has been formulated to comply with air pollution regulations which allow a maximum VOC of 340 grams of solvent minus water per liter of paint (2.8 lb/gal) as delivered, and does not require thinning for brush or spray application. The paint described by this specification is military unique because it is specified as part of the reactor plant painting schedule for nuclear powered Navy vessels. The paint has been specifically formulated to prevent secondary radiation hazards.

6.2 Acquisition requirements. Acquisition documents must specify the following:

(a) Title, number, and date of the specification.
(b) Issue of the DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
(c) Whether first article is required (see 3.1 and 6.4).
(d) Request for directions for use (see 3.5).
(e) Packaging requirements (see 5.1 and 6.9).
(f) Whether MSDS and ASTM F 718 data sheets are required with each shipment (see 6.6).

6.3 NAVSEA approval and direction. Deviations from specified materials, procedures, and requirements and selection of specific alternative materials and procedures require NAVSEA approval or direction. Requests should include supporting documentation.

6.4 First article inspection. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first article production item, a sample selected from the first production items, a standard production item from the contractor's current inventory (see 3.1), and the number of items to be tested as specified in 4.2. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspections to those bidders offering a product which has been previously acquired or tested by the government, and that

bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.5 Volatile content. Although the container marking specifically refers to the Federal regulations, the paints may be used anywhere else a product complying with 3.2 is allowed. This includes other air pollution control districts or similar areas controlling the emission of solvents into the atmosphere.

6.6 Material safety data sheet (MSDS). The contracting activity should be provided a material safety data sheet at the time of contract award. The MSDS should be provided in accordance with OSHA section 1910.1200, 29 CFR Chapter XVII and found as part of FED-STD-313. OSHA section 1910.1200 requires reporting threshold criteria for known or suspected human carcinogens on MSDS 0.1 percent or greater, and 1 percent or greater for other health hazards. The MSDS should be included with each unit of issue of material covered by the specification, when specified (see 6.2).

6.6.1 Material safety data sheets and ASTM F 718. 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. When specified, ASTM F 718 data sheet should be included with each shipment of the material covered by this specification (see 6.2).

6.7 Toxicity. Questions pertinent to this requirement should be referred by contracting activity to the qualifying activity. The qualifying activity will act as advisor to the contracting activity. The qualifying activity will arrange for review of questions by the appropriate departmental medical service.

6.8 Toxicological product formulations. The contractor should 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.

6.9 Suggested packaging requirements. Suggested packaging is contained in tables VII and VIII.

TABLE VII. Suggested packing and packaging.

Packaging	Recommended requirements for direct Government acquisitions
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).
Containers	(a) The components should be furnished in cans of appropriate volume such as 3.78L (1 gallon) or multiples thereof. (b) 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. (c) Pails should be to PPP-P-704. (d) All containers should comply with the requirements of the Uniform Freight Classifications (UFC), the National Motor Freight Classification (NMFC), and the applicable requirements of 49CFR, Department of Transportation (DOT).
Intermediate containers	(a) Paints should be packaged in intermediate containers. (b) 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 conform to the ASTM D 4727. ASTM D 4727 classes should be domestic fire-retardant or weather resistant fire-retardant as specified.
Commercial packaging	(a) Commercial packaging should be to ASTM D 3951. (b) All 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).

TABLE VII Suggested packing and packaging - Continued.

Packaging	Recommended requirements for direct Government acquisitions
Packing	Packing should be specified as follows: Overseas delivery (level A) packing. Intermediate containers of paint should be packed in close-fitting wood boxes conforming to 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. 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. Commercial packing. The paint, in the specified unit and intermediate containers should, as applicable, be packed in multiples of like sizes in accordance with UFC, NMFC, and 49CFR requirements.
Palletization	Intermediate containers should be palletized in accordance with MIL-HDBK-774. Only one size unit or intermediate container should be placed on a pallet.
Packing for Navy acquisitions	Treated lumber and plywood. All lumber and plywood, including laminated veneer materials, used in shipping container and pallet construction, member, blocking, bracing, and reinforcing should 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.
Material safety data sheets (MSDS) and ASTM F 718	A copy of the MSDS and ASTM F 718 data sheet should be attached to the shipping document for each destination (see 6.6).

TABLE VIII. Suggested marking.

Marking type	Recommended marking
Bar codes	Marking should include bar codes
Hazardous warnings	(a) Labels should be in accordance with 29 CFR 1910, 1915, 1917, 1918, 1926, and 1928 as well as PPP-P-1892. (b) All 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 FED-STD-313.
Volatile organic content (VOC)	"Contains a maximum of 340 grams of solvent of volatile organic content (VOC) per liter (2.8 pounds per gallon) of paint 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 reinspection (insert here date 1 year after date of manufacture)".
OSHA Hazard Communication Act and FED-STD-313.	Markings should include all information necessary to comply with OSHA Hazard Communication Act and FED-STD-313.
Mixing and use instructions	Directions should include mixing, application equipment directions, limitations on thinning, temperature range for use and surface preparation recommendations. Directions should refer user to data sheets, MSDS and ASTM F 718 for information.

6.10 Lot acceptance and rejection criteria. Failure of a sample to pass any test should be cause for rejection of the lot.

6.11 Subject term (key word) listing.

Alkyd
Cobalt compounds
Manganese compounds

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 extent of the changes.

Custodians:
Army - AV
Navy - SH

Preparing activity:
Navy - SH
(Project 8010-0026)