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MIL-E-698B
30 April 1968
SUPERSEDING
MIL-P-698A
8 January 1957
(See 6.7)

MILITARY SPECIFICATION

ENAMEL, ALKYD, DECK, BLACK (FORMULA NO. 24)

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

1. SCOPE

1.1 This specification covers black deck enamel Formula No. 24 suitable for shipboard use on exterior or interior decks and hulls over marine primers.

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

TT-D-643 - Drier, Paint, Naphthenate, Liquid, Concentrated.
TT-N-97 - Naphtha, Aromatic.
TT-P-143 - Paint, Varnish, Lacquer, and Related Materials; Packaging, Packing, and Marking of.
TT-P-350 - Pigment, Lampblack - Dry.
TT-R-266 - Resin, Alkyd; Solutions.
TT-T-291 - Thinner; Paint, Volatile Mineral Spirits (Petroleum-Spirits).

MILITARY

MIL-P-15173 - Pigment, Magnesium-Silicate; Dry (Paint Pigment).
MIL-V-15218 - Varnish (Mixing, Phenolic).
MIL-P-15486 - Zinc Oxide, Technical (Acicular, Paint Use).

STANDARDS

FEDERAL

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

MILITARY

MIL-STD-755 - Labels Containing Symbols for Packages and Containers for Hazardous Industrial Chemicals and Materials.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Description. The enamel shall be ready-mixed and prepared in accordance with the Table I formula designated as Navy Standard Formula No. 24. When Formula No. 24 is specified, the enamel shall conform to this specification.

3.2 Composition. The enamel shall consist of ingredients conforming to the requirements of applicable specifications in the proportions shown in Table I, except that the amount of lampblack may be varied as necessary to meet the color requirement. Additionally, to assist in meeting brushing, condition-in-container, and storage stability requirements, small amounts of antisettling, antisagging, and antiskinning agents may be added provided that all the other requirements of the specifications are met and the exact formula used in furnished in the record required by method 1031 of FED-STD-141.

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TABLE I - Formula No. 24.

Ingredients	Specification	Pounds[1/]
Lampblack	TT-P-350	30[2/]
Zinc oxide	MIL-P-15486	60
Magnesium silicate	MIL-P-15173, Type A	210
Varnish, phenolic, mixing	MIL-V-15218, Type I	265
Alkyd resin solution	TT-R-266, Type I, class A	225
Aromatic petroleum naphtha	TT-N-97, Type III	16
Paint thinner	TT-T-291, grade 1	155[2/]
Lead Naphthenate drier	TT-D-643, Type I	17
Cobalt naphthenate drier	TT-D-643, Type II	3.9
Manganese naphthenate drier	TT-D-643, Type III	3.0

[1/] The formula is given slightly in excess of 100 gallons to allow for normal manufacturing loss.

[2/] The amount of tinting pigment and thinners may be adjusted to meet the correct color and consistency, provided all other requirements are complied with.

3.3 Manufacture. The component raw materials shall be mixed and dispersed as required to produce a product which is uniform, homogeneous, entirely suitable for the purpose intended, and in full conformity with the requirements of this specification.

3.4 Quantitative requirements. The enamel shall conform to the quantitative requirements shown in Table II when tested in accordance with 4.4.

TABLE II - Quantitative Requirements.

Characteristics	Requirements	
	Minimum	Maximum
Pigment, percent by weight	29.0	32.0
Volatiles, percent by weight	34.0	37.5
Nonvolatile vehicle, percent by weight (calculated by difference)	32.0	35.5
Phthalic anhydride, percent by weight on non-volatile vehicle	11.0	14.0
Water, percent by weight	----	0.5
Coarse particles and skins (as residue retained on No. 325 sieve), percent by weight of enamel	----	0.2
Consistency, Krebs-Stormer Shearing rate, 200 rpm Grams	140	190
Krebs Units (equivalent)	70	80
Weight per gallon, pounds	9.3	9.9
Drying time; within 30 days of manufacture		
Set-to-touch, hours	0.5	2.0
Dry hard, hours	-----	5.0
Fineness of grind	5	-----
Gloss, 60° specular	-----	60
Flash point (degrees F.)	86	-----
Zinc oxide (ZnO), percent by weight of pigment	19.0	21.0

3.5 Qualitative requirements.

3.5.1 Brushing properties. The enamel, when tested as specified in 4.4.4, 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 and runs, and shall show a minimum of brush marks.

3.5.2 Spraying properties. The enamel, when tested as specified in 4.4.5, shall spray satsifactorily in all respects, and shall show no running, sagging, or streaking. The film shall show no dusting, mottling, or color separation.

3.5.3 Flexibility. A film of enamel, prepared and tested as specified in 4.4.6, shall withstand bending without cracking or flaking when observed at 7-diameter magnification.

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3.5.4 Water resistance. A film of enamel, prepared and tested as specified in 4.4.7, shall show no wrinkling, blistering, whitening, blooming, softening, or loss of adhesion.

3.5.5 Color. The color shall acceptably match the dry standard color card (see 6.4) when tested as specified in 4.4.8.

3.5.6 Stability in partially full container. A three-quarter filled, closed, 8-ounce glass jar of enamel shall show no skinning at the end of 48 hours when tested as specified in 4.4.9. After aging as in 4.4.9, the enamel shall show no livering, curdling, seeding, hard caking, or gummy sediment. It shall mix readily to a smooth, homogeneous state and any skin formed shall be continuous and easily removed.

3.5.7 Dilution stability. When thinned as specified in 4.4.10, the enamel shall remain stable and uniform showing no precipitation, curdling, or separation. Slight pigment settling shall be permitted.

3.5.8 Rosin and rosin derivatives. The enamel shall give a negative test for the presence of rosin and rosin derivatives when tested as specified in 4.4.11.

3.5.9 Phenolic resins. The enamel shall give a positive test for the presence of phenolic resins when tested as specified in 4.4.12.

3.5.10 Condition in container. The enamel shall be readily broken up with a paddle to a smooth, uniform consistency, and shall not liver; exceed 90 Krebs Units in viscosity (258 grams Krebs-Stormer shearing rate at 200 rpm); exceed 8 hours dry hard time; gel, or shown any other objectionable properties, for at least one year after the date of manufacture, as specified in 4.4.13.

3.5.11 Odor. The odor shall be normal for the volatiles permitted when tested, as specified in 4.4.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may utilize 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 the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Quality assurance. Quality assurance shall be provided in accordance with method 1031 of FED-STD-141. Submission of forms in accordance with method 1031 of FED-STD-141 shall cover complete tests other than the one year condition-in-container test. The condition-in-container requirement shall apply for one year after manufacture regardless of other testing or prior acceptance of the material.

4.2.1 Manufacturing control. In addition to the other requirements of method 1031 of FED-STD-141, the manufacturer shall forward to the cognizant inspection office and testing laboratory a copy of the certification that each ingredient raw material conforms to the applicable specification.

4.2.2 Ingredient materials. When requested by the testing laboratory or other controlling authority, one pint of each ingredient in the formula specified in Table I shall be supplied for test purposes.

4.3 Acceptance. Acceptance of the enamel shall be based upon conformance of the enamel to the requirements of this specification. Failure to pass any test shall be cause for rejection of the lot.

4.4 Test procedures. The enamel shall be tested in accordance with the applicable methods specified in Table III and as hereinafter specified.

4.4.1 Phthalic anhydride. Phthalic anhydride shall be determined by method 7021 of FED-STD-141. A suitable portion of the vehicle, collected during the determination of pigment and evaporated on a steam bath until the volume has been reduced to approximately 10 milliliters (ml.), shall be used as the sample. (If desired, phthalic anhydride may be determined on the vehicle isolated by supercentrifuging (method 4032).)

4.4.2 Drying time. Drying time shall be determined in accordance with method 4061 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.

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TABLE III - Index.

Item	Test Method		Section of this specification giving requirements
	Applicable method in FED-STD-141	Section of this specification giving further reference	
Pigment content	4021	------	Table II
Volatiles	4041	------	Table II
Nonvolatile vehicle content	4053	------	Table II
Phthalic anhydride	7021	4.4.1	Table II
Water	4081	------	Table II
Coarse particles	4091	------	Table II
Consistency, Krebs-Stormer	4281	------	Table II
Weight per gallon	4184	------	Table II
Drying time	4061	4.4.2	Table II
Fineness of grind	4411	------	Table II
Flash point	4293	------	Table II
Zinc oxide	7091	4.4.3	Table II
Brushing properties	4321	4.4.4	3.5.1
Spraying properties	4331	4.4.5	3.5.2
Flexibility	6221	4.4.6	3.5.3
Water resistance	6011	4.4.7	3.5.4
Color	4250	4.4.8	3.5.5
Stability in partially full container	3021	4.4.9	3.5.6
Dilution stability	4203	4.4.10	3.5.7
Rosin and rosin derivatives	5032	4.4.11	3.5.8
Phenolic resins	5141	4.4.12	3.5.9
Condition in container	3011	4.4.13	3.5.10
Odor	4401	------	3.5.11
Gloss, 60° specular	6101	4.4.14	Table II

4.4.3 Pigment analysis (zinc oxide). Weigh out a 0.500 gram sample of the extracted pigment, transfer to a 400 ml. beaker, moisten with alcohol, add 10 ml. of hydrochloric acid and 20 ml. of water and heat until the zinc oxide is dissolved. Filter, catching the filtrate in a 400 ml. beaker, and wash the residue until free of zinc with hot 1:4 hydrochloric acid. Drop a small piece of litmus paper into a beaker containing the filtrate, add NH_4OH until slightly alkaline, then add diluted HCl until just acid, and then add 3 ml. of strong HCl. Dilute to approximately 250 ml. with hot water and heat nearly to boiling. Titrate with standard ferrocyanide as described in method 7091 of FED-STD-141.

4.4.4 Brushing properties. Apply the enamel as packaged in accordance with method 4321 of FED-STD-141, and observe for compliance with 3.5.1.

4.4.5 Spraying properties. Reduce five parts by volume enamel with one part by volume of thinner conforming to TT-T-291, grade 1. Spray on a steel panel to a dry film thickness between 0.0009 to 0.0011 inch and observe for spraying properties in accordance with method 4331 of FED-STD-141, for compliance with 3.5.2. For referee test use automatic application as per method 2131 of FED-STD-141.

4.4.6 Flexibility. Determine flexibility in accordance with method 6221 of FED-STD-141.

4.4.6.1 Panel preparation. Prepare a flat tin plate panel in accordance with method 2012 of FED-STD-141, using the petroleum naphtha-ethylene glycol monoethyl ether mixture. Apply a 2-inch wide film of enamel on the tin plate with a suitable film applicator that will give a dry film thickness of 1.4 ± 0.3 mil. Air dry the enamel in a horizontal position for 2 hours then bake for 24 hours at 102° ± 2°C. (216°±4°F.). Condition the panel for 1/2 an hour under referee test conditions given in method 6221 of FED-STD-141.

4.4.6.2 Procedure. Bend 180° 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 3.5.3.

4.4.7 Water resistance.

4.4.7.1 Panel preparation. Prepare a flat tin panel in accordance with method 2012 of FED-STD-141 using the petroleum naphtha-ethylene glycol monoethyl ether mixture. Apply a brushed-out film of the enamel to obtain a dry film thickness of 1.5 ± 0.3 mil. using a suitable film applicator. Air dry the enamel for 48 hours.

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4.4.7.2 Procedure. Immerse the panel in distilled water at 26° ± 1°C. for 18 hours in accordance with method 6011 of FED-STD-141. At the end of the test period, remove and allow to recover for 2 hours. Examine for compliance with 3.5.4.

4.4.8 Color. Prepare panel for test by applying a single drawdown coat of the enamel to a plain piece of opaque white glass using a doctor blade with a clearance of 0.006 inch (designed to give a wet film thickness of approximately 0.003 inch). After a 48 hour drying period, compare the panel with the standard color card, (see 6.4), as specified in method 4250 of FED-STD-141. If doubt exists after visual comparison as to the acceptability of the match, determine the color difference by instrument, as specified in method 6123 of FED-STD-141. An acceptable color match shall be exact or within two units in the direction of minus $\triangle L$, $\triangle a$, and $\triangle b$.

4.4.9 Stability in partially full container. Determine skinning after 48 hours in accordance with method 3021 of FED-STD-141. Reseal and age for 7 days at 60°C. and observe for compliance with 3.5.6.

4.4.10 Dilution stability. Reduce one part by volume of enamel as packaged with one part by volume of mineral spirits conforming to grade 1 of TT-T-291. Then test according to method 4203 of FED-STD-141 for compliance with 3.5.7.

4.4.11 Rosin and rosin derivatives. Test for rosin and rosin derivatives in accordance with method 5031 of FED-STD-141. Use a portion of the separated nonvolatile vehicle for the test.

4.4.12 Phenolic resins. Test for phenolic resins in accordance with method 5141 of FED-STD-141. Use a portion of the separated nonvolatile vehicle for the test.

4.4.13 Condition in container. The supplier shall determine package condition at time of acceptance testing in accordance with method 3011 of FED-STD-141, and observe for compliance with 3.5.6. The Government, at its option and at any time not to exceed one year after manufacture, may test enamel stored in its original containers for package condition, viscosity, dry hard time, and color difference from the standard color card. (Any action by the Government to disqualify enamel after prior acceptance shall be based on the examination of enamel stored in its original containers.) For the purpose of developing a quality history of the supplier's product, the Government shall allow a full one-quart can of enamel to stand undisturbed at a temperature of 21°C. to 32°C. (70°F. to 90°F.) for a period not to exceed 12 months and then shall examine for compliance with 3.5.10 (see 6.2).

4.4.14 Gloss, 60° specular. The gloss shall be determined in accordance with method 6101 of FED-STD-141 with panels prepared as in 4.4.8.

5. PREPARATION FOR DELIVERY

(The preparation for delivery requirements specified herein apply only for direct Government procurements. Preparation for delivery requirements of referenced documents listed in Section 2 do not apply unless specifically stated in the contract or order. Preparation for delivery requirements for products procured by contractors shall be specified in the individual orders.)

5.1 Packaging, packing, and marking. The enamel shall be furnished in the size of container specified (see 6.2). Enamel shall be packaged level A or C; packed level A, B, or C as specified (see 6.2) and marked in accordance with TT-P-143.

5.2 Marking. In addition to any special marking specified in the contract or order, each container shall have affixed a warning label of appropriate size similar to Class 2 of MIL-STD-755, or shall be lithographed, or stencilled with a reasonable likeness thereof. Under "contains" shall be inserted "petroleum thinner of 100°F. minimum flash point." For unit containers that also serve as shipping containers, any conflict with ICC Regulations shall be resolved by reasonable modification of size of label or use of warning statement without label design.

6. NOTES

6.1 Intended use. Black deck enamel is used on interior or exterior steel decks and hulls over marine primers where a fast dry is not required. The enamel is a semi-gloss enamel with good brushing and application properties.

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6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number, and date of this specification.
(b) Special samples if required (see 4.2.2).
(c) Size of container (see 5.1).
(d) Level of packaging and level of packing required (see 5.1).
(e) Special marking required (see 5.2).

6.3 The enamel should be purchased under this specification by volume, the unit being one U. S. gallon of 231 cubic inches at 15.5°C. (60°F.).

6.4 Color cards. Color cards may be obtained upon application to the Chemical Laboratory, Norfolk Naval Shipyard, Portsmouth, Virginia 23709. The purpose for which the cards are desired should be specified.

6.5 If it is desired to use alkyd resin solution conforming to the requirements for Type I, class B of TT-R-266, the weight of the alkyd resin solution, as specified in this specification, should be multiplied by 1.17, and the paint thinner, petroleum spirits (grade 1 of TT-T-291), reduced by 0.17 times the weight of alkyd resin solution specified in this specification.

6.6 Composition by volume. For information only, and with the understanding that weight-volume relationships of ingredients may vary slightly, the following approximation of composition by volume is included.

Ingredients	Gallons	
Lampblack	2.1	
Zinc oxide	1.3	
Magnesium silicate	9.0	
Phenolic varnish solution	34.4	(18.7)[1/]
Alkyd resin solution	28.5	(18.9)[1/]
Aromatic petroleum naphtha	2.5	
Paint thinner	23.1	
Lead naphthenate drier	1.7	
Cobalt naphthenate drier	0.4	
Manganese naphthenate drier	0.3	
TOTAL VOLUME	103.3	

[1/] Figures in parentheses refer to volume of resin solids (nonvolatile).

6.7 CHANGES FROM PREVIOUS ISSUE. THE OUTSIDE MARGINS OF THIS DOCUMENT HAVE BEEN MARKED "#" TO INDICATE WHERE CHANGES (DELETIONS, ADDITIONS, ETC.) FROM THE PREVIOUS ISSUE HAVE BEEN MADE. THIS HAS BEEN DONE AS A CONVENIENCE ONLY AND THE GOVERNMENT ASSUMES NO LIABILITY WHATSOEVER FOR ANY INACCURACIES IN THESE NOTATIONS. BIDDERS AND CONTRACTORS ARE CAUTIONED TO EVALUATE THE REQUIREMENTS OF THIS DOCUMENT BASED ON THE ENTIRE CONTENT AS WRITTEN IRRESPECTIVE OF THE MARGINAL NOTATIONS AND RELATIONSHIP TO THE LAST PREVIOUS ISSUE.

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SPECIFICATION ANALYSIS SHEET

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INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity *(as indicated on reverse hereof)*.

SPECIFICATION

ORGANIZATION *(Of submitter)*	CITY AND STATE

CONTRACT NO.	QUANTITY OF ITEMS PROCURED	DOLLAR AMOUNT
		$

MATERIAL PROCURED UNDER A

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1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

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3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO IF "YES", IN WHAT WAY?

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