METRIC

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(See 6.7)

MILITARY SPECIFICATION

ENAMEL, EXTERIOR, ALKYD, OCEAN GRAY,
NO. 17 (FORMULA NO. 5-0) (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 ocean gray No. 17, exterior, alkyd enamel (Formula No. 5-0) for shipboard use.

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

FEDERAL
TT-R-266 - Resin, Alkyd; Solutions.
TT-T-291 - Thinner-Paint, Volatile Spirits, Petroleum Spirits.
PPP-P-1892 - Paint, Varnish, Lacquer, and Related Materials; Packaging, Packing, and Marking of.

MILITARY
MIL-P-15173 - Pigment, Magnesium Silicate, Dry (Paint Pigment).
MIL-Z-15486 - Zinc Oxide, Technical (Acicular, Paint Use).

STANDARDS

FEDERAL
FED-STD-141 - Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling, and Testing.
FED-STD-313 - Material Safety Data Sheets, Preparation and the Submission of.
FED-STD-595 - Colors.

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated the issue in effect on date of invitation for bids or request for proposal shall apply.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Ship Engineering Center, SEC 6124, Department of the Navy, Washington, DC 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 8010

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
D 34 - White Pigments, Chemical Analysis of.
D 93 - Flash Point by Pensky-Martens Closed Tester, Test for.
D 209 - Lampblack, Spec. for.
D 476 - Titanium Dioxide Pigments, Spec. for.
D 562 - Consistency of Paints Using the Stormer Viscosimeter, Test for.
D 563 - Phthalic Anhydride Content of Alkyd Resins and Resin Solutions, Test for.
D 600 - Liquid Paint Driers, Spec. for.
D 1210 - Fineness of Dispersion of Pigment-Vehicle Systems, Test for.
D 1296 - Odor of Volatile Solvents and Diluents, Test for.
D 1306 - Phthalic Anhydride Content of Alkyd Resins and Esters Containing Other Dibasic Acids (Gravimetric), Test for.
D 1308 - Effect of Household Chemicals on Clear and Pigmented Organic Finishes, Test for.
D 1475 - Density of Paint, Varnish, Lacquer, and Related Products, Test for.
D 1542 - Rosin in Varnishes, Qualitative Tests for.
D 2369 - Volatile Content of Paints, Test for.

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

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 Toxicity. The material shall have no adverse effect on the health of personnel when used for its intended purpose (see 4.6). Questions pertinent to this effect shall be referred by the procuring activity to the appropriate service medical department which will act as advisor to the procuring activity.

3.2 Formula. The enamel shall consist of ingredients conforming to the applicable specifications in the proportions specified (see table I), except that the amount of lampblack may be varied as necessary to conform to the color requirement (see 3.5.2). Small quantities of antisettling, antisagging, and antiskinning agents may also be added to the formulation, provided that all other requirements of the specification are met. Test reports required by method 1031 of FED-STD-141 shall include the exact formula used.

TABLE I. Formula No. 5-0.

| Ingredients | kg (pounds) 1/ |
|---|---|
| Titanium dioxide (ASTM D 476, type III) | 22.7 (50) |
| Zinc oxide (MIL-Z-15486) | 91.3 (200) |
| Lampblack (ASTM D 209) | 1.365 (3) |
| Magnesium silicate (MIL-P-15173, type B) | 63.8 (140) |
| Alkyd resin solution (TT-R-266, type I, class A) (see 6.6) 2/ | 208.5 (460) |
| Paint thinner (TT-T-291, type II, grade A) | 93.55 (205) |
| Lead naphthenic drier (ASTM D 600, Class B) | 1.91 (4.2) |
| Cobalt naphthenic drier (ASTM D 600, Class B) | 0.73 (1.6) |
| Manganese naphthenic drier (ASTM D 600, Class B) | 0.73 (1.6) |

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

2/ The solvent shall consist of mineral spirits conforming to type II, grade A of TT-T-291, except as modified by 3.4.1.

3.2.1 The formula shown in table I is designated Navy Standard Formula No. 5-0. Whenever Formula No. 5-0 is specified, the enamel shall conform to this specification (see 6.6).

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

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

TABLE II. Quantitative requirements.

| Characteristic | Requirements | |
|---|---|---|
| | Minimum | Maximum |
| Pigment, percent by weight of enamel | 36.5 | 40.0 |
| Volatiles, percent by weight of enamel | 29.0 | 33.0 |
| Nonvolatile vehicle, percent by weight of enamel (calculated by difference) | 30.0 | 34.0 |
| Phthalic anhydride, percent by weight of nonvolatile vehicle | 23.0 | -------- |
| Coarse particles and skins (as residue on No. 325 sieve), percent by weight of enamel | ------- | 0.5 |
| Water, percent by weight of enamel | ------- | 0.5 |
| Viscosity, Krebs units (equivalent) | 67 | 77 |
| Weight per gallon, kg (pounds) | 4.68 (10.3) | 4.86 (10.7) |
| Drying time - set to touch, hours | ------- | 1.0 |
| dry hard, hours | ------- | 8.0 |
| Fineness of grind | 5 | -------- |
| Flash point, °C (°F) | 37.8 (100) | -------- |
| Titanium dioxide, percent by weight of pigment | 11.5 | -------- |
| Zinc oxide, percent by weight of pigment | 49.5 | -------- |

3.4.1 Solvent. The solvent portion of the formulation shall conform to requirements herein specified.

(a) A combination of hydrocarbons, alcohols, aldehydes, ethers, esters, or ketones having an olefinic or cycloolefinic type of unsaturation except perchloroethylene: 5 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 percent maximum.
(c) A combination of ethylbenzene, ketones having branched hydrocarbon structures, trichloroethylene, or toluene: 20 percent maximum.

3.5 Qualitative requirements. The enamel shall conform to the qualitative requirements specified herein.

3.5.1 Odor. The odor shall be characteristic of the volatiles permitted when tested as specified (see table III).

3.5.2 Color. The color of the enamel shall match the dry color chip No. 36173 of FED-STD-595 when tested as specified (see 4.4.4).

3.5.3 Flexibility. The enamel shall show no evidence of cracking when tested as specified (see 4.4.5).

3.5.4 Compatibility with thinner. There shall be no evidence of incompatibility of any of the ingredients of the enamel as received, when tested as specified (see 4.4.6).

3.5.5 Condition in container. The enamel, as received in its filled original container, shall be readily mixable, either by paddle, shaker, or mechanical stirrer, to a smooth, uniform consistency and shall conform to all requirements related to the finished product as listed in table II. The enamel shall not increase more than 10 Krebs units in viscosity or increase more than 2 hours in drying time. It shall not curdle, liver, gel, seed, or develop any other objectionable properties for a minimum of 1 year after date of manufacture, when tested as specified (see 4.4.7).

3.5.6 Skinning. The enamel shall not skin within 48 hours in a three-quarters filled container when tested as specified (see 4.4.8).

3.5.7 Rosin and rosin derivatives. Rosin and rosin derivatives shall not be present when tested as specified (see 4.4.9).

3.5.8 Phenolic resins. Phenolic resin shall not be present when tested as specified (see 4.4.10).

3.5.9 Application characteristics.

3.5.9.1 Brushing properties. The product, when tested as specified (see 4.4.11), shall be capable of being brushed out and laid off without excess drag on the brush. When dry, the brush-coated surface shall be free from sags, runs, wrinkles, excess brush marks, or other film defects. The film shall exhibit good adhesion and a smooth, uniform appearance.

3.5.9.2 Spraying properties. The enamel, when tested as specified (see 4.4.12), shall show no running, sagging, streaking, dusting, mottling, color separation, or any other film defects. The film shall exhibit good adhesion and a smooth, uniform appearance.

3.5.10 Resistance to water immersion. There shall be no evidence of blistering, softening, or loss of adhesion, when the enamel is tested as specified (see 4.4.13).

3.5.11 Material safety data sheet. The procuring activity shall be provided a material safety data sheet (MSDS) at the time of contract award. The MSDS is DD Form 1813 and found in and part of FED-STD-313. The MSDS shall be included with each shipment of the material covered by this specification.

4. QUALITY ASSURANCE PROVISIONS

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

4.2 Quality conformance inspection. Quality conformance inspection shall be provided in accordance with method 1031 of FED-STD-141 and as herein supplemented.

4.3 Ingredient materials. When requested by the testing laboratory or other controlling authority (see 6.2), 1 pint of each ingredient in the formula specified (see table I) shall be supplied for test purposes.

4.4 Test procedures. Tests shall be conducted in accordance with the methods in table III.

TABLE III. Test procedures.

| Tests | Applicable method in FED-STD-141 | Applicable ASTM test method |
|---|---|---|
| Pigment content | 4021.1 | ---------- |
| Volatiles | ------- | D 2369 |
| Nonvolatile vehicle (by difference) | 4053 | ---------- |
| Phthalic anhydride | ------- | D 563 |
| Drying time | 4061.1 | ---------- |
| Water | 4081 | ---------- |
| Condition in container | 3011.1 | ---------- |
| Skinning (partially filled container) | 3021 | ---------- |
| Coarse particles and skins | 4092.1 | ---------- |
| Weight per gallon | ------- | D 1475 |
| Compatibility with thinner | 4203.1 | ---------- |
| Color | 4250 | ---------- |
| Viscosity, Krebs-Stormer | ------- | D 562 |
| Flash point | -------- | D 93 |
| Brushing properties | 4321.1 | ---------- |

TABLE III. Test procedures. - Continued

| Tests | Applicable method in FED-STD-141 | Applicable ASTM test method |
|---|---|---|
| Spraying properties | 4331.1 | ---------- |
| Odor | -------- | D 1296 |
| Fineness of grind | -------- | D 1210 |
| Rosin and rosin derivatives | -------- | D 1542, sect. 4 |
| Phenolic resins | 5141.1 | ---------- |
| Water immersion | -------- | D 1308, sect. 5 |
| Flexibility | 6221 | ---------- |
| Titanium dioxide | 7081 | ---------- |
| Zinc oxide | --------- | D 34 |

4.4.1 Pigment analysis.

4.4.1.1 Pigment content. Extract the pigment from a weighed sample of enamel as in method 4021 of FED-STD-141 using extraction mixture A. Dry and weigh extracted pigment. Calculate percent pigment in the enamel.

4.4.1.2 Zinc oxide. Determine zinc oxide in the extracted pigment by ASTM D34, except that the solution shall be filtered just prior to adding methyl orange indicator in order to remove lampblack and other insoluble material which would make the end point difficult to perceive.

4.4.1.3 Titanium dioxide. Weigh 1.000 gram (g) of extracted pigment into a clean porcelain crucible. Heat at 538°C to 649°C (1,000°F to 1,200°F) in a muffle furnace until the lampblack is destroyed. Transfer the contents of the ignited crucible to a 250-milliliter (mL) beaker and determine titanium dioxide by method 7081 of FED-STD-141.

4.4.1.4 Interfering elements. The methods specified for determining zinc oxide and titanium dioxide are based on the assumption that elements such as iron are not present in sufficient quantity to interfere with the determination by the specified method. If such elements are introduced, for example, as a result of the method of grinding, in amounts sufficient to interfere, suitable modification of these methods shall be made to eliminate the interference.

4.4.2 Phthalic anhydride. Determine phthalic anhydride content of the nonvolatile vehicle in accordance with ASTM D 563, applying the correction procedure described in paragraph 4.2 of the test method. If dibasic acids other than phthalic are present, ASTM D 1306 shall be used.

4.4.3 Drying time. Determine drying time by 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.

4.4.4 Color. Prepare test panel by applying a single drawdown coat of the enamel to a planar piece of opaque white glass using a doctor blade with a clearance of 0.152 millimeter (mm) (0.006 inch) [designed to give a wet film thickness of approximately 0.076 mm (0.003 inch)]. The coated panel shall be allowed to dry 24 hours under prevailing laboratory conditions before comparing with the standard color card in accordance with method 4250 of FED-STD-141 (see 3.5.2).

4.4.5 Flexibility. Determine flexibility in accordance with method 6221 of FED-STD-141. Draw down a 5.08-centimeter (cm) (2-inch) wide film of the enamel with a suitable film applicator that will give a dry film thickness of 0.0254 mm ± 0.0076 mm (0.0010 ± 0.0003 inch) on a flat tin panel prepared in accordance with method 2012 of FED-STD-141, using the aliphatic naphtha ethylene glycol monoethyl ether mixture. Air dry the test specimen for 2 hours in a horizontal position; then bake for 24 hours in an air-circulating oven at 100°C to 105°C (212°F to 221°F). At the end of the baking period, condition the panel for 30 minutes at 25°C ± 5°C (77°F ± 9°F) and bend over a 3.18-mm (1/8-inch) mandrel. The coated surface of the panel shall be uppermost during the bending, which shall be accomplished at a uniform rate over approximately 1 second. The panel shall be examined at the bend using a seven-power lens and conformance to 3.5.3 shall be noted.

4.4.6 Compatibility with thinner. Determine compatibility with thinner in accordance with method 4203 of FED-STD-141. Fifty mL of enamel shall be mixed with 50 mL of mineral spirits conforming to type II, grade A of TT-T-291. Observations shall be made immediately after mixing and repeated in 30 minutes.

4.4.7 Condition in container. Determine the condition of the enamel as received in its container in accordance with method 3011 of FED-STD-141 and observe for compliance with 3.5.5. The Government, at its option and at any time not to exceed 1 year after manufacture, may test enamel stored in its original containers for product condition, viscosity, and dry hard time. (Any action by the Government to disqualify enamel after prior acceptance shall be based on the examination of enamel stored in its original containers).

4.4.8 Skinning. Determine skinning characteristics of the material in a partially filled container in accordance with method 3021 of FED-STD-141.

4.4.9 Rosin and rosin derivatives. Conduct test for rosin and rosin derivatives in accordance with section 4 of ASTM D 1542. A portion of the separated, nonvolatile vehicle shall be used for the test.

4.4.10 Phenolic resins. Conduct test for phenolic resins in accordance with method 5141 of FED-STD-141. A portion of the nonvolatile vehicle shall be used for the test.

4.4.11 Brushing properties. Determine brushing properties of the enamel in accordance with method 4321 of FED-STD-141 and observe for compliance with 3.5.9.1.

4.4.12 Spraying properties. Determine spraying properties of the enamel in accordance with method 4331 of FED-STD-141. Reduce eight parts by volume of enamel with one part by volume of thinner conforming to TT-T-291 type II, grade A. Spray coat the steel panel to a dry film thickness of 0.0254 mm ± 0.0076 mm (0.001 ± 0.0001 inch) and observe for compliance with 3.5.9.2. For referee tests, the automatic film application described in method 2131 of FED-STD-141 shall be used.

4.4.13 Resistance to water immersion. Determine water immersion properties of the enamel in accordance with section 5 of ASTM D 1308. The test panel shall be prepared as prescribed in method 2012 of FED-STD-141, using the aliphatic naphtha-ethylene glycol monoethyl ether mixture. Using a suitable applicator, apply the coating film a dry film thickness of 0.0254 mm ± 0.0076 mm (0.0010 ± 0.0003 inch). Allow the coating to air dry 48 hours at prevailing laboratory conditions;, then immerse the coated panel in distilled water at 25°C ± 5°C (77°F ± 9°F) for 18 hours. After removal from the water, allow a 2-hour recovery period before examination for compliance with 3.5.10.

4.5 Inspection of preparation for delivery. Inspect the packaging, packing, and marking of the material to determine compliance with the requirements of section 5 of this specification.

4.6 Toxicity. A manufacturer of material shall disclose the formulation of his product to the Navy Bureau of Medicine and Surgery, Navy Department, Washington, DC 20372. The disclosure of proprietary information, which shall be held in confidence by the Bureau of Medicine and Surgery, shall include: the name, formula, and approximate percentage by weight and volume of each ingredient in the product; the results of any toxicological testing of the product; identification of its pyrolysis products; and any such other information as may be needed to permit an accurate appraisal of any toxicity problem associated with the handling, storage, application, use, or disposal of the material.

## 5. PREPARATION FOR DELIVERY

(The preparation for delivery requirements specified herein apply only for direct Government procurements.)

5.1 Packaging, packing, and marking. The paint shall be packaged level A, B, or C (see 6.2), packed level A, B, or C as specified (see 6.2), and marked in accordance with PPP-P-1892. The enamel shall be furnished in 1-gallon cans or 5-gallon pails as specified (see 6.2).

5.1.1 Special marking. In addition to the markings required by the contract or order (see 6.2), each container, interior and exterior, shall be marked with the following:

"The volatile content of the material in this container is not photochemically reactive as defined by Rule 102 of the South Coast Air Quality Management District." (See 6.5.)

6. NOTES

6.1 Intended use. This enamel is intended for use on exterior shipboard surfaces. It may be applied where air pollution regulations apply.

6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number, and date of this specification.
(b) Special samples if required (see 4.3.1)
(c) Level of packaging and level of packing required (see 5.1)
(d) Size of container required (see 5.1)
(e) Special marking required (see 5.1.1).

6.3 Level B packaging. Level B is intended to provide economical but limited protection and should be specified only when it is determined the paint will be held in covered storage no more than 1 year from date of initial packaging.

6.4 Enamel should be purchased under this specification by volume, the unit being 1 U.S. gallon (231 cubic inches) at 15.5°C (60°F).

6.5 Volatile content. Although the container marking specifically refers to the South Coast Air Quality Management District, the enamel may be used anywhere else an enamel complying with 3.4.1 is allowed. This includes other air pollution control districts or similar areas controlling the emission of solvents into the atmosphere. Information regarding Los Angeles County Air Pollution Rules 102, 442, and 443 may be obtained from: South Coast Air Quality Management District, Metropolitan Zone, 434 South San Pedro Street, Los Angeles, California 90013.

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

TABLE IV. Composition by volume.

| Ingredients | Gallons | |
|---|---|---|
| Titanium dioxide | 1.47 | |
| Zinc oxide | 4.29 | |
| Lampblack | .20 | |
| Magnesium silicate | 6.02 | |
| Alkyd resin solution | 57.50 | (36.59) 1/ 2/ |
| Paint thinner | 31.06 | |
| Lead naphthenic drier | .42 | |
| Cobalt naphthenic drier | .20 | |
| Manganese naphthenic drier | .21 | |
| Total volume | 101.37 | |

1/ Figure in parentheses refers to volume of resin solids (nonvolatile).

2/ Alternate resin. If it is desired to use an 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 table I of this specification should be multiplied by 1.17 and the weight of paint thinner (petroleum spirits) reduced by 0.17 times the specified weight of alkyd resin solution. The resin solution used in any case should contain as solvent, paint thinner conforming to type II, grade A of TT-T-291.

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

OMB Approval
No. 22-R255

INSTRUCTIONS: The purpose of this form is to solicit beneficial comments which will help achieve procurement of suitable products at reasonable cost and minimum delay, or will otherwise enhance use of the document. DoD contractors, government activities, or manufacturers/vendors who are prospective suppliers of the product are invited to submit comments to the government. Fold on lines on reverse side, staple in corner, and send to preparing activity. 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. Attach any pertinent data which may be of use in improving this document. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity.

DOCUMENT IDENTIFIER AND TITLE

NAME OF ORGANIZATION AND ADDRESS

CONTRACT NUMBER

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE DOCUMENT CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?
   A. GIVE PARAGRAPH NUMBER AND WORDING.

   B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY DOCUMENT REQUIREMENT CONSIDERED TOO RIGID

3. IS THE DOCUMENT RESTRICTIVE?

   ☐ YES ☐ NO *(If "Yes", in what way?)*

4. REMARKS

SUBMITTED BY *(Printed or typed name and address - Optional)*

TELEPHONE NO.

DATE

**DD FORM 1 JAN 72 1426** REPLACES EDITION OF 1 JAN 68 WHICH MAY BE USED S/N 0102-014-1802