

MIL-E-699C  
 20 December 1967  
 SUPERSEDING  
 MIL-P-699B  
 22 June 1962  
 (See 6.6 and 6.7)

MILITARY SPECIFICATION  
 ENAMEL, DECK, GRAY, EXTERIOR  
 (FORMULA NO. 20)

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

1. SCOPE

1.1 Scope. This specification covers one type of paint, deck, gray, outside (Formula No. 20).

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 this specification to the extent specified herein:

SPECIFICATIONS

FEDERAL

RR-S-366 - Sieve, test.  
 TT-D-643 - Drier, Paint, Naphthenate, Liquid, Concentrated.  
 TT-P-143 - Paint, Varnish, Lacquer, and Related Materials; Packaging and Marking of.  
 TT-P-350 - Pigment, Lampblack-Dry.  
 TT-P-442 - Pigment, Titanium Dioxide, (For Protective Coatings).  
 TT-R-266 - Resin, Alkyd; Solutions.  
 TT-T-291 - Thinner, Paint, Volatile Spirits (Petroleum-Spirits).

MILITARY

MIL-M-15173 - Pigment, Magnesium Silicate; Dry (Paint Pigment).  
 MIL-S-15191 - Silica, Diatomaceous (Flatting Extender Pigment).  
 MIL-S-15192 - Silica, Pulverized.  
 MIL-V-15218 - Varnish, (Mixing, Phenolic).  
 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.

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.)

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.

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

MIL-E-699C

## 3. REQUIREMENTS

## 3.1 Formula.

3.1.1 The paint shall consist of ingredients conforming to the requirements of the applicable specifications in the proportions shown in table I, except that the amount of lampblack may be varied as necessary to meet the color requirements. Also small additions of antiscotling and antiskinning agents may be added provided all the requirements of the specification are met and the exact formula used is furnished in the record required by method 1031 of FED-STD-141.

3.1.2 The formula shown in table I is designated Standard Formula No. 20. Whenever Formula No. 20 is specified, the paint shall meet the requirements of this specification.

Table I - Formula No. 20.

| Ingredients  | Pounds per<br>100 gallons |
|--|---------------------------|
| Pigment, titanium dioxide (type III, TTT-P-442)            | 36                        |
| Zinc oxide (MIL-Z-15486)                                   | 125                       |
| Lampblack (TT-P-350)                                       | 13                        |
| Magnesium silicate (type B, MIL-M-15173)                   | 135                       |
| Silica, pulverized (Spec. MIL-S-15192)                     | $\frac{1}{100}$           |
| Alkyd resin solution (type I, class A, TT-R-266) (see 6.4) | 221                       |
| Varnish, phenolic (type I, MIL-V-15218)                    | 240                       |
| Petroleum spirits (grade 1, TT-T-291)                      | 159                       |
| Lead naphthenate (type I, TT-D-643)                        | 15                        |
| Cobalt naphthenate (type II, TT-D-643)                     | 2                         |
| Manganese naphthenate (type III, TT-D-643)                 | 1                         |

<sup>1/</sup>In order to meet the gloss requirement of this specification a maximum of 35 percent of the pulverized silica may be replaced by diatomaceous silica conforming to MIL-S-15191.

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

3.2.1 Quantitative requirements. The quantitative requirements specified in table II shall be criteria by laboratory tests, as specified in 4.3 that the paint has been manufactured in accordance with the formula and good practice.

Table II - Quantitative requirements.

| Characteristics   | Requirements  |                    |
|---|---------------|--------------------|
|   | Minimum       | Maximum            |
| Pigment, percent by weight of paint   | 38.5          | 42.0               |
| Volatiles, percent by weight of paint   | 28.5          | 32.0               |
| Nonvolatile vehicle, percent by weight of paint (calculated by difference)  | 29.0          | 32.5               |
| Phthalic anhydride, percent by weight of nonvolatile vehicle  | 11.0          | -----              |
| Water, percent by weight of paint   | -----         | 0.5                |
| Coarse particles and skins (as residue retained on standard NO. 325 sieve) (RR-S-366), percent by weight of paint | -----         | 0.5                |
| Weight per gallon, pounds   | 10.4          | 10.8               |
| Gloss (without correction of diffuse reflection)  | -----         | 35                 |
| Time of setting to touch, hours   | -----         | 1                  |
| Fineness of grind   | 4             | -----              |
| Flash point, degrees F.   | 86            | -----              |
| Zinc oxide, percent by weight of pigment  | 29.5          | -----              |
| Titanium dioxide, percent by weight of pigment  | 8.0           | -----              |
|   | Optimum Value | Allowance          |
| Consistency, krebs units  | 72            | Minus 4,<br>plus 6 |
| Time of drying hard, hours  | 6             | Plus 2             |

MIL-E-699C

3.3 Qualitative requirements. The paint shall conform to the following qualitative requirements.

3.3.1 Odor. The odor shall be normal for the volatiles permitted when tested as specified in 4.3.2.1.

3.3.2 Color. The color shall match the dry standard card (see 6.2).

3.3.3 Flexibility. The paint shall show no evidence of cracking when subjected to the flexibility test specified in 4.7.

3.3.4 Rosin and resin derivatives. Rosin and resin derivatives shall not be present when tested as specified in 4.8.

3.3.5 Phenolic resin. The presence of phenolic resin shall be determined by the method specified in 4.3.2.1.

3.3.6 Compatibility with thinner. There shall be no evidence of incompatibility of any of the ingredients of paint as received when tested as specified in 4.9.

3.3.7 Resistance to water immersion. There shall be no evidence of blistering, softening, or loss of adhesion when tested by the method specified in 4.10.

3.3.8 Condition in container. The product shall be capable of being readily broken up with a paddle to a smooth, uniform consistency and shall not liver, exceed 90 Krebs units in viscosity, exceed 8 hours dry hard time, curdle, gel, nor show any objectionable properties for at least one year after date of manufacture.

#### 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, the supplier may utilize his own facilities or any commercial laboratory acceptable to 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.

4.2.1 Ingredient materials. A one pint sample from each lot of the alkyd resin and phenolic varnish and when requested by the proper authority, a one pint sample from each lot of the other ingredient materials shall be taken by the Government representative for test purposes.

#### 4.3 Test procedure.

4.3.1 Ingredient materials. The phenolic varnish and alkyd resin shall be tested to determine compliance with the applicable specification. Other ingredient materials submitted shall be tested to determine compliance with the applicable specifications (see table I).

#### 4.3.2 Finished paint.

4.3.2.1 The following tests shall be made in accordance with the methods specified in FED-STD-141:

| <u>Tests</u>                                   | <u>Methods</u> |
|--|----------------|
| Pigment  | 4021           |
| Volatiles                                      | 4041           |
| Nonvolatile vehicle (calculated by difference) | 4053           |
| Water  | 4081           |
| Coarse particles and skins                     | 4091           |
| Viscosity                                      | 4281           |
| Weight per gallon                              | 4184           |
| Flash point                                    | 4293           |
| Odor   | 4401           |
| Phenolic resins                                | 5141           |
| Fineness of grind                              | 4411           |

MIL-E-699C

4.3.2.2 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 the steam bath until the volume has been reduced to approximately 10 milliliters (ml.) shall be used as the sample. The alcoholate precipitate obtained shall be corrected by use of the procedure specified in method 7021 of FED-STD-141.

4.3.2.3 Gloss. The gloss shall be determined by method 6101 of FED-STD-141. The panel for test shall be prepared by applying a single drawn-down coat of the paint 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 approx. 0.003 inch). Forty-eight hours' drying time under standard air-drying laboratory conditions as specified in Section 7 of Standard FED-STD-141 shall be allowed before making the readings.

4.4 Time of setting-to-touch and drying hard. Time of setting-to-touch and drying hard shall be determined by method 4061 of FED-STD-141.

#### 4.5 Pigment analysis.

4.5.1 Zinc oxide. Determine zinc oxide in the extracted pigment by method 7091 of Standard FED-STD-141, 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.

4.5.2 Titanium dioxide. Weigh 1,000 grams (gm.) of the extracted pigment into a clean porcelain crucible. Heat at 1,000° to 1,200° Fahrenheit (F.) in a muffle furnace until the lampblack is destroyed. Transfer the contents of the ignited crucible to a 250-ml. beaker and determine titanium dioxide by method 7081 of FED-STD-141.

4.5.3 Interfering elements. The methods specified for 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 modifications of these methods shall be made to eliminate the interference.

4.6 Color. Prepare panel as specified in 4.3.2.3. After a 48-hour drying period, compare the panel with the standard color card (see 6.2), 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 one and one-half units in the direction of minus  $\Delta L$ ,  $\Delta a$ , or  $\Delta b$ .

4.7 Flexibility. Determine flexibility in accordance with method 6221 or Standard FED-STD-141. Apply the primer to a flat tin plated panel of approximately 31 gage by means of a doctor blade capable of yielding a dry film thickness of 0.0020 +0.0003 inch. Allow the panel to air-dry for 2 hours, then bake for 24 hours at 100° to 105° centigrade (C.). Remove from the oven and allow to stand for 30 minutes at 25°C. + 5°C. Bend over 1/8 inch mandrel and examine the film at the bend under a magnification of 5 diameters.

4.8 Rosin and rosin derivatives. Test for rosin and rosin derivatives shall be conducted according to method 5031 of FED-STD-141. A portion of the separated non-volatile vehicle shall be used for the test.

4.9 Compatibility. Compatibility shall be determined in accordance with method 4025 of FED-STD-141 using 50 ml. of paint and 50 ml. of petroleum spirits conforming to the requirements for grade I of TT-T-291. Observe immediately after mixing and also 30 minutes after mixing.

4.10 Resistance to water immersion. The test panel shall be prepared as specified in 4.7. The panel shall be dried 48 hours under prevailing laboratory conditions and then immersed for 24 hours in distilled water to a depth corresponding to two-thirds of the height of the painted surface. The water shall be at a temperature of 25° plus or minus 5°C. The panel shall be removed and allowed to recover for 2 hours prior to evaluation.

4.11 Additional chemical and physical test. Additional chemical and physical tests shall be run as may be necessary to determine that the ingredients and properties specified in 3.1 have been used.

4.12 Inspection of preparation for delivery. Sample packs shall be selected and inspected to verify conformance of the requirements of section 5 herein.

MIL-E-699C

## 5. PREPARATION FOR DELIVERY

(Preparation for delivery requirements specified herein apply only to direct Government procurement. Preparation for delivery requirements between contractors and sub-contractors shall be as specified in the individual order.)

5.1 Packaging, packing, and marking. The paint shall be furnished in the quantity specified (see 6.1). The paint shall be packaged level A or C; packed level A, B, or C and marked as specified (see 6.1) in accordance with TT-P-143.

5.2 Marking.

5.2.1 Warning label. In addition to any special marking specified in the contract or order, each container shall have affixed a warning label of approximate 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 thinners of 86 F. minimum flash point." For unit containers, any conflict with ICC Regulations shall be resolved by reasonable modification of size of label or use of warning label with label design.

## 6. NOTES

6.1 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Quantity required (see 5.1).
- (c) Level of packaging and level of packing required (see 5.1).
- (d) Special marking required (see 5.2).

6.2 Color cards. Color cards may be obtained upon application to the Laboratory Officer, Chemical Laboratory, Norfolk Naval Shipyard, Portsmouth, Va. 23704. When requesting, specify for what purpose cards are desired. For other than actual color matching purposes, color 26081 of FED-STD-595 may be used for a rough approximation.

6.3 Composition by volume. For information only, the following composition by volume is included:

| Ingredients           | Gallons per<br>100 gallons |
|-----------------------|----------------------------|
| Titanium dioxide      | 1.02                       |
| Zinc oxide            | 2.69                       |
| Lampblack             | .87                        |
| Magnesium silicate    | 5.67                       |
| Silica, pulverized    | 4.50                       |
| Alkyd resin solution  | 28.00                      |
| Varnish               | 31.00                      |
| Petroleum spirits     | 24.31                      |
| Lead naphthenate      | 1.56                       |
| Cobalt naphthenate    | .25                        |
| Manganese naphthenate | .13                        |

6.4 If it 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 I of TT-T-291), reduced by 0.17 times the weight of alkyd resin solution.

6.5 Paint covered by this specification should be purchased by volume, the unit being a United States gallon 15.5°C. (60°F.).

6.6 Deletion. Type II, nonskid paint, deck gray, has been deleted from this specification. Future procurement of type II, nonskid paint, deck gray, formerly covered under this specification should be made under Military Specification MIL-D-23003, type II.

6.7 CHANGES FROM PREVIOUS ISSUE. THE EXTENT OF CHANGES (DELETIONS, ADDITIONS, ETC.) PRECLUDE THE ANNOTATION OF THE INDIVIDUAL CHANGES FROM THE PREVIOUS ISSUE OF THIS DOCUMENT.

Custodians:  
Navy - SH  
Air Force - 84

Preparing activity:  
Navy - Ships  
(Project 8010-0154)

Review activities:  
Navy - SH, YD  
Air Force - 84, 85  
USAF - IS

User activity:  
Army - ME

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| SPECIFICATION ANALYSIS SHEET   |                            | Form Approved<br>Budget Bureau No. 119-R004 |
|--|----------------------------|---|
| <b>INSTRUCTIONS</b>  |                            |   |
| 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<br>\$                         |
| MATERIAL PROCURED UNDER A  |                            |   |
| <input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> SUBCONTRACT   |                            |   |
| 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.  |                            |   |
| 2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID  |                            |   |
| 3. IS THE SPECIFICATION RESTRICTIVE?   |                            |   |
| <input type="checkbox"/> YES <input type="checkbox"/> NO IF "YES", IN WHAT WAY?  |                            |   |
| 4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)   |                            |   |
| SUBMITTED BY (Printed or typed name and activity)  |                            | DATE  |