

MIL-E-19603C
31 July 1974

SUPERSEDING
MIL-E-19603B
25 September 1958

MILITARY SPECIFICATION

ENAMEL, BAKING, FOR ROLLER COAT APPLICATION

This specification is approved for use for all departments and agencies of the Department of Defense.

1. SCOPE

1.1 **Scope.** This specification covers two classes of enamel for roller application over a size coat on metal containers. (See 6.1.) This specification meets Air Pollution Regulations (Rule 66).

1.2 **Classification.** Roller coat enamel shall be of the following classes, as specified (see 6.2).

| | |
|---------|-----------|
| Class 1 | Gloss |
| Class 2 | Semigloss |

2. APPLICABLE DOCUMENTS

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

SPECIFICATION

Federal

QQ-T-425

Tin Plate (Hot Dip and Electrolytic)

TT-P-143

Paint, Varnish, Lacquer and Related Materials;
General Specification for Packaging, Packing and
Marking

FSC 8010

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Military

MIL-P-19602

Primer, Size Coating, Baking, for Roller Coat Application

STANDARDS

Federal

FED-STD-141

Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling and Testing

FED-STD-595

Colors

Military

MIL-STD-129

Marking for Shipment and Storage

(Copies of specifications and standards 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 document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials

ASTM D476

Specifications for Titanium Dioxide Pigments

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

3. REQUIREMENTS

3.1 Color. The enamel shall be furnished in the FED-STD-595 color number specified in the contract or purchase order (see 6.2). When tested as in 4.4.3 it shall acceptably match standard color chip FED-STD-595 except the gloss of color standards 26231 and 25109 shall be disregarded when matching the gloss enamel colors of blue-gray and medium blue.

3.2 Composition.

3.2.1 **Pigments.** Any combination of the pigments listed in table I for any specific color shall make up the basic hiding pigmentation for that color. Hiding pigments shall be chemically pure and free from extenders. The titanium dioxide shall be rutile chalk resisting type conforming to types III or IV of ASTM D 476. Small amounts of other shading pigments may be used when necessary to match the color chips provided these additional pigments have good color permanence. Extender pigments for the semigloss enamels are permitted. Based on total pigment weight, the extenders shall not exceed 75 percent for black, 55 percent for blue-gray and medium blue and 48 percent for olive drab. The extender pigments shall be siliceous matter and barytes.

Table I

PIGMENTATION

| FED-STD-595 Color No. | | Color | Pigmentation |
|-----------------------|-------|-------------|--|
| 17038 | 27038 | Black | Carbon black, lampblack |
| 14087 | 24087 | Olive Drab | Yellow iron oxide, red iron oxide, carbon black, lampblack, chrome yellow, phtalocyanine blue, titanium dioxide. |
| — | 26231 | Blue-Gray | Yellow iron oxide, red iron oxide, carbon black, lampblack, chrome yellow, phtalocyanine blue, titanium dioxide. |
| — | 25109 | Medium Blue | Iron blue, lampblack, yellow iron oxide, titanium dioxide. |

3.2.2 **Vehicle.** The vehicle for the enamel shall be an epoxy varnish or a vinyl resin solution. Small amounts of other resins or film formers may be used to impart desired film characteristics. The vehicle shall give a negative test for rosin and rosin derivatives (see 4.4.2).

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3.2.3 Volatile content. The volatile content shall conform to the following requirements by volume when tested as in 4.4.4.

a. Solvents having an olefinic or cyclo-olefinic type of unsaturation: 5 percent maximum.

b. A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethyl benzene: 8 percent maximum.

c. A combination of ethyl benzene, ketones having branched hydrocarbon structures, or toluene: 20 percent maximum.

d. Total of a + b + c: 20 percent maximum.

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

Table II

QUANTITATIVE REQUIREMENTS

| Characteristics | Minimum | Maximum |
|---|---------|---------|
| Fineness of grind | 6 | — |
| Coarse particles and skins retained on a No. 325 sieve, percent by weight of enamel | — | 0.5 |
| Specular gloss, 60° | | |
| Class 1 | 65 | — |
| Class 2 | 30 | 50 |

3.4 Qualitative requirements.

3.4.1 Condition in container. When tested as in 4.4.6 the enamel shall show little or no settling in the freshly opened package and shall mix readily to a smooth homogeneous state. It shall show no evidence of living or curdling and shall be free from skins and lumps.

3.4.2 Application. When tested as in 4.4.7 the enamel shall produce uniform films of 6 to 12 milligrams per square inch dry coating weight (see 6.5).

3.4.3 Baking schedule. The manufacturer shall provide the baking schedule; however, it shall not exceed 10 minutes at 400° F (metal temperature).

3.4.4 Coating system. Panels prepared as in 4.4.8 shall show no lifting of the size coat.

3.4.5 Blocking. When tested as in 4.4.9 none of the enamel shall separate from the coated surface and adhere to or be retained on the uncoated surfaces. A slight tendency of the specimens to stick together will be permissible.

3.4.6 Flexibility. When tested as in 4.4.10 the coating system shall not crack, flake or show loss of adhesion at the bend. In addition it shall be capable of withstanding all forming operations normally employed in fabricating containers without showing evidence of any type of film failure.

3.4.7 Knife test. When tested as in 4.4.11 the coating system shall adhere tightly to the metal and shall show good adhesion between the size coat and the enamel. The film shall not chip or flake from the metal.

3.4.8 Accelerated weathering. When tested as in 4.4.12 the coating system shall show no more than slight chalking (photo no. 8 method 6411 of FED-STD-141) and a color change equivalent to a lightness index difference not exceeding three units.

3.4.9 Salt spray resistance. When tested as in 4.4.13 the coating system shall show no rust creepage or undercutting beyond one-sixteenth inch from the score mark. At all other points there shall be no rusting or blistering. Upon removal of the coating system the metal substrate shall be free from rusting, pitting, or corrosion except on the area immediately adjacent to the score.

3.4.10 Toxicity. The enamel shall contain no benzene (benzol), methanol, chlorinated compounds, hydrolyzable chlorine derivatives, or other ingredients which are deemed toxicologically hazardous under normal conditions of usage.

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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 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 **Sampling, inspection and testing.** Unless otherwise specified, sampling, inspection and testing shall be in accordance with method 1031 of FED-STD-141.

4.3 **Classification of tests.** Testing under this specification shall be for the purpose of acceptance of individual lots.

4.4 Test methods.

4.4.1 **Test conditions.** The routine and referee testing conditions shall be in accordance with section 7, FED-STD-141 except as otherwise specified herein.

4.4.2 The following tests of table III shall be conducted in accordance with applicable methods of FED-STD-141 or as required in this specification. The right is reserved to make any additional tests deemed necessary to determine that the roller coat enamel meets the requirements of this specification.

4.4.3 **Color.** In accordance with method 4250 of FED-STD-141 compare the specified color chip of FED-STD-595 with the pigmented coating as prepared in 4.4.8 for compliance with 3.1.

4.4.4 **Volatile content.** Determine solvents as in methods 7355 and 7356 of FED-STD-141 for compliance with 3.2.3.

4.4.5 **Specular gloss, 60°.** Using a panel prepared as in 4.4.8 measure the gloss as specified in method 6101 of FED-STD-141 for compliance with table II.

Table III

INDEX

| Tests | Applicable method in FED-STD-141 | Paragraph of this specification giving further references | Paragraph of this specification giving requirements |
|---|----------------------------------|---|---|
| Color | 4250 | 4.4.3 | 3.1 |
| Rosin and rosin derivatives in isolated vehicle | 5031 | — | 3.2.2 |
| Volatile content | 7355, 7356 | 4.4.4 | 3.2.3 |
| Fineness of grind | 4411 | — | Table II |
| Coarse particle and skins retained on a 325 mesh screen | 4092 | — | Table II |
| Specular gloss, 60° | 6101 | 4.4.5 | Table II |
| Condition in container | 3011 | 4.4.6 | 3.4.1 |
| Application | — | 4.4.7 | 3.4.2 |
| Baking schedule | — | — | 3.4.3 |
| Coating system (Preparation of test panels) | — | 4.4.8 | 3.4.4 |
| Blocking | 6216 | 4.4.9 | 3.4.5 |
| Flexibility | 6221 | 4.4.10 | 3.4.6 |
| Knife test | 6304 | 4.4.11 | 3.4.7 |
| Accelerated weathering | 6152 | 4.4.12 | 3.4.8 |
| Salt spray resistance | 6061 | 4.4.13 | 3.4.9 |
| Toxicity | — | 4.4.14 | 3.4.10 |

4.4.6 Condition in container. Determine package condition in accordance with method 3011 of FED-STD-141 and observe for compliance with 3.4.1.

4.4.7 Application. Cut a 4- by 4-inch section from each of three size coated panels which have been baked. Weigh the specimens and then remove the film either cathodically or by the use of a solvent. Re-weigh and by difference calculate the average coating weight per square inch. Reduce the enamel for roller coat application in accordance with the manufacturers recommendation and apply the enamel to three size coated panels of known coating weight. Bake, then follow the procedure outlined above to determine the coating weight of the combined system (size plus gloss enamel). By difference determine the weight of the enamel (weight of the system coated panel minus the weight of the stripped panel minus the weight of the size coat equals the weight of the gloss enamel). Check for compliance with 3.4.2.

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4.4.8 Preparation of test panels. Apply a size coat conforming to MIL-P-19602 (see 6.6) to a dry film weight of 1 to 3 milligrams per square inch to ten (10) 4- by 8-inch tin panels conforming to QQ-T-425 grade 4, class 25 with bright finish. Bake according to the manufacturer's recommended schedule. Using eight of the sized panels apply the roller coating enamel to a dry film weight of 6 to 12 milligrams per square inch (see 4.4.7). Bake according to the manufacturer's recommendation and use the panels where applicable in the subsequent tests.

4.4.9 Blocking. Cut six 2- by 2-inch specimens from panels prepared as in 4.4.8. Stack the specimens so that the coated surface of the one below is in contact with the uncoated surface of the one directly above. Place the stacked specimens in an oven for 24 hours at $120^{\circ} \pm 2^{\circ}$ F. with a weight sufficient to exert 10 lb per square inch resting on them. Cool to room temperature and pry apart using the pointed end of a needle. Observe for compliance with 3.4.5.

4.4.10 Flexibility test. Determine flexibility as in method 6621 of FED-STD-141 on 2- by 4-inch sections cut from each of two panels prepared as in 4.4.8. After baking the panels according to the manufacturer's recommendation, bake for an additional 48 hours at $220^{\circ} \pm 4^{\circ}$ F. Condition at room temperature for one hour and bend over a 1/8-inch mandrel. Examine for compliance with 3.4.6.

4.4.11 Knife test. Perform the knife test as in method 6304 of FED-STD-141 on the flat portion of the panels from the flexibility test. Check for compliance with 3.4.7.

4.4.12 Accelerated weathering. Perform the test on 3- by 6-inch panels cut from two panels prepared as in 4.4.8. After baking as recommended air dry the panels for 24 hours. Expose for 168 hours to accelerated weathering as in method 6152 of FED-STD-141 using a twin arc apparatus. Examine the exposed panels for chalking by rubbing with a piece of velvet or cheesecloth wrapped around the finger. The rubbing shall be done under moderate pressure by drawing the cloth across the width of the panel in two different locations. Measure the directional reflectance (method 6121) on an unrubbed area of the exposed panel and determine the amount of color change, expressed as lightness index difference (ΔL), using method 6122 of FED-STD-141. Check for compliance with 3.4.8.

4.4.13 Salt spray resistance. Prepare two panels as in 4.4.8. Make an X score across the center of the panels and bend through 180° on a conical mandrel. Expose the panels to salt spray for 168 hours as in method 6061 of FED-STD-141. Face the bend toward the source of the salt fog with the sharp end facing downward. Immediately upon removal wash the panels gently in running water until free from any visible salt deposits and examine for compliance with 3.4.9.

4.4.14 Toxicity. The manufacturer shall certify that the enamel contains no benzene (benzol), methanol, chlorinated compounds or hydrolyzable chlorine derivatives.

5. PREPARATION FOR DELIVERY

5.1 The enamel shall be furnished in 1-quart or 1-gallon multiple friction top containers, in 5-gallon lug cover steel pails or in 55-gallon steel drums as specified (see 6.2). The enamel shall be packaged level A or C; packed level A or C as specified (see 6.2) in accordance with TT-P-143.

5.2 Marking. In addition to any special marking interior packages and exterior containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. The enamels covered by this specification are intended for use in combination with a primer size coat and with or without a final coat of finishing varnish as a coating system for clean tin and terne containers. The system is intended for roller application to stock metal prior to fabrication of the containers. This specification in conjunction with MIL-P-19602 is applicable to the coating manufacturer only. If and when required the finishing varnish should conform to MIL-V-21064.

6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number and date of this specification
- b. Size of container
- c. Level of packaging and level of packing
- d. Class (see 1.2).

6.3 The enamel should be purchased by volume, the unit being one U.S. liquid gallon of 231 cubic inches at 68° F (20° C).

6.4 While the performance requirements of the specification are based on application on clean tin, a coating based on the composition specified will perform equally well over clean terne plate. Although vapor degreasing in this specification is for test purposes only, attention is called to the desirability of adequately cleaning all metal surfaces prior to production application of the coating.

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6.5 During normal production line application, it will be permissible to use additional thinner to maintain proper working viscosity; however, the decrease in viscosity shall not be such that an unsatisfactory coating results.

6.6 Products tested under this specification have not been tested for their lifting tendencies with all primers conforming to MIL-P-19602. Compatibility of the primer and color coat should be determined prior to use of mixed systems from different manufacturers.

6.7 Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodians:

Army - MR
Navy - OS

Preparing activity:

Navy - OS
(Project No. 8010-0774)

| SPECIFICATION ANALYSIS SHEET | | Form Approved Budget Bureau No. 22-R255 |
|--|-----------------|--|
| <p>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. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.</p> | | |
| SPECIFICATION | | |
| MIL-E-19603C, ENAMEL, BAKING, FOR ROLLER COAT APPLICATION | | |
| ORGANIZATION | | |
| CITY AND STATE | CONTRACT NUMBER | |
| MATERIAL PROCURED UNDER A | | |
| <input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> SUBCONTRACT | | |
| <p>1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?</p> <p>A. GIVE PARAGRAPH NUMBER AND WORDING.</p> | | |
| <p>B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES</p> | | |
| <p>2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID</p> | | |
| <p>3. IS THE SPECIFICATION RESTRICTIVE?</p> <p><input type="checkbox"/> YES <input type="checkbox"/> NO (If "yes", in what way?)</p> | | |
| <p>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)</p> | | |
| SUBMITTED BY (Printed or typed name and activity - Optional) | | DATE |

DD FORM 1426
1 JAN 66

REPLACES EDITION OF 1 OCT 64 WHICH MAY BE USED.

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