

MIL-E-22118B (OS)
9 July 1974

SUPERSEDING
MIL-E-22118A (WEP)
9 October 1964

MILITARY SPECIFICATION

ENAMEL, ELECTRICAL - INSULATING

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

1. SCOPE

1.1 This specification covers one type and grade of synthetic insulating enamel for use on electrical equipment, and for general purpose use. This specification meets Air Pollution Regulations (Rule 66).

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.

SPECIFICATIONS

Federal

P-D-680	Dry Cleaning Solvent
QQ-S-698	Steel, Sheet and Strip, Low-Carbon
TT-B-846	n-Butyl Alcohol
TT-P-143	Paint, Varnish, Lacquer, and Related Materials; Packaging, Packing and Marking of
TT-T-548	Toluene

FSC 8010

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Military

MIL-F-17111

Fluid, Power Transmission

STANDARDS

Federal

FED-STD-141

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

(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 date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials

ASTM D115

Method of Testing Varnishes Used for Electrical
Insulation.

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

3. REQUIREMENTS

3.1 **Color.** The color of the enamel shall be characteristic of red iron oxide pigment.

3.2 **Composition.**

3.2.1 **Pigment.** The pigment portion of the enamel shall conform to the requirements of table I.

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3.2.2 Vehicle. The vehicle shall be a phthalic alkyd resin together with the necessary addition of volatile solvents and driers.

3.2.3 Volatile content. The volatile content shall conform to the following requirements by volume when tested as in 4.4.3.

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 I.

Table I

QUANTITATIVE REQUIREMENTS

Characteristics	Minimum	Maximum
Total solids, percent by weight of enamel	58	—
Pigment, percent by weight of enamel	25	—
Vehicle solids, percent by weight of enamel	32	—
Phthalic anhydride, percent by weight of nonvolatile vehicle	30	—
Iron oxide (Fe ₂ O ₃), percent by weight of pigment	28	—
Calcium oxide, percent by weight of pigment	—	1.5
Coarse particles and skins, percent by weight of pigment	—	0.5
Extenders, percent by weight of pigment	—	70
Water, percent by weight of enamel	—	0.5
Viscosity, Krebs Stormer	61	69
Weight per gallon, pounds	9	—
Drying time, air drying		
Tack-free, hours	—	1/2
Dry through, hours	—	2
Baking; dry through 230° F or equivalent heat treatment, hours	—	4

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3.4 Qualitative requirements

3.4.1 Condition in container. When tested as in 4.4.4 the enamel shall be free from grit, seeds, skins, lumps, abnormal thickening, livering, or excessive pigment flotation and shall show no more pigment settling or caking than can be readily reincorporated to a smooth homogeneous state.

3.4.2 Odor. When tested as in 4.4.5 the odor of the wet paint and of the film at any interval of drying shall not be obnoxious or objectionable.

3.4.3 Dilution stability. When tested as in 4.4.6 there shall be no evidence of precipitation, curdling or separation. Slight pigment settling shall be permitted.

3.4.4 Brushing properties. When tested as in 4.4.7 the enamel shall brush satisfactorily in all respects and shall dry to a smooth, uniform film, free from seeds, runs, sags or streaks.

3.4.5 Spraying properties. When tested as in 4.4.8 the enamel shall spray satisfactorily in all respects, and shall show no running, sagging or streaking. The dried film shall show no dusting, mottling, or color separation, and shall present a smooth finish free from seeds.

3.4.6 Dipping properties. When tested as in 4.4.9 the enamel shall show satisfactory dipping properties and shall present a smooth appearance, free from sagging, running, or excessive silking.

3.4.7 Baking properties. When tested as in 4.4.11 the enamel shall be full hard, smooth, and free from all defects. It shall show no more than a slight discoloration. The film shall be considered to be full hard when it is very difficult to remove with a knife blade.

3.4.8 Knife test. When tested as in 4.4.12 the enamel shall adhere tightly and not flake, crack, or powder from the metal. The cut shall show beveled edges.

3.4.9 Drying cleaning solvent resistance. When tested as in 4.4.13 the enamel shall show no softening, loss of adhesion, wrinkling, or blistering. A slight change in color shall be disregarded.

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3.4.10 **Hydraulic fluid resistance.** When tested as in 4.4.14 the enamel shall show no blistering, softening, or other film defects. A slight change in color shall be disregarded.

3.4.11 **Salt spray resistance.** When tested as in 4.4.15 the enamel shall show no rust creepage or undercutting beyond one-eighth inch from the score mark. At all other points there shall be no rusting or blistering. There shall be no softening of the film.

3.4.12 **Dielectric strength.** When tested as in 4.4.16 the dielectric strength of the enamel shall not be less than 1200 volts/mil dry and 300 volts/mil wet.

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 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 enamel meets the requirements of this specification.

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Table II

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Tests	Test Method		
	Applicable method in FED-STD-141	Paragraph of this specification giving further references	Paragraph of this specification giving requirements
Total solids	4041	—	Table I
Pigment solids	4022	—	Table I
Pigment analysis	4021	—	Table I
Fe ₂ O ₃ —iron oxide	7141	—	Table I
Calcium oxide	7141	—	Table I
Coarse particles and skins	4092	—	Table I
Extender pigment	5271	—	Table I
Vehicle solids	4052	—	Table I
Phthalic anhydride	7021	—	Table I
Water	4082	—	Table I
Viscosity	4281	—	Table I
Weight per gallon	4184	—	Table I
Volatile content	7355, 7356	4.4.3	3.2.3
Drying time	4061	—	Table I
Condition in container	3011	4.4.4	3.4.1
Odor	4401	4.4.5	3.4.2
Dilution stability	4203	4.4.6	3.4.3
Brushing properties	4321	4.4.7	3.4.4
Spraying properties	4331	4.4.8	3.4.5
Dipping properties	4341	4.4.9	3.4.6
Panel preparation	—	4.4.10	—
Baking properties	4061	4.4.11	3.4.7
Knife test	6304	4.4.12	3.4.8
Dry-cleaning solvent resistance	6011	4.4.13	3.4.9
Hydraulic fluid resistance	6011	4.4.14	3.4.10
Salt spray resistance	6061	4.4.15	3.4.11

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

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

4.4.5 **Odor.** Test the enamel in accordance with method 4401 of FED-STD-141 for compliance with 3.4.2.

4.4.6 **Dilution stability.** Reduce one volume of packaged enamel with one volume of thinner conforming to table III. Test according to method 4203 of FED-STD-141 for compliance with 3.4.3.

4.4.7 **Brushing properties.** Apply the enamel to a 4- by 12-inch steel panel, conforming to QQ-S-698 using a 1-1/2-inch brush, in accordance with method 4321 of FED-STD-141 for compliance with 3.4.4.

4.4.8 **Spraying properties.** Reduce the enamel for spraying with thinner conforming to table III in a ratio as recommended by the manufacturer. Test according to method 4331 of FED-STD-141 for compliance with 3.4.5.

4.4.9 **Dipping properties.** Reduce the enamel for dipping with thinner conforming to table III in a ratio as recommended by the manufacturer. Test according to method 4341 of FED-STD-141 for compliance with 3.4.6.

Table III

THINNER

Ingredient	Percent by weight
VM&P naphtha (8% max. aromatic)	65
n-Butyl alcohol (TT-B-846)	20
Toluene (TT-T-548)	15

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4.4.10 Panel preparation. Spray the enamel to a dry film thickness between 0.0008 and 0.0012 inch on ten (10) 3- by 6-inch steel panels conforming to QQ-S-698, solvent cleaned in accordance with method 2011 of FED-STD-141. Air dry for 24 hours and use where applicable in the subsequent tests.

4.4.11 Baking properties. Panels prepared as in 4.4.10 shall be air dried for two hours and baked at $230^{\circ} \pm 4^{\circ}\text{F}$ for 4 hours or equivalent heat treatment. Examine for compliance with 3.4.7.

4.4.12 Knife test. Perform the knife test in accordance with method 6304 of FED-STD-141 on a panel prepared as in 4.4.10 for compliance with 3.4.8.

4.4.13 Dry-cleaning solvent resistance. Immerse two panels prepared as in 4.4.10 in dry-cleaning solvent conforming to P-D-680 for 100 hours in accordance with method 6011 of FED-STD-141. Examine for compliance with 3.4.9.

4.4.14 Hydraulic fluid resistance. Immerse two panels prepared as in 4.4.10 in hydraulic fluid conforming to MIL-F-17111 for 100 hours in accordance with method 6011 of FED-STD-141. Examine for compliance with 3.4.10.

4.4.15 Salt spray resistance. Expose two panels prepared as in 4.4.10 to the salt spray as in method 6061 of FED-STD-141 for 100 hours. Examine for compliance with 3.4.11.

4.4.16 Dielectric strength. Determine dielectric strength on two panels prepared as in 4.4.10 in accordance with ASTM Standard D 115 for compliance with 3.4.12.

5. PREPARATION FOR DELIVERY

5.1 The enamel shall be furnished in pressurized dispensers, 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 size coat shall be packaged level A or C; packed level A, B, or C as specified (see 6.2) in accordance with TT-P-143.

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6. NOTES

6.1 **Intended use.** The enamel covered by this specification is intended for use primarily as an insulating protective coating on electrical equipment. It is also useful as a heat and oil resistant protective coating and sealant. It is not intended for applications requiring high film flexibility. The enamel is not recommended for outdoor exposure.

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.

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

Custodian:

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Preparing activity:

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(Project No. 8010-N117)

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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-22118B (OS), ENAMEL, ELECTRICAL-INSULATING		
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.