

MIL-F-52891B(ME)
28 January 1988
SUPERSEDING
MIL-E-52891A(ME)
12 July 1978

MILITARY SPECIFICATION

ENAMEL, LUSTERLESS, ZINC PHOSPHATE, STYRENATED ALKYD TYPE

This specification is approved for use within the USA Belvoir Research, Development, and Engineering Center, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers a zinc phosphate type of quick-drying synthetic lusterless enamel used as a finishing coat on ammunition and other metal surfaces. It complies with South Coast Air Quality Management District Rule 442.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications, and standards, form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: USA Belvoir Research, Development, and Engineering Center, ATTN: STRBE-TSE, Fort Belvoir, VA 22060-5606 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 8010

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MIL-E-52891B(ME)

SPECIFICATIONS

FEDERAL.

- | | |
|------------|---|
| TT-C-490 | - Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings. |
| PPP-P-1892 | - Paint, Varnish, Lacquer, and Related Materials; Packaging, Packing, and Marking of. |
| PPP-T-60 | - Tape: Packaging, Waterproof. |

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 Submission of. |
| FED-STD-595 | - Colors. |

MILITARY

- | | |
|-------------|---|
| MIL-STD-147 | - Palletizing Unit Loads (4 Inches by 48 Inches 4-Way Partial and 4-Way Pallets). |
|-------------|---|

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

DEPARTMENT OF TRANSPORTATION (DOT)

- | | |
|----------------|--|
| 49 CFR 171-178 | - Regulations for the Transportation of Explosives and Other Dangerous Articles by Land and Water. |
|----------------|--|

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, DC 20204. Orders should cite the latest edition and supplements thereto.)

(Copies of specifications, standards, handbooks, drawings, publications, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

MIL-E-52891B(ME)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- B 117 - Salt Spray (Fog) Testing, Standard Method of.
- D 50 - Chemical Analysis of Yellow, Orange, Red, and Brown Pigments Containing Iron and Manganese, Standard Method of.
- D 476 - Titanium Dioxide Pigments, Specification For.
- D 562 - Consistency of Paints Using the Stormer Viscosimeter, Method of Test For.
- D 563 - Phthalic Anhydride Content of Alkyd Resins and Resin Solutions, Standard Test Method for.
- D 610 - Evaluating Degree of Rusting on Painted Steel Surfaces, Standard Method of.
- D 659 - Evaluating Degree of Chalking of Exterior Paints, Standard Method of.
- D 823 - Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels, Standard Method of.
- D 1200 - Viscosity of Paints, Varnishes, and Lacquers by Ford Viscosity Cup, Standard Method of Test For.
- D 1210 - Fineness of Dispersion of Pigment-Vehicle Systems, Standard Test Method for.
- D 1298 - Determination of the Pigment Content of Solvent Type Paints by High Speed Centrifuging Standard Method for.
- D 1308 - Effect of Household Chemicals on Clear and Pigmented Organic Finishes, Standard Test Method for.
- D 1364 - Water in Volatile Solvents (Fischer Reagent Titration Method), Standard Test Method for.
- D 1394 - Chemical Analysis of White Titanium Pigments, Standard Method for.
- D 1542 - Qualitative Test for Rosin in Varnishes, Standard Method of.
- D 3272 - Vacuum Distillation of Solvents from Solvent-Base Paints for Analysis, Standard Method for.
- E 97 - Directional Reflectance Factor, 45-Deg 0-Deg, of Opaque Specimens by Broad-Band Filter Reflectometry, Test Method For.
- G 26 - Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water For Exposure of Nonmetallic Materials, Standard Practice for.

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

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Rule 442 - Usage of Solvents.

(Application for copies should be addressed to the South Coast Air Quality Management District, 9150 East Flair Drive, El Monte, CA 91731).

NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, Inc., Agent

National Motor Freight Classification

MIL-E-52891B(ME)

(Application for copies should be addressed to the American Trucking Association, Inc., ATTN: Traffic Department, 2200 Mill Road, Alexandria, VA 22314.)

UNIFORM CLASSIFICATION COMMITTEE, Agent

Uniform Freight Classification

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. Enamel furnished under this specification shall be products which are qualified for listing on the applicable qualified products list (see 6.4).

3.1.1 Changes. Any changes in the formulation of a qualified product will necessitate its requalification. The material supplied under the contract shall be identical, within manufacturing tolerances, to the product receiving qualification.

3.2 Color. The enamel shall be furnished in FED-STD-595, color number specified in the contract (see 6.2). When tested as specified in 4.3.8, it shall acceptably match the standard color chip in FED-STD-595.

3.3 Composition.

3.3.1 Vehicle. The vehicle shall be styrenated phthalic alkyd resin together with the necessary amounts of driers and volatile solvents. The resin solution shall have a color value at 50 percent solids content no darker than 10 (Gardner Color Standards of 1953). Small amounts of antioxidants, wetting agents, and stabilizers may be present. The vehicle shall show a negative test for rosin and phenol resin. The volatile material shall contain no benzene, methanol, chlorinated compounds or other solvent of a highly toxic nature. The volatile solvents used shall conform to the following requirements by volume when tested as specified in 4.3.2:

- a. Aromatic compounds with eight or more carbon atoms except ethyl benzene: 8 percent maximum.

MIL-E-52891B(ME)

- b. Ethyl benzene, toluene and ketones having branched hydrocarbons structures: 20 percent maximum.
- c. Solvents with an olefinic or cyclo-olefinic type of unsaturation: negative test.
- d. Total of a. plus b.: 20 percent maximum.

Note: Above requirements are in compliance with Rule 442, South Coast Air Quality Management District.

3.3.2 Pigment. Any combination of the pigments listed in table I shall make up the basic hiding pigmentation. Iron oxides used as hiding pigments shall be of sythetic origin and not naturally occurring. The titanium dioxide shall be rutile chalk resisting type conforming to type III of ASTM D 476. (If other shading pigments are used to match the color chip, these additional pigments must have good color stability.) Zinc phosphate shall constitute 15 \pm 1 percent of the pigment content. Extender pigments shall be siliceous matter, or siliceous matter and barytes, and shall not exceed the amount specified in table II. The amount of barytes shall not exceed 20 percent of the extender content by weight. Calcium sulfate or carbonate shall not be employed alone or as a component part of any pigment.

TABLE I. Pigmentation.

Color	FED-STD-505 Color No.	Pigmentation
Non-camouflage Forest Green	34083	Yellow iron oxide, medium chrome yellow, phthalocyanine blue, carbon or lampblack
Olive Drab	34088	Red or yellow iron oxide, carbon or lampblack, medium chrome yellow, titanium dioxide.
Light Green	34558	Titanium dioxide, yellow iron oxide, chrome yellow, phthalocyanine blue or green, carbon or lampblack.
Light Blue	35193	Titanium dioxide, yellow iron oxide, phthalocyanine blue, carbon or lampblack.
Blue Gray	36231	Titanium dioxide, yellow iron oxide, carbon or lampblack.
Black	37038	Black iron oxide, carbon or lampblack.

3.4 Quantitative requirements.

3.4.1 Specific quantitative requirements. Each color shall conform to its specific requirements in table II when tested as specified in 4.3.3.

MIL-E-52891B(ME)

TABLE II. Specific quantitative requirements.

Color Corresponding to Table I	Solids, percent by weight of enamel			Pigment, percent by weight of total pigment				Dry Opa- civ
	Total Solids	Pigment Solids		Prime Pigment ^{1/}	Extender Pigment	Zinc Phosphate		
		Min.	Min.			Max.	Min.	
Non-camouflage Forest Green 34083	55	34	38	20(Fe ₂ O ₃)	50	14	16	0.98
Olive Drab 34088	55	33	37	^{2/} 24(Fe ₂ O ₃)	50	14	16	0.98
Light Green 34558	55	36	40	36(TiO ₂)	50	14	16	0.98
Light Blue 35193	55	34	38	24(TiO ₂)	50	14	16	0.98
Blue Grey 36231	55	34	38	36(TiO ₂)	50	14	16	0.98
Black 37038	55	34	38	15(Fe ₃ O ₄)	68	14	16	0.98

^{1/} On analysis compute prime pigment as indicated in parenthesis.

^{2/} Lead chromate (PbCrO₄) may be substituted on an equal weight basis.

3.4.2 General quantitative requirements. The enamel tested as in 4.3 shall comply with the requirements of table III.

TABLE III. General quantitative requirements.

Characteristics	Requirements	
	Minimum	Maximum
Vehicle solids, percent by weight of enamel.	18	--
Phthalic anhydride, percent by weight of vehicle solids.	18	26
Rosin and rosin derivatives.	Negative	
Phenolic resin.	Negative	
Water, percent by weight of enamel.	--	1.0
Coarse particles and skins, percent by weight of pigment.	--	1.0

MTL-E-52891B(ME)

TABLE III. General quantitative requirements. (Cont'd)

Characteristics	Requirements	
	Minimum	Maximum
Viscosity:		
Package, Krebs Stormer shearing rate - 200 rpm:		
Grams.	125	175
Equivalent Krebs Units (K.U.).	67	77
Reduced, No. 4 Ford cup, seconds.	12	24
Fineness of grind		
Hegman.	5	--
ASTM (MICRONS).	--	40
Specular gloss.	--	8
Drying time:		
Set to touch, minutes.	--	6
Dry hard, minutes.	--	10
After tack free, minutes.	--	15
Dry through, minutes.	--	20
Full hardness, hours.	--	72

3.5 Qualitative requirements.

3.5.1 Condition in container. When tested as specified in 4.3.9, the enamel shall be free from grit, seeds, skins, lumps, or livering in a freshly opened full container and shall show no more pigment settling or caking than can be easily and completely reincorporated to a smooth homogeneous state.

3.5.2 Storage stability.

3.5.2.1 Partially full container. When tested as specified in 4.3.10.1, the enamel shall show no skinning. After aging as specified in 4.3.10.1, the enamel shall show no livering, curdling, tough gummy sediment, or hard caking. It shall mix readily to a smooth homogeneous state, and any skin formed shall be continuous and easily removed.

3.5.2.2 Full container. When tested as specified in 4.3.10.2, the enamel shall show no skinning, livering, curdling, hard caking, or tough gummy sediment. It shall remix readily to a smooth homogeneous state, shall have a maximum viscosity of 89 Krebs units, and shall meet all other requirements of this specification.

3.5.3 Dilution stability. When tested as specified in 4.3.11, the enamel shall remain stable and uniform showing no precipitation, curdling, or separation. Slight pigment settling shall be permitted.

3.5.4 Suspension properties. When tested as specified in 4.3.12, the enamel shall completely redisperse to a smooth homogeneous state.

MIL-E-52891B(ME)

3.5.5 Brushing properties. When tested as specified in 4.3.13, the enamel shall brush satisfactorily in all respects and shall dry to a smooth, uniform film free from seeds, sags, or streaks.

3.5.6 Dipping properties. When tested as specified in 4.3.14, the enamel shall show satisfactory dipping properties and shall present a smooth appearance free from sagging, running, or excessive silking.

3.5.7 Spraying properties. When tested as specified in 4.3.15, the enamel shall spray satisfactorily in all respects and shall show no running, sagging, streaking, or blushing. The dried film shall show no dusting, mottling, or color separation, and shall present a smooth lusterless finish free from seeds.

3.5.8 Flexibility. When tested as specified in 4.3.16, a film of enamel shall withstand bending without cracking or flaking.

3.5.9 Knife test. When tested as specified in 4.3.17, a film of enamel shall adhere tightly and not flake, crack, or powder from the metal. The cut shall show beveled edges.

3.5.10 Adhesion. When tested as specified in 4.3.18.2, a film of enamel shall show no removal of the coating by the adhesive tape beyond 1/16 inch on either side of the score line.

3.5.11 Water resistance. When tested as specified in 4.3.19, a film of enamel shall show no wrinkling or blistering immediately after removal of the panel from the water. The enamel shall be no more than slightly affected when examined 2 hours after removal. After 24 hours air drying, the portion of the panel which was immersed shall be almost indistinguishable with regard to hardness, color, and gloss from a panel prepared at the same time but not immersed.

3.5.12 Recoating. When tested as specified in 4.3.20, a film of enamel shall not blister, wrinkle, or show other evidence of lifting. The film shall contain no bleeding pigments which will discolor the white enamel.

3.5.13 Salt spray resistance. When tested as specified in 4.3.21 and examined immediately after removal from the test, a film of enamel shall show no rust creepage or undercutting beyond 1/8 inch from the score mark. At all other points of the panel, there shall be no more than a trace of rusting as defined in ASTM D 610 and no more than five scattered blisters, none larger than 1 mm in diameter. After removal of the enamel, the surface of the steel shall show no more than a trace of rusting, pitting, or corrosion.

3.5.14 Accelerated weathering. When tested as specified in 4.3.22, a film of enamel shall show no more than slight chalking as defined in ASTM D 659 and a color change equivalent to a lightness index difference not exceeding 4 units.

3.5.15 Weather resistance. When tested as specified in 4.3.23, a film of enamel shall show no checking, cracking, or film deterioration. There shall be no more than light chalking. After removal of any chalking which has occurred, the original color shall be substantially restored and the washed area shall show

MIL-E-52891B(ME)

no more than slight fading or darkening. On removal of the enamel, the surface of the steel shall show no more than a trace of rusting, pitting, or corrosion as defined in ASTM D 610. Rust creepage shall not extend beyond 1/8 inch from the score mark.

3.6 Special markings. In addition to the marking specified in 5.4, all containers shall be legibly marked or labeled with the following:

CAUTION: The Surgeon General requires airline respirators to be used unless air sampling shows exposure to be below standards, then either chemical cartridge respirators or airline respirators are required.

Thinning directions. For application, the manufacturer shall include on the label thinning recommendations and solvent required.

Flammable liquid. No smoking. During application avoid skin and eye contact and inhalation of vapors. For other safety recommendations refer to the material safety data sheet.

3.7 Material safety data sheet. A material safety data sheet shall be prepared in accordance with FED-STD-313. The contractor shall overpack a copy of the material safety data sheet with each shipment of material (see 6.6).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, 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.

4.1.1 Sampling and inspection. Sampling and inspection shall be performed in accordance with section 1000 of FED-STD-141.

4.2 Classification of tests. Testing under this specification shall be for the following:

- a. Qualification
- b. Acceptance of individual lots.
- c. Acceptance for use as component on end item.

4.2.1 Qualification tests. The qualification tests shall consist of tests for all requirements specified in section 3 (see 6.4).

4.2.2 Acceptance tests. Acceptance tests for acceptance of individual lots shall consist of the following tests as specified in section 3:

MIL-F-52891B(ME)

Condition in container.
 Total solids.
 Viscosity.
 Fineness of grind.
 Specular gloss.
 Drying time.
 Color.
 Hiding power.

4.2.3 Component on an end item. When approved by the cognizant activity, acceptance of lots for use as component on an end item shall be based on compliance with specified requirements for the following characteristics:

Condition in container.
 Total solids.
 Viscosity.
 Fineness of grind.
 Specular gloss.
 Drying time.
 Color.
 Hiding power.

4.3 Test methods.

4.3.1 Test conditions. The routine and referee testing conditions shall be in accordance with section 7 of FED-STD-141 except as otherwise specified herein. Failure of any test result to fall within the ranges specified in 3.2, 3.3, 3.4, or 3.5, as applicable, shall constitute failure of the applicable test.

4.3.1.2 Test procedures. The following test (table IV) shall be conducted in accordance with FED-STD-141, or ASTM, and as specified herein. The right is reserved to make any additional test deemed necessary to determine that the enamel meets the requirements of this specification.

TABLE IV. Tests and methods.

Test	Applicable method in FED-STD-141	Applicable ASTM Method	Test paragraph	Requirement paragraph
1	2	3	4	5
Isolation of vehicle (super centrifuge).	--	D 2698	--	3.3.1
Phthalic anhydride.	--	D 563	--	3.4.2
Rosin in isolated vehicle.	--	D 1542	--	3.4.2
Phenolic resin.	5141	--	--	3.4.2
Benzene.	7356 proc. B 7360	--	--	3.3.1

MIL-E-52891R(ME)

TABLE IV. Tests and methods. (cont'd)

Test	Applicable method in FED-STD-141	Applicable ASTM Method	Test Paragraph	Requirement Paragraph
1	2	3	4	5
Menthol.	5133	--	--	3.3.1
Chlorinated solvents.	5132	--	--	3.3.1
Solvents analysis.	7356	D 3272	4.3.2.1	3.3.1
Ketones.	--	--	4.3.2.2	3.3.1
Total solids.	--	--	4.3.3.1	3.4.1
Pigment solids.	--	--	4.3.3.2	3.4.1
Vehicle solids.	--	--	4.3.3.3	3.4.1
Pigment analysis.	4021	--	--	3.4.1
Fe ₂ O ₃ , Fe ₃ O ₄ - Iron Oxide	--	D 50	4.3.3.4	3.4.1
PbCrO ₄ - Lead Chromate.	7131	--	4.3.3.5	3.4.1
TiO ₂ - Titanium Dioxide	--	D 1394	4.3.3.6	3.4.1
Zinc phosphate	--	--	4.3.3.7	3.4.1
Extender pigment, total.	5271	--	4.3.3.8.1	3.4.1.
Extender pigment, analysis.	7281	--	4.3.3.8.2	3.3.2
Dry opacity.	4122	--	4.3.4	3.4.1
Water.	--	D 1364	--	3.4.2
Coarse particles and skins	4092	--	--	3.4.2
Viscosity:				
Package	--	D 562	4.3.5.1	3.4.2
Reduced	--	D 1200	4.3.5.2	3.4.2
Fineness of grind.	--	D 1210	--	3.4.2
Specular gloss,				
60 degree	6101	--	4.3.6	3.4.2
Drying time:	4061	--	4.3.7	3.4.2
Set to touch.	4061	--	--	3.4.2
Dry hard.	4061	--	--	3.4.2
Free from after tack.	4061	--	--	3.4.2
Dry through.	4061	--	4.3.7.1	3.4.2
Full hardness.	--	--	4.3.7.2	3.4.2
Color.	4250	--	4.3.8	3.2
Condition in container.	3011	--	4.3.9	3.5.1
Storage stability:	--	--	4.3.10	3.5.2
Partially full container.	3021	--	4.3.10.1	3.5.2.1
Full container.	3022	--	4.3.10.2	3.5.2.2

MIL-E-52891B(ME)

TABLE IV. Tests and methods. (cont'd)

Test	Applicable method in FED-STD-141	Applicable ASTM Method	Test Paragraph	Requirement Paragraph
1	2	3	4	5
Dilution stability.	--	--	4.3.11	3.5.3
Suspension properties.	--	--	4.3.12	3.5.4
Brushing properties.	4321	--	4.3.13	3.5.5
Dipping properties.	--	D 823 Method B	4.3.14	3.5.6
Spraying properties.	4331, 2131	--	4.3.15	3.5.7
Flexibility.	6221	--	4.3.16	3.5.8
Knife test.	6304	--	4.3.17	3.5.9
Adhesion.	--	--	4.3.18	3.5.10
Water resistance.	--	D 1308 Sect. 6.4	4.3.19	3.5.11
Recoating.	--	--	4.3.20	3.5.12
Salt spray resistance.	2011	B 117	4.3.21	3.5.13
Accelerated weathering.	6122	G 26 Method A Type BH	4.3.22	3.5.14
Weather resistance	--	D 610	4.3.23	3.5.15

4.3.2 Solvent analysis.

4.3.2.1 Solvent analysis. Determine the amount of aromatic hydrocarbons, and olefinic and cyclo-olefinic compounds by subjecting the enamel to test method 7356, procedure B of FED-STD-141. Nonconformance to 3.3.1 shall constitute failure of this test.

4.3.2.2 Ketones.

4.3.2.2.1 Reagent. The reagent shall be 2 grams of 2,4-dinitrophenylhydrazine plus 4 mL of concentrated sulfuric acid plus 30 mL methanol (add slowly) plus 10 mL water.

4.3.2.2.2 Procedure. Pipette 1 mL of reagent into a 20 x 170 mm test tube. Add 10 drops of distillate and shake for 30 seconds. A yellow precipitate or cloud in the reagent layer indicates the presence of ketones. Run a blank using 1 milliliter of reagent and 10 drops of mineral spirits. Nonconformance to 3.3.1 shall constitute failure of this test.

4.3.3 Solids content and pigment analysis. Determine the total solids, the pigment content and vehicle solids by following the methods. Extract the pigment as specified in method 4021 of FED-STD-141, using extraction mixture C.

MIL-E-52891B(ME)

4.3.3.1 Total solids. Place a portion of the thoroughly mixed sample in a dropping bottle and weigh to the nearest one-tenth mg. Weigh a 60 mm aluminum dish with fourth-decimal accuracy. Transfer a small sample that does not exceed 0.3 g to the dish, determine its exact weight by loss in weight of the bottle. Dissolve the sample in 2 mL of A.C.S. reagent grade toluene and dry in a gravity convection oven at 105 °C for 1 hour. Upon cooling, reweigh the dish to the nearest one-tenth mg. From the weight of the residue in the dish and the weight of the sample taken, calculate the percent nonvolatile or volatile as required. Nonconformance to 3.4.1 shall constitute failure of this test.

4.3.3.2 Pigment content. Weigh accurately about 15 g of the sample into a weighed centrifuge tube. Add about 20 mL of toluene, mix thoroughly with a stirring rod, rinse stirring rod, and add toluene to make a total of about 40 mL in the tube. Centrifuge with a counter-balanced second tube similarly prepared. Decant the clear supernatant liquid. Repeat the extraction twice with 30 mL of toluene. After decanting the liquid, place the tube in a 105 °C oven for 2 hours. Cool, weigh, and calculate the percentage of pigment. Nonconformance to 3.4.1 shall constitute failure of this test.

4.3.3.3. Vehicle solids. Calculate the vehicle solids, as percent by weight of enamel, by subtracting pigment content from total solids. Nonconformance to 3.4.1 shall constitute failure of this test.

4.3.3.4 Iron oxide (Fe₂O₃) content. Determine the iron oxide (Fe₂O₃) content on the extracted pigment in accordance with ASTM D 50. Nonconformance to 3.4.1 shall constitute failure of this test.

4.3.3.5 Lead chromate (PbCrO₄) content. Determine the lead chromate (PbCrO₄) content on the extracted pigment in accordance with method 7131 of FED-STD-141. Nonconformance to 3.4.1 shall constitute failure of this test.

4.3.3.6 Titanium dioxide (TiO₂) content. Determine the titanium dioxide (TiO₂) content on the extracted pigment in accordance with ASTM D 1394. Nonconformance to 3.4.1 shall constitute failure of this test.

4.3.3.7 Zinc phosphate content. Determine the zinc phosphate content in accordance with 4.3.3.1 and 4.3.3.2.

4.3.3.7.1 Determination of zinc.

4.3.3.7.1.1 Reagents.

- a. Buffer solution (pH 10): 350 mL conc. NH₄OH + 54 g NH₄Cl + H₂O to give 1000 mL.
- b. Eriochrome black T (0.5%): 0.25g eriochrome black T + 2.2g hydroxylamine hydrochloride per 50 mL methanol solution.
- c. Primary standard zinc oxide (0.200N): Accurately weigh 4.069g of oven-dried ZnO. Dissolve it in 250 mL of the buffer solution and dilute to 500.0 mL.

MIL-E-52891B(MF)

- d. $\frac{N}{5}$ Disodium ethylenediaminetetraacetate dihydrate (EDTA): 37.2g EDTA per liter aqueous solution.

4.3.3.7.1.2 Procedure.

- Accurately weigh approximately 1.0 grams of pigment into a 250 mL glass-stoppered Erlenmeyer flask.
- Add 25 ml. of buffer, stopper, and shake vigorously every few minutes over a period of 30 minutes.
- Filter through fine paper into a 400 mL beaker, washing well with water until 200 mL of filtrate are collected.
- Add 20.0 mL of the EDTA (an excess) to the filtrate.
- Add 10 drops of eriochrome black T.
- Titrate with standard ZnO to a wine-red end point (V_s).
- Run a blank by titrating 20.0 mL of the EDTA in 200 mL of an aqueous solution containing 25 mL of the buffer (V_b).

4.3.3.7.1.3 Calculations.

$$\text{percent Zn} = \frac{(V_b - V_s) \times 0.2 \times 3.269}{\text{Sample wt}} \quad (\text{Req} = 6.5 - 7.4\%)$$

$$\text{Percent zinc phosphate} = \frac{(V_b - V_s) \times 0.2 \times 7.035}{\text{Sample wt}} \quad (\text{Req} = 14 - 16\%)$$

4.3.3.7.2 Determination of phosphate.4.3.3.7.2.1 Reagents.

- Conc NH_4OH .
- Conc HNO_3 .
- NH_4NO_3 .
- Ammonium molybdate - Johnson's Formula: Mix 55g of $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ and 50g of NH_4NO_3 with 18 mL of conc NH_4OH and 20 ml H_2O . Stir. Dilute to about 700 mL with H_2O , heat with occasional stirring until all salts have dissolved. Dilute to 1000 mL. Let stand overnight. Filter through fine paper but do not wash the residue.

4.3.3.7.2.2 Procedure.

- Accurately weigh approximately 2 g of pigment into a 250 mL glass-stoppered Erlenmeyer flask.
- Add 25 mg of conc. NH_4OH , stopper, and shake vigorously every few minutes over a period of 60 minutes.
- Add 25 mL of H_2O and filter through fine paper into a 400 mL beaker, washing well with water.
- Neutralize the filtrate with 7.5N HNO_3 (requires about 35 mL).
- Add 15 mL conc. HNO_3 and 6g NH_4NO_3 . Stir.

MIL-E-52891B(ME)

- f. Heat the clear solution to 80 °C (no higher) and add 75 mL of ammonium molybdate with constant stirring.
- g. Stir for several minutes and let the precipitate settle for 2 hours.
- h. Filter through a tared crucible (Gooch or medium glass), transfer the precipitate, and wash with 1 percent HNO₃ (5 mL conc. HNO₃ per 500 mL solution). The washing should be thorough.
- i. Give the collected precipitate a final wash with a small amount of water.
- j. Dry the crucible for 2 hours in a 105 °C oven.
- k. Cool crucible in a desiccator and determine the weight of the precipitate (it should not exceed 3 g; if it does, repeat the determination with a smaller sample).

4.3.3.7.2.3 Calculations.

$$\text{percent PO}_4 = \frac{\text{wt. ppt.} \times 5.029}{\text{Sample wt.}} \quad (\text{Req.} = 6.3 - 7.2\%)$$

$$\text{Percent zinc phosphate} = \frac{\text{wt. ppt.} \times 11.18}{\text{Sample wt.}} \quad (\text{Req.} = 14 - 16\%)$$

4.3.3.7.3 Failure criteria. Nonconformance to 3.4.1 shall constitute failure of this test.

4.3.3.8 Extender pigment.

4.3.3.8.1 Total extender pigment content. Determine matter insoluble in acid in the extracted pigment by method 5271 of FED-STD-141. Nonconformance to 3.4.1 shall constitute failure of this test.

4.3.3.8.2 Extended pigment analysis. Determine barium sulfate, siliceous material, and calcium (sulfate or carbonate) by the applicable portions of method 7281 of FED-STD-141. Nonconformance to 3.3.2 shall constitute failure of this test.

4.3.4 Dry opacity. Draw down the enamel on black and white Moresst card using a film applicator that will deposit a 3-inch-wide film having a dry film thickness of 0.0010 inch maximum. Air dry 72 hours. Determine the reflectance of the film over the black and white portions of the card and calculate the dry opacity. Nonconformance to 3.4.1 shall constitute failure of this test.

4.3.5 Viscosity.

4.3.5.1 Package. Proceed as in ASTM D 562, except that the method of mixing shall be to agitate the can for 3 minutes on a paint shaker powered by approximately a 1/4-hp motor, operating at about 1350 shakes per minute, manufactured by Red Devil Tools, or equal.

4.3.5.2 Reduced viscosity. Reduce 3 parts by volume of enamel with 1 part by volume of thinner conforming to table V and determine viscosity in accordance with ASTM D 1200.

MIL-E-52891B(ME)

4.3.5.3 Failure criteria. Nonconformance to 3.4.2 shall constitute failure of this test.

TABLE V. Thinner.

Ingredient	Percent by weight
VMP naphtha (8% max aromatic)	65
n-Butyl alcohol	20
Toluene	15

4.3.6 60 degree specular gloss. Draw down the package material to a dry film thickness of 0.001 \pm 0.0001 inch. Measure the gloss as specified in method 6101 of FED-STD-141. Nonconformance to 3.4.2 shall constitute failure of this test.

4.3.7 Drying time. Determine drying time in accordance with method 4601 of FED-STD-141 under referee conditions, except that the enamel shall be drawn down to a dry film thickness of 0.001 \pm 0.0001 inch. Nonconformance to 3.4.2 shall constitute failure of this test.

4.3.7.1 Dry through. Determine dry through in accordance with method 4061, except the enamel shall be drawn down as in 4.3.7 on a 4 x 12 inch steel panel that has been phosphoric acid etched as in method 2011, procedure B of FED-STD-141.

4.3.7.2 Full hardness. Determine full hardness on a panel prepared as specified in 4.3.7.1. The film shall be considered to have reached full hardness when it is very difficult to remove with a knife blade.

4.3.8 Color. In accordance with method 4250 of FED-STD-141, compare the color with the film of enamel on the panel prepared for the hiding power test. Nonconformance to 3.2 shall constitute failure of this test.

4.3.9 Condition in container. Determine package condition for quality conformance testing in accordance with method 3011 of FED-STD-141. For qualification testing, determine pigment settling or caking as follows: Process as in method 3011 of FED-STD-141, but do not stir. Reseal and then agitate the can for 3 minutes on a paint shaker. On re-examination of the contents, the disclosure of any gel bodies or undispersed pigment indicates unsatisfactory settling properties. Nonconformance to 3.5.1 shall constitute failure of this test.

4.3.10 Storage stability.

4.3.10.1 Partially full container. Determine 48 hours skinning in accordance with method 3021 of FED-STD-141 and observe for compliance with 3.5.2.1. Reseal and age for 7 days at 60 °C. Nonconformance to 3.5.2.1 shall constitute failure of this test.

MIL-E-52891B(ME)

4.3.10.2 Full container. In accordance with method 3022 of FED-STD-141, allow a full standard quart can of the packaged enamel to stand undisturbed for 6 months and examine the contents. Evaluate pigment settling or caking as in 4.3.9, but agitate the can for 5 minutes on the paint shaker prior to re-examination. Determine viscosity. Nonconformance to 3.5.2.2 shall constitute failure of this test.

4.3.11 Dilution stability. Reduce 1 volume of packaged enamel with 1 volume of thinner conforming to table V by slowly adding the thinner to the enamel with constant stirring. Allow to stand 24 hours, thoroughly remix, and, using a 0.0005 inch (0.0010 inch gap clearance) film applicator, draw down a film of the mixture on clear plate glass. Before and after the film is dry, examine by transmitted light. Nonconformance to 3.5.3 shall constitute failure of this test.

4.3.12 Suspension properties. Reduce the enamel as specified in 4.3.5.2. Place 6 ounces of the reduced enamel in an 8-ounce glass jar. Allow the stoppered jar to remain undisturbed for 24 hours and then place the unopened jar on a paint shaker (see 4.3.5.1) and agitate the contents for 20 seconds. Re-examine the material for any evidence of nonhomogeneity or undispersed pigment. Nonconformance to 3.5.4 shall constitute failure of this test.

4.3.13 Brushing properties. Apply the enamel to a 4 x 12-inch steel panel, using a 1-1/2-inch brush, and observe for brushing properties in accordance with method 4321 of FED-STD-141. Nonconformance to 3.5.5. shall constitute failure of this test.

4.3.14 Dipping properties. Reduce 3 parts by volume of enamel with 1 part volume of thinner conforming to table V. Test dipping properties of the thinned enamel in accordance with ASTM D 823, method B. Nonconformance to 3.5.6 shall constitute failure of this test.

4.3.15 Spraying properties. Reduce the enamel as specified in 4.3.5.2. Spray on a steel panel to give a dry film thickness of 0.0009 to 0.0011 inch and observe for spraying properties in accordance with method 4331 of FED-STD-141. For referee test, use automatic application per method 2131 of FED-STD-141. Nonconformance to 3.5.7 shall constitute failure of this test.

4.3.16 Flexibility. Determine flexibility in accordance with method 6221 of FED-STD-141. Draw down a 2-inch-wide film of enamel with a suitable film applicator that will give a dry film thickness of 0.0009 to 0.0011 inch on a smooth finish steel panel prepared in accordance with method 2012 of FED-STD-141, using a propylene glycol monoethylene ether mixture. Allow the test panel to air dry 1/2 hour and then bake for 24 hours at 105 ± 2 °C (221 ± 4 °F). Condition the panel for 1/2 hour at 25 ± 1 °C. Bend over a 1/4 inch mandrel. Nonconformance to 3.5.8 shall constitute failure of this test.

4.3.17 Knife test. Perform the knife test in accordance with method 6304 of FED-STD-141 using a flat portion of the baked panel from the flexibility test specified in 4.3.16. Nonconformance to 3.5.9 shall constitute failure of this test.

MIL-E-52891B(ME)

4.3.18 Adhesion, tape test.

4.3.18.1 Panel preparation. Draw down a 2-inch-wide film of the enamel to a dry film thickness of 0.001 ± 0.0001 inch on a steel panel, cleaned with solvent and etched with phosphoric acid as specified in procedure B, method 2011 of FED-STD-141.

4.3.18.2 Procedure. Air dry the specimen for 1 hour under referee conditions and then score a line through to the metal across the width of the film using a sharp pointed knife. The film shall then be taped perpendicular to and across the score line with waterproof, pressure-sensitive adhesive tape 3/4 inch wide, conforming to PPP-T-60, type IV. The tape shall be pressed in firm contact with the film and shall extend for approximately 1 inch on each side of the score line. All air bubbles shall be rolled out by firm pressure of the thumb. Allow approximately 10 seconds for the test area to return to room temperature. Grasp a free end of the tape and, at a rapid speed, strip it from the specimen by pulling the tape back upon itself at an angle of 180 degrees. Nonconformance to 3.5.10 shall constitute failure of this test.

4.3.19 Water resistance. Prepare two panels as specified in 4.3.18.1 and air dry for 72 hours. Coat all exposed, uncoated metal surfaces with wax or other suitable coating and immerse one of the panels for 18 hours in distilled water at 23 ± 1 °C (73.4 ± 2 °F) in accordance with ASTM D 1308, section 6.4. At the end of the test period, remove the panel from the water. Nonconformance to 3.5.11 shall constitute failure of this test.

4.3.20 Recoating. Prepare two panels as specified in 4.3.18.1 and air dry for 24 and 72 hours, respectively. At end of its drying period, immerse each panel to a depth of 2-1/2 inches in enamel which has been reduced with 1 part by volume of thinner conforming to table V to 4 parts by volume of package material. At the end of 5 seconds, remove the panel, dry in a vertical position. Nonconformance to 3.5.12 shall constitute failure of this test.

4.3.21 Salt spray resistance. Solvent clean three 4- x 12-inch steel panels in accordance with method 2011 of FED-STD-141 and apply a phosphate coating conforming to TT-C-490, type I. Reduce the enamel as specified in 4.3.5.2 and spray the test panels to a uniform dry film thickness of 0.0009 to 0.0011 inch. Air dry for 72 hours, score, and expose to 5 percent salt spray for 150 hours as specified in ASTM B 117. Upon removal, wash the panels gently in running water not warmer than 100 °F until free from any visible salt deposits. Strip the enamel film from the panels by means of lacquer thinner and inspect the steel for rust, pitting, or corrosion. Nonconformance to 3.5.13 shall constitute failure of this test.

4.3.22 Accelerated weathering. Prepare a film of the enamel as specified in 4.3.16 and air dry for 72 hours. Measure the directional reflectance and expose the panel to accelerated weathering for 240 hours in accordance with ASTM G 26, type BH. Examine the exposed panel for chalking by rubbing with a piece of velvet or cheesecloth wrapped around the finger. Using moderate pressure, draw the cloth across the width of the panel in two different directions. Measure

MIL-E-52891B(ME)

the directional reflectance (ASTM E 97) 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. Nonconformance to 3.5.14 shall constitute failure of this test.

4.3.23 Weather resistance. Prepare two scored test panels as specified in 4.3.21. Air dry for 72 hours and place on outdoor exposure for 18 months at an angle of 45 degrees south in the climate of Washington, DC. At the conclusion of the exposure period, inspect the panels. Determine chalking as specified in 4.3.22. Wash the panels with a warm soap solution using a soft sponge or cloth, rinse dry, and examine for color change. Strip the enamel from the panels by means of lacquer thinner and inspect the steel for rust, pitting, or corrosion. Nonconformance to 3.5.15 shall constitute failure of this test.

4.4 Inspection of packaging. Inspection of military levels of packaging shall be in accordance with the applicable quality conformance inspection requirements of PPP-P-1892. Commercial packaging shall be inspected for compliance with the requirements specified herein. Marking shall be examined for compliance with the requirements of 3.6 and 5.4.

5. PACKAGING

5.1 Preservation. Preservation shall be level A or commercial as specified (see 6.2).

5.1.1 Unit containers. The unit containers for the enamel shall, as specified (see 6.2), be 1-quart or 1-gallon multiple friction plug containers, 5-gallon lug cover steel pails or 55-gallon steel drums.

5.1.2 Level A. Unit containers of the types and sizes specified in 5.1.1 (see 6.2), shall be in accordance with the level A packaging requirements, and as applicable, the level A packing requirements, shown in PPP-P-1892 for pigmented liquid products.

5.1.3 Commercial. Unit containers of the types and sizes specified in 5.1.1 (see 6.2), shall be those containers normally used for products of this nature providing there will be no interaction chemically or physically with the contents so as to damage the container or alter the strength, quality, or purity of the contents. The containers shall comply with the requirements of the National Motor Freight Classification (NMFC), the Uniform Freight Classification (UFC), and the applicable requirements of the Code of Federal Regulation 49 CFR, Department of Transportation (DOT).

5.2 Packing. Packing shall be level A or commercial as specified (see 6.2).

5.2.1 Level A. Enamel, in unit containers of the types and sizes specified in 5.1.1, shall be packed in accordance with the level A packing requirements as shown in PPP-P-1892.

5.2.2 Commercial. Enamel, in unit containers of the types and sizes specified in 5.1.1, shall be packed in containers that will assure safe delivery

MIL-E-52891B(MF)

at destination. The containers shall comply with the requirements of the NMFC, the IFC and the applicable requirements of 49 CFR (DOT). The 5-gallon pails and 55-gallon drums shall not require additional protection.

5.3 Palletization. When specified (see 6.2), pails and drums shall be palletized in accordance with MIL-STD-147.

5.4 Marking. In addition to any special or identification markings required by the contract or purchase order and the requirements of 3.6, each shipping container shall be marked in accordance with PPP-P-1892.

6. NOTES

6.1 Intended use. The enamel covered by this specification is intended for use as a finish coat on phosphated or primed metal surfaces and on ammunition components. It is not intended for use where gasoline resistance is a prime requisite such as automotive equipment.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents shall specify the following:

- a. Title, number, and date of this specification.
- b. Color and color number (see 3.2).
- c. Degree of preservation and degree of packing required (see 5.1 and 5.2).
- d. Size of container required (see 5.1.1).
- e. When palletization is required (see 5.3).
- f. Any special marking (see 5.4).

6.3 Basis of purchase. The enamel covered by this specification should be purchased by volume, the unit being 1 U.S. gallon of 231 cubic inches at 68 °F (20 °C).

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time set for opening of bids, qualified for inclusion in the applicable qualified products list whether or not such products have actually been so listed by that date. The attention of the contractors is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the qualified products list is the U.S. Army Belvoir Research, Development, and Engineering Center, ATTN: STRBE-VO, Fort Belvoir, VA 22060-5606 and information pertaining to qualification of products may be obtained from that activity.

6.5 Packaging stability. Enamels of this type show some tendency to be thixotropic at higher viscosities. The use of a material such as diethylamine to the extent of 0.5 to 1.0 percent on the resin solids basis has been found to reduce this condition materially and improve the package stability.

MIL-E-52891B(MF)

6.6 Material safety data sheet. Contracting officers will identify those activities requiring copies of completed material safety data sheets prepared in accordance with FED-STD-313. The pertinent government mailing addresses for submission of data are listed in appendix B of FED-STD-313.

6.7 Subject term (key word) listing.

Ammunition topcoat
Coating
Quick dry lusterless enamel

6.8 Changes from previous issue. Asterisks (or vertical lines) are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodian:
Army - ME

Preparing activity:
Army - MF

Review activity:
Army - MR

Project 8010-A300

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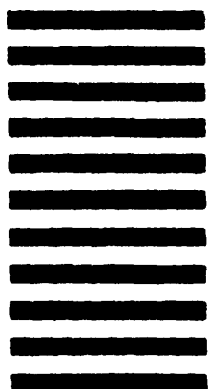


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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER MIL-E-52891B(ME)		2. DOCUMENT TITLE Enamel, Lusterless, Zinc Phosphate, Styrenated Alkyl Type	
3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION (Mark one)	
b. ADDRESS (Street, City, State, ZIP Code)		<input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> OTHER (Specify): _____	
5. PROBLEMS AREAS			
a. Paragraph number and wording			
b. Recommended wording			
c. Reason/Rationale for Recommendation:			
6. REMARKS			
7a. NAME OF SUBMITTER (Last, First MI) - Optional		7. WORK TELEPHONE NUMBER (include Area Code) - Optional	
7c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional		8. DATE OF SUBMISSION (YYMMDD)	