[METRIC]
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November 9, 1994
Superseding
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January 9, 1991

ENAMEL (ACRYLIC-EMULSION, EXTERIOR)

The General Services Administration has authorized the use of this specification by all Government Agencies

1. **SCOPE AND CLASSIFICATION**. This specification covers a lead, mercury and hexavalent chromate free acrylic emulsion enamel in the following types for exterior use on primed metal, concrete, masonry, and properly prepared wood:

Type I – Gloss
Type II – Semigloss
Type III – Flat

2. **APPLICABLE DOCUMENTS**. The following documents of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

Federal Standards:

FED-STD-141 - Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling, and Testing
FED-STD-313 – Preparation and Submission of Material Safety Data Sheets (MSDS)
FED-STD-595 – Colors Used in Government Procurement

Military Standards:

MIL-STD-105 – Sampling Procedures and Tables for Inspection by Attributes

(Copies of standards required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

American Society for Testing and Materials (ASTM) Standards:

D 523 – Specular Gloss
D 562 – Consistency of Paints Using the Stormer Viscometer
D 659 – Evaluating Degree of Chalking of Exterior Paints
D 1210 – Fineness of Dispersion of Pigment Vehicle Systems
D 1308 – Effect of Household Chemicals on Clear and Pigmented Organic Finishes
D 1640 – Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
D 1729 – Visual Evaluation of Color Differences of Opaque Materials
D 1849 – Package Stability of Paint
D 2091 – Print Resistance of Lacquers
D 2243 – Freeze Thaw Resistance of Latex and Emulsion Paints
D 2244 – Calculation of Color Differences from Instrumentally Measured Color Coordinates
D 2697 – Volume Nonvolatile Matter in Clear or Pigmented Coatings
D 3168 – Qualitative Identification of Polymers in Emulsion Paints
D 3273 – Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
D 3274 – Evaluating Degree of Surface Disfigurement of Paint Films by Fungal Growth or Soil and Dirt Accumulation
D 3335 – Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
D 3624 – Low Concentrations of Mercury in Paint by Atomic Absorption Spectroscopy
D 3960 – Volatile Organic Content (VOC) of Paints and Related Coatings
E 260 – Practice for Packed Column Gas Chromatography
G 53 – Operating Light- and Water Exposure Apparatus (Fluorescent UV Condensation Type) for Exposure of Nonmetallic Materials

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

Beneficial comments should be addressed to: Director, Engineering and Commodity Mgmt. Division, 9FTE-10, 400 15th St., SW, Auburn, WA 98001-6599

FSC 8010

3. REQUIREMENTS

3.1 **Materials.** Nonvolatile organic film-forming material shall consist of an acrylic or a styrene modified acrylic polymer and shall be tested as specified in table I. Material not specified shall be free from toxic materials under normal conditions of use.

3.1.1 **Prohibited materials**. When tested as specified in table I and 4.3.1, the enamel shall not contain benzene, halogenated solvents or ethylene based glycol ethers and their acetates. Lead, mercury and hexavalent chromium compounds shall not exceed the limits specified in table I.

3.2 **Qualitative requirements**.

3.2.1 **Condition in container**. When examined as specified in table I, the enamel shall show no evidence of putrefaction, hard settled pigment, or corrosion of the container. The enamel shall be dispersible to a uniform condition by 5 minutes hand stirring without decanting and remixing.

3.2.2 **Accelerated storage stability**. After storage at 52°C (125°F) for 30 days, as specified in table I, a sealed, filled one quart can of enamel shall show no coagulation or hard settled pigment. The enamel shall be dispersible to a uniform condition and shall pass the application properties tests specified in 3.2.5.

3.2.3 **Freeze thaw stability**. When tested as specified in table I at -9°C (16°F) for 3 freeze thaw cycles, the enamel shall show no coagulation or flocculation, the consistency shall not change more than 8 KU, and the enamel shall pass the application properties tests specified in 3.2.5.

3.2.4 **Color**. When tested as specified in table I at complete hiding, the enamel shall match the color specified.

3.2.5 **Application properties**. When tested as in 4.3.2, the enamel shall brush, roll, and spray easily; shall permit lapping after a minimum time of 10 minutes; and shall dry to a smooth uniform film free from lap marks, excessive brush marks, orange peel, craters or dusting.

3.2.6 **Flexibility**. When tested as in 4.3.3, the enamel film shall not crack or flake.

3.2.7 **Alkali resistance**. When tested as in 4.3.4, the enamel shall show no blistering or re-emulsification immediately after test. After 24 hours recovery, the film shall show no change in hue or hardness when compared with the untested portion of the enamel film.

3.2.8 **Immersion resistance**. When tested as in 4.3.5, the enamel shall show no blistering or re-emulsification immediately after test. After 24 hours recovery, the film shall show no change in hue, gloss or hardness when compared with the untested portion of the enamel film.

3.2.9 **Print resistance**. When tested as specified in 4.3.6, the tested area shall show no imprint.

3.2.10 **Biological growth**. When tested as specified in table I, the enamel shall attain a surface disfigurement rating of 8 or greater when evaluated against Adjunct No. 12 432740 00 specified in ASTM D 3274.

3.2.11 **Accelerated weathering**. When tested as in 4.3.7, the enamel shall show no chalking. Color after exposure shall show a maximum change of 4.0 CIELAB units for yellow, orange or red hues, or 2.0 for other hues. 60° gloss after exposure shall be 65 minimum for Type I, 25 minimum for Type II and 8 maximum for Type III.

3.3 **Quantitative requirements**. The enamel shall meet the quantitative requirements specified in table I.

Table I. Quantitative Requirements and Test References

Characteristics	Numeric Limits	Requirement Paragraph	Test Paragraph	Test Method[1]
Materials	–	3.1	–	D 3168
Prohibited materials	–	3.1.1	–	–
Solvents	–	3.1.1	–	E 260
Lead, percent of nonvolatile	0.06 max	3.1.1	4.3.1	D 3335
Mercury, parts per million	10 max	3.1.1	–	D 3624
Hexavalent chromium	none	3.1.1	4.3.1	–
Condition in container	–	3.2.1	–	3011
Accelerated storage stability	–	3.2.2	–	D 1849
Freeze-thaw stability	–	3.2.3	–	D 2243
Color	–	3.2.4	–	D 1729

Table I. Quantitative Requirements and Test References (Continued)

Characteristics	Numeric Limits	Requirement Paragraph	Test Paragraph	Test Method[1]
Application properties	–	3.2.5	4.3.2	2112, 2131, 214
Flexibility	–	3.2.6	4.3.3	6221
Alkali resistance	–	3.2.7	4.3.4	D 1308
Immersion resistance	–	3.2.8	4.3.5	–
Print resistance	–	3.2.9	4.3.6	D 2091
Biological growth	–	3.2.10	–	D 3273, D 327
Accelerated weathering	–	3.2.11	4.3.7	D 659, D 2244, G
Total solids, percent volume of enamel	–	–	–	D2697
Types I and II	35 min			
Type III	40 min			
Consistency, KU	77 - 85	–	–	D 562
Fineness of dispersion,	–	–	–	D 1210
Types I and II	6 min			
Type III	4 min			
60° specular gloss	–	–	4.3.8	D 523
Type I	70 min			
Type II	30 - 50			
Type III	8 max			
Drying time (dry through), hours	8 max		–	D 1640
Volatile organic compound (VOC) content, grams per liter (lb/gal). Less water and exempt solvents	200 (1.7) max	–	–	D 3960
Contrast ratio [(at 11.0 m^2/L) (450 ft^2/gal)]	–	–	–	4121[2]
FED-STD-595 Color numbers[3] 12199, 13655	0.92 min			
11105, 11136, 11140, 12197, 13538	0.93 min			
Other colors				
Reflectivity 80 and above	0.94 min			
76 - 79	0.95 min			
72 - 75	0.96 min			
68 - 71	0.97 min			
61 - 67	0.98 min			
60 and lower	0.99 min			

1. Methods with letter prefix are ASTM methods. Others are FED-STD-141 methods.
2. Procedure B, method B
3. These limits apply to all color numbers having the same last 4 digits.

3.4 **Special marking**. Each container and shipping container shall be marked:

"PROTECT FROM FREEZING STORE ABOVE 2°C (35°F)"

3.5 **Material Safety Data Sheet**. A Material Safety Data Sheet (MSDS) shall be submitted in accordance wit FED-STD-313 (See 6.2).

4. **QUALITY ASSURANCE PROVISIONS**

4.1 **Responsibility for inspection**. Unless otherwise specified in the contract or order, the contractor responsible for the performance of all inspection requirements specified herein using facilities approved by th Government. The Government reserves the right to perform any of the inspections set forth herein when deeme necessary to assure that the enamel conforms to prescribed requirements.

4.2 **Classification of inspections**. Inspections shall be classified as follows:
(a) Quality conformance inspection (see 4.3).
(b) Inspection of preparation for delivery (see 4.2.1).

4.2.1 **Preparation for delivery**. A random sample of filled containers shall be selected in accordance with MI STD 105, inspection level S 2, acceptable quality level (AQL) 2.5 percent defective, and examined for compliance with 3.4 and 5.

4.3 **Quality conformance inspection**. The enamel shall be tested in accordance with the methods specified i table I and as otherwise specified herein to determine compliance with the requirements of section 3. Unles otherwise specified, all tests shall be conducted at conditions specified in section 9 of FED-STD-141. Failure c any test shall be cause for rejection of the lot from which the sample was taken.

4.3.1 **Prohibited materials**.

4.3.1.1 **Lead content**. Determine lead content in accordance with ASTM D 3335 or by the use of an X ray fluorescence spectrometer capable of determining lead at a minimum range of 0.03 through 1.0 percent mass of nonvolatile with an accuracy within plus or minus 5.0 percent. The X ray method shall be used in case of dispute.

4.3.1.2 **Hexavalent chromium content**. Add 5 mL 25 percent aqueous KOH to 1/2 gram extracted pigment in a centrifuge tube. Agitate by shaking and centrifuge. A yellow color in the supernatant liquid indicates the presence of hexavalent chromium.

4.3.2 **Application properties**.

4.3.2.1 **Brushing properties**. Brush the enamel in accordance with method 2141, FED-STD-141 at a spreading rate of 9.8 m^2/L (400 ft^2/Gal) on one half of a smooth metal panel prepared in accordance with FED-STD-141 method 2011, procedure A. Allow the enamel to air dry 10 minutes and brush the enamel on the other half of the panel to a wet edge and note if the enamel can be lapped. Evaluate during brushing and after drying for compliance with 3.2.5.

4.3.2.2 **Roller coating properties**. Roll the enamel in accordance with method 2112, FED-STD-141 at a spreading rate of 9.8 m^2/L (400 ft^2/Gal). Evaluate during rolling and after drying for compliance with 3.2.5.

4.3.2.3 **Spraying properties**. Spray the enamel in accordance with method 2131, FED-STD-141. Evaluate during spraying and after drying for compliance with 3.2.6.

4.3.3 **Flexibility**. Prepare the test panel in accordance with method 2012, FED-STD-141. Supplement the panel cleaning with an additional cleaning with abrasive soap so that the surface shows no water break. Draw down the enamel on the clean, dry panel with a film applicator to obtain a dry film thickness of 25 ± 2 microns (0.001 ± 0.0001 inch). Air dry 18 hours, bake at 105 ± 2°C (221 ± 4°F) for 3 hours, and cool 1/2 hour at room temperature. Bend over a 3.18 mm (1/8 inch) diameter cylindrical mandrel and examine under a magnification of 7 diameters in accordance with method 6221, FED-STD-141.

4.3.4 **Alkali resistance.** Prepare and dry a panel as specified in 4.3.3. Test the dried film using 1.0 normal NaOH solution in accordance with paragraph 7.2, ASTM D 1308. Wash the reagent off with distilled water after 4 hours contact time and examine the film immediately and after 24 hours recovery. Evaluate for compliance with 4.2.7.

4.3.5 **Immersion resistance**. Prepare panels as specified in 4.3.3 and air dry 7 days. Test as specified below and evaluate for compliance with 3.2.8.

4.3.5.1 **Water resistance**. Immerse the panel halfway in distilled water for 18 hours.

4.3.5.2 **Hydrocarbon resistance**. Immerse the panel halfway in a hydrocarbon mixture consisting of 70 percent by volume of iso-octane and 30 percent toluene for 4 hours.

4.3.6 **Print resistance**. Prepare a panel as in 4.3.3 and air dry 24 hours. Test the film in accordance with ASTM D 2091 using Army duck, a pressure of 3.5 kPa (1/2 lb/in^2) and a contact time at room temperature of 30 minutes. Evaluate for compliance with 3.2.9.

4.3.7 **Accelerated weathering**.

4.3.7.1 **Panel preparation**. Draw down duplicate films on plane surfaced aluminum panels with a film applicator to obtain dry film thickness of 37 ± 2 microns (0.0015 ± 0.0001 inch). Air dry 168 hours and measure color in accordance with ASTM D 2244 using illuminant D65.

4.3.7.2 **Exposure**. Weather the panels for 200 hours in accordance with ASTM G 53 using UV A 351/302 lamps and a cycle of 8 hours UV exposure at 60°C (140°F) followed by 4 hours condensation at 50°C (122°F).

4.3.7.3 **Evaluation**. Examine the exposed panels for chalking in accordance with ASTM D 659 using a black velvet cloth. Determine gloss in accordance with ASTM D 523, measure color as in 4.3.6.1 and calculate color difference, delta E, in accordance with ASTM D 2244.

4.3.8 **Gloss**. Draw down the enamel on plane surfaced glass panels. Use a film applicator that will produce a wet film thickness of 76 ± 2 microns (0.003 ± 0.001 inch). Determine 60° specular gloss in accordance with ASTM D 523 after 7 days drying at standard conditions in a dust free environment.

5. PREPARATION FOR DELIVERY

5.1 **Packaging, packing, and marking**. The enamel shall be furnished in quantities specified (see 6.2). The packaging, packing, and marking shall be as specified (see 6.2).

6. NOTES

6.1 **Intended use**. This acrylic emulsion enamel is intended for use on exterior primed metal, concrete, masonry, and wood. It may be used in areas were air pollution regulations limit the use of solvent based coatings. This is a durable long lasting coating when applied over properly prepared surfaces and is characterized by excellent gloss retention. Chalk and loose paint should be removed before painting. Application temperatures should be above 10°C (50°F) to insure proper drying and film formation. This enamel is not intended for water immersion service.

Theoretical coverage at 1 mil (0.001 inch) dry film thickness: 450 square feet.

6.2 **Ordering data**. Purchasers should include the following information in procurement documents:
(a) Title, number, and date of this specification.
(b) Type and color required (see 1).
(c) Packaging, packing, and marking required.
(d) Size of container and quantity required.
(e) Instructions and address for submission of MSDS (See 3.5).

6.3 **Part numbers**. Part or identifying numbers (PIN) for cataloging purposes under this specification are coded as follows:

Type	Container Size	FED-STD-595 Color Number
1 - Gloss	A - 946 mL (Quart)	1NNNN
2 - Semigloss	B - 3.78 L (Gallon)	2NNNN
3 - Flat	C - 18.9 L (5 Gallon)	3NNNN

Example: TT-E-2784-1 A 17038

- 17038 — Color (Gloss Black)
- A — Container size (Quart)
- 1 — Type (Gloss)
- TT-E-2784 — Specification identification

MILITARY INTEREST:
Custodians:
Air Force - 99

Review activities:
Navy - AS
Army - MI
Air Force - 11
Army - AR
Navy - OS
DoD - DS

User activities:
Marine Corps - MC
Navy - YD

CIVIL AGENCY COORDINATING ACTIVITY:
GSA FSS

PREPARING ACTIVITY

GSA FSS

Project 8010 0423