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TT-V-109C
January 30, 1978
SUPERSEDING
Fed. Spec. TT-V-109B
March 1, 1968

FEDERAL SPECIFICATION

VARNISH, INTERIOR, ALKYD-RESIN

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE

1.1 Scope. Varnish covered by this specification is a clear, air-drying varnish of the alkyd-resin type for interior use.

2. APPLICABLE DOCUMENTS

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

Federal Specification:

TT-P-320 - Pigment, Aluminum; Powder and Paste for Paint.

Federal Standards:

Fed. Std. No. 123 - Marking for Shipment (Civil Agencies).
Fed. Test Method Std. No. 141 - Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling and Testing.

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other Federal Specifications required by activities outside the Federal Government for bidding purposes are available without charge from Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Philadelphia, Washington, DC, Atlanta, Chicago, Kansas City, MO, Fort Worth, Houston, Denver, San Francisco, Los Angeles, Seattle, WA.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

Military Standard:

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

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(Copies of Military 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.)

Laws and Regulations:

49 CFR 178 - Department of Transportation (DOT) Shipping Container Specifications.

(The Code of Federal Regulations (CFR) and the Federal Register (FR) are for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. When indicated, reprints of certain regulations may be obtained from the Federal agency responsible for issuance thereof.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTM) Standards:

D 563 - Phthalic Anhydride Content of Alkyd Resins and Resin Solutions.
D 1308 - Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
D 1398 - Fatty Acid Content of Alkyd Resin and Resin Solutions.
D 1542 - Qualitative Tests for Rosin in Varnishes.
D 1544 - Color of Transparent Liquids (Gardner Color Scale).
D 1545 - Viscosity of Transparent Liquids by Bubble Time Method.
D 1644 - Nonvolatile Content of Varnishes.
D 1951 - Ash in Drying Oils and Fatty Acids.
D 3272 - Vacuum Distillation of Solvents form Solvent Base Paints for Analysis.
D 3278 - Flash Point of Liquids by Setaflash Closed Tester.

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

National Motor Freight Traffic Association, Inc., Agent:

National Motor Freight Classification.

(Application for copies should be addressed to the American Trucking Associations, Inc., Traffic Department, 1616 P Street, N.W., Washington, DC 20036.)

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.)

3. REQUIREMENTS

3.1 Material. The varnish shall consist of a vegetable oil-modified phthalic alkyd resin, thinners, driers, and antiskinning agents as required to meet the requirements of this specification.

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3.1.1 The volatile solvent, when tested as specified in 4.4.3, shall conform by volume to the requirements controlling the emission of solvents into the atmosphere as called out in (a), (b), (c), (d), (e), and (f).

(a) A combination of aldehydes or branched chain ketones: 20 percent maximum.
(b) A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethylbenzene: 8 percent maximum.
(c) A combination of ethylbenzene or toulene: 20 percent maximum.
(d) A combination of solvents with olefinic or cyclo-olefinic unsaturation: 5 percent maximum.
(e) Total of (a) + (b) + (c) + (d) = 20 percent maximum.
(f) Benzene shall not be used in this product. A trace amount of 0.5 percent maximum is allowed for benzene as in impurity in other solvents.

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3.1.2 There shall be no halogenated compounds when tested as specified in 4.4.3.4.

3.2 Quantitative requirements. The material shall meet the requirements specified in table I.

TABLE I. Quantitative requirements

Characteristics	Minimum	Maximum
Acid number	----	7
Nonvolatile matter, percent by weight of varnish	44	----
Phthalic anhydride, percent by weight of nonvolatile	30	----
Vegetable oil acids, percent by weight of nonvolatile	45	55
Ash content, percent by weight of varnish	----	0.3
Flash point (Setaflash Closed Tester)	38 deg. C	----
Drying time:		
Set-to-touch, hours	0.5	3
Dry hard, hours	----	18
Viscosity, Gardner-Holdt tubes	C	F
Rosin and rosin derivatives	----	none
Lead content, percent by weight of total nonvolatile	----	0.06

3.3 Qualitative requirements.

3.3.1 Condition in container. A freshly opened container shall show no skinning, livering, thickening, or gelling when tested as specified in table III.

3.3.2 Color. When tested as specified in table III, the varnish shall be no darker in color than the No. 11 tube of the Gardner Color Scale.

3.3.3 Appearance. The varnish shall be clear, homogeneous, and free from sediment and suspended material when tested as specified in table III.

3.3.4 Working properties and appearance of dried film. When tested as specified in 4.4.4, the varnish shall flow smoothly and evenly. The air-dried film shall be clear, smooth, and glossy, and free from streaks and blisters.

3.3.5 Self-lifting properties. When tested as specified in 4.4.5, the film shall be smooth and uniform, and contain no blisters or pinholes.

3.3.6 Baking properties. A film of the varnish prepared and tested as specified in 4.4.6 shall be hard, tough, smooth, transparent, and free from checking, wrinkling, dulling, and discoloration.

3.3.7 Flexibility. The varnish shall show no cracking, flaking, or loss of adhesion when tested as specified in 4.4.7.

3.3.8 Immersion resistance (hot water). When tested as specified in 4.4.8, the film shall show no checking, blistering, or whitening 15 minutes after removal. Three hours after removal, the film on the immersed portion of the panel shall show no softening, no change in gloss, and no loss of adhesion compared to the film on the portion of the panel not immersed in water.

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3.3.9 Immersion resistance (hydrocarbon). When tested as specified in 4.4.9, the film shall show no softening, no change in gloss, and no loss of adhesion compared to a film on a similarly prepared panel which has not been subjected to the hydrocarbon test fluid.

3.3.10 Aluminum vehicle properties. An aluminum paint made with varnish, aluminum pigment conforming to TT-P-320, and mineral spirits as specified in 4.4.10.1 shall conform to the following requirements.

3.3.10.1 Spraying and brushing properties. When tested as specified in 4.4.10.2, the paint shall flow smoothly and evenly.

3.3.10.2 Coating toughness. When prepared and tested as specified in 4.4.10.3, the paint shall ribbon or curl from the panel, but shall not flake or chip.

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3.3.11 Storage stability.

3.3.11.1 Partially full container. When tested as specified in 4.4.11.1, the varnish shall show no skinning, livering or gummy sediment, and shall readily remix to a smooth, homegeneous material.

3.4 Quantities. The varnish shall be furnished in 1-pint, 1-quart, 1-gallon, 5-gallon, and 55-gallon quantities, as specified (see 6.2).

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 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.

4.2 Inspection of preparation for delivery. An inspection shall be made to determine whether the packaging, packing, and marking comply with the requirements of section 5. The sample unit shall be one shipping container fully prepared for delivery and selected at random. Sampling shall be in accordance with MIL-STD-105. The lot size shall be the number of shipping containers in the end item inspection lot. The packaging and packing shall be examined as specified in table II for the cited defects. The inspection level shall be S-2 with an AQL of 4.0 defects per hundred units.

TABLE II. Classification of preparation for delivery defects

Examine	Defects
Markings	Omitted; incorrect; illegible; improper size, location, sequence, or method of application.
Material	Any component missing or damaged or wrong type.
Workmanship	Inadequate application of components such as incomplete closure of container flaps, loose strapping, inadequate stapling, or distortion of container.

4.3 Testing of the end item.

4.3.1 Lot. The varnish shall be assembled into lots as specified in MIL-STD-105. In MIL-STD-105, the words "essentially the same conditions" shall be interpreted to mean a manufacturer’s batch and defined as the end product of all raw materials mixed, blended, or processed in a single operation.

4.3.2 Sampling of the end item. For the purposes of sampling, the lot shall be expressed in units of gallons. Samples from lots shall be taken in accordance with MIL-STD-105 using inspection level S-2 and an acceptable quality level (AQL) of 2.5 percent defective.

4.4 Test procedures.

4.4.1 The varnish shall be tested according to the test methods indicated in table III. Unless otherwise specified, standard testing conditions are a temperature of 23 deg. +/- 1 deg. C and a relative humidity of 50 +/- 5 percent. All test reports shall contain the individual values utilized in expressing the final result. All tests shall be evaluated for conformance to the requirements specified in section 3. Failure to pass any

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test, or noncompliance with any requirement, shall be cause for rejection of the sample.

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TABLE III. Test methods

Characteristic	Requirement Reference	Fed. Test Method Std. No. 141	ASTM Method	Test Paragraph Reference
Acid number	Table I	----------	D 1639	----------
Nonvolatile matter	Table I	----------	D 1644[1]	----------
Phthalic anhydride	Table I	----------	D 563	----------
Vegetable oil acids	Table I	----------	D 1398	----------
Ash content	Table I	----------	D 1951	----------
Flash point	Table I	----------	D 3278	----------
Drying time	Table I	4061	------	4.4.2
Viscosity	Table I	----------	D 1545	----------
Rosin and rosin derivatives	Table I	----------	D 1542	----------
Solvent analysis	3.1.1	7356, 5132	D 3272	4.4.3
Condition in container	3.3.1	3011	------	----------
Color	3.3.2	----	D 1544	----------
Appearance	3.3.3	4261	------	----------
Working properties	3.3.4	----------	------	4.4.4
Self-lifting properties	3.3.5	----------	------	4.4.5
Baking properties	3.3.6	----------	------	4.4.6
Flexibility	3.3.7	6221	------	4.4.7
Immersion resistance (hot water)	3.3.8	----------	D 1308	4.4.8
Immersion resistance (hydrocarbon)	3.3.9	----------	D 1308	4.4.9
Aluminum vehicle properties:				
Spraying and brushing	3.3.10.1	----------	------	4.4.10.2
Coating toughness	3.3.10.2	6304	------	4.4.10.3
Storage stability:				
Partially full container	3.3.11.1	3021	------	4.4.11.1
Lead content	Table I	----------	------	4.4.12

[1] Use method A of ASTM D 1644.

4.4.2 Drying time. Using a film applicator, apply the varnish to a dry film thickness of 25 um (0.001 in) to a glass panel prepared as specified in method 2021 of Fed. Test Method Std. No. 141. Run set-to-touch and dry hard items according to method 4061 of Fed. Test Method Std. No. 141, and evaluate for compliance with the requirements in table I.

4.4.3 Solvent analysis.

4.4.3.1 Solvent extraction. The solvent shall be extracted from the varnish in accordance with ASTM D 3272.

4.4.3.2 Solvent composition. The solvent composition shall be determined in accordance with 4.4.3.3, method 7356 of Fed. Test Method Std. No. 141 and 4.4.3.4 to determine compliance with requirement of 3.1.1.

4.4.3.3 Aromatic and oxygenated solvents. The 1.83 m (6 ft) column shall be installed and the operating conditions described in method 7356

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shall be followed. About 3 microliters of the isolated distillate shall be injected and the chromatogram scanned. The aliphatic solvents will emerge within 1 minute and the complete chromatogram should develop in about 5 minutes. From the position of the peaks observed on the chromatogram, an internal standard that will be free of interference shall be selected, such as cyclopentanol or cyclohexanol. Six-tenths of a ml of internal standard shall be added to 3 ml of the distillate. The sample shall be analyzed according to the above procedure. Peaks emerging after 1 minute are aromatic solvents along with any oxygenated solvents that may be present. The percent of aromatic and oxygenated solvents shall be calculated as indicated.

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$$\text{Percent aromatic and oxygenated solvents, v/v} = \frac{A \times B}{C \times D}$$

Where: A = Percent of internal standard added (in this case, 20)
B = Area of aromatic and oxygenated solvents
C = Calibration factor for the internal standard. This factor is dependent on the internal standard used and on the performance of the chromatograph, and should be determined daily
D = Area of the internal standard (in this case cyclopentanol or cyclohexanol)
v/v = Volume by volume

4.4.3.4 Halogenated compounds. The presence of halogenated compounds shall be determined in accordance with method 5132 of Fed. Test Method Std. No. 141, and evaluated for compliance with 3.1.1.

4.4.4 Working properties. The varnish shall be applied to steel panels conforming to method 2011 of Fed. Test Method Std. No. 141 by brushing (method 4321) and spraying (method 4331). The varnish shall be sprayed 152 to 203 mm (6 to to 8 in) from the panel, and may be reduced (if necessary) for spraying with mineral spirits not to exceed 1 pint per gallon of varnish. Observe the leveling properties of the varnish. Air-dry the film for 24 hours, and evaluate for compliance with the requirement in 3.3.4.

4.4.5 Self-lifting properties. Using a film applicator, apply varnish to a wet-film thickness of 51 um (.002 in) to a steel panel conforming to method 2011 of Fed. Test Method Std. No. 141. Air-dry the panel for 24 hours at standard conditions. Apply a second coat of varnish in the same manner as the first. Air-dry for 24 hours, and evaluate for compliance with the requirement in 3.3.5.

4.4.6 Baking properties. Using a film applicator, apply the varnish to a wet-film thickness of 51 um (.002 in) on a clear glass panel conforming to method 2021 of Fed. Test Method Std. No. 141. Air-dry the panel for 30 minutes at standard conditions and then bake in an oven in a horizontal position at 80 to 85 deg. C for 2 hours. Remove from oven, cool for 1 hour at standard conditions, and evaluate for compliance with the requirement in 3.3.6.

4.4.7 Flexibility. Using a film applicator, apply the varnish to a wet-film thickness of 51 um (.002 in) on a tin panel conforming to method 2012 of Fed. Test Method Std. No. 141. Air-dry the panel for 24 hours at standard conditions and then bake in an oven at 105 +/- 2 deg. C for 24 hours. Remove from the oven, and condition the panel and a 3.2 mm (1/8 in) mandrel at 0 deg. C for 1 hour. Determine the flexibility according to method 6221 of Fed. Test Method Std No. 141, except the intensity of the light used for magnification shall be 45 to 55 footcandles. Also, viewing the coating at north window illuminated by a fairly overcast sky is not allowed in this specification. Evaluate for compliance with the requirement in 3.3.7.

4.4.8 Immersion resistance (hot water). Using a film applicator, apply the varnish to a wet-film thickness of 51 um (.002 in) on a steel panel conforming to method 2011 of Fed. Test Method Std. No. 141 and cleaned by solvent spray according to procedure A of method 2011. Condition the panel for 1 week at standard conditions. Immerse panel in boiling water for 20 minutes in accordance with ASTM D 1308, section 5.4. Examine the panel for compliance with the requirement in 3.3.8.

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4.4.9 Immersion resistance (hydrocarbon). Using a film applicator, apply the varnish to a wet-film thickness of 51 um (.002 in) on a steel panel conforming to method 2011 of Fed. Test Method Std. No. 141. Condition the panel for 1 week at standard conditions. Immerse the panel in a test fluid, consisting of 70 percent iso-octane and 30 percent toluene (by volume) for 4 hours in accordance with ASTM D 1308, section 5.4. Remove the panel and condition for 24 hours at standard conditions. Evaluate the panel for compliance with the requirement in 3.3.9.

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4.4.10 Aluminum vehicle properties.

4.4.10.1 Preparation of aluminum test paint. Prepare 1-pint of aluminum paint by mixing the ingredients in the following ratio: 1 gallon of varnish, 16 ounces (avoir.) of aluminum paste (TT-P-320, type II, class 2), and 1 pint of mineral spirits. Add the mineral spirits slowly to the paste with constant stirring and stir frequently for a 15 minute period to ensure complete wetting and dispersion of the pigment in the mineral spirits, and add the varnish with continuous stirring. Stir vigorously for at least 2 minutes, and observe the surface of the paint for brillance and uniformity for 1 minute after cessation of stirring. Allow the paint to stand for 2 hours, stir thoroughly, and run the following tests:

4.4.10.2 Spraying and brushing properties. Use clear glass panels cleaned as specified in method 2021 of Fed. Test Method Std. No. 141. The paint shall be brushed on clean glass panels according to method 4321 of Fed. Test Method Std. No. 141. Additionally, paint shall be sprayed on other clean glass panels, at a distance of 152 to 203 mm (6 to 8 in) from the panel, according to method 4331 of Fed. Test Method Std. No. 141. Evaluate the panels for compliance with the requirement in 3.3.10.1.

4.4.10.3 Coating toughness. Use a clear glass panel cleaned as specified in method 2021 of Fed. Test Method Std. No. 141. Apply one coat of paint to the glass panel by brushing as specified in method 4321 of Fed. Test Method Std. No. 141, and dry for 24 hours at standard conditions. Using a knife, test the coated panel in accordance with method 6304 of Fed. Test Method Std. No. 141, and evaluate for compliance with the requirement in 3.3.10.2

4.4.11 Storage stability.

4.4.11.1 Partially full container. Determine skinning of the varnish after 48 hours, in accordance with method 3021 of Fed. Test Method Std. No. 141, and evaluate for compliance with the requirement in 3.3.11.1.

4.4.12 Lead content.

4.4.12.1 Sample preparation. Using a 150 um (0.006-in) film applicator and a mechanical applicator plate, duplicate drawdowns for each sample of well-mixed varnish shall be made on a standard paint penetration chart and dried for 24 hours. The drawdown shall be at least 10 inches long on the sealed portion of the penetration chart. The drawdown shall be cut into discs of appropriate size to fit the sample holder of a fluorescence X-ray spectrometer.

4.4.12.2 Procedure. Lead content shall be determined using an X-ray fluorescence spectrometer capable of determining lead content at at minimum level of 0.03 percent by weight of the total nonvolatile. The settings for a wavelength dispersive fluorescence spectrometer shall be as follows: [1]

Element	Analytical Line	Angle	Crystal	Detection	Collimeter	X-ray tube (MO)
Pb	L┌[is proportional to]┌[1]┐┐	33.93	LiF(200)	Flow S.C.	Fine	60 Kv 45Ma
Pb (backgrd I)		33.00	LiF(200)	Flow S.C.	Fine	60 Kv 45Ma
Pb (backgrd II)		35.50	LiF(200)	Flow S.C.	Fine	60 Kv 45Ma

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Mo	K┌[is proportional to]┌0┐┐	20.33	LiF(200) Flow S.C.	Fine	60 Kv 45Ma

Pulse height selection shall be used in all measurements, and counting time shall be 100 seconds. Place the sample disc in the wavelength dispersive unit. Measure the count rates of lead, lead background, and the Molybdenum Compton scattered background from the X-ray tube.

[1] Energy dispersive fluorescence spectrometers shall be set up according to the manufacturer’s manual.

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4.4.12.3 Calculation.

$$R = \frac{I_{[Pb]} - \left[\frac{I_{[Pb]}\ (\text{background I}) + I_{[Pb]}\ (\text{Background II})}{2}\right]}{I_{[Mo]}}$$

where I equals gross intensity. These results shall be compared to those obtained using a 0.06 percent lead standard made up from the same type of varnish sample, and evaluated for compliance with table I.

5. PREPARATION FOR DELIVERY

5.1 Packaging. Packaging shall be level A or Commercial, as specified (see 6.2).

5.1.1 Level A. The varnish shall be furnished in 1-quart metal cans, 1-gallon metal cans, 5-gallon metal pails, or 55-gallon steel drums, as specified (see 6.2). The metal cans, pails, and drums shall meet or exceed the requirements of DOT Specifications under 49 CFR 178.

5.1.2 Commercial. The varnish shall be packaged in cans, pails, or drums, as applicable, in accordance with normal commercial practice. The complete package shall be designed to protect the item against damage during shipment, handling, and storage.

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

5.2.1 Level A. Forty-eight 1-pint cans or twelve 1-quart cans, or four 1-gallon cans of varnish, packaged as specified in 5.1, shall be packed in fiberboard boxes made from weather-resistant fiberboard with a bursting test strength of not less than 275 lbs per square inch. The box flaps shall be secured with water-resistant adhesive applied to not less than 75 percent of the surface area of contact between the flaps, or with 3 inch wide waterproof tape applied to the full length of the seams and extending over the ends not less than 3 inches. Alternatively, wirebound, cleated plywood, or nailed wood boxes shall be acceptable. Alternatively, wirebound, cleated plywood, or nailed wood boxes shall be acceptable shipping containers when lined with a waterproof barrier material. The barrier material shall be sealed at the edges with waterproof tape or adhesive. Five-gallon metal pails or 55-gallon steel drums need no further packing.

5.2.2 Commercial. The 1-pint, 1-quart, and 1-gallon varnish, packaged as specified in 5.1, shall be packed in fiberboard boxes to insure safe delivery at destination, to provide for safe redistribution by the initial receiving activity, and shall be acceptable by common carrier under the National Motor Freight Classification or Uniform Freight Classification.

5.3 Unitization. When shipments to Government depots are full car or truckload, the shipping containers shall be unitized for shipment and handling in accordance with normal commercial practice. The unitized load shall not exceed 2,500 lbs in weight, 63 inches in height, 56 inches in length, and 45 inches in width.

5.4 Marking. Packages, shipping containers, and unitized loads (when applicable) shall be marked in accordance with Fed. Std. No. 123.

6. NOTES

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6.1 Intended use. The varnish covered by this specification is intended for interior use, primarily as a transparent protective finish for wood. It serves as an undercoat for enamels when used on wooden construction and is also suitable for use as a aluminum vehicle. However, aluminum paint using this varnish as a vehicle should be used within hours after it is made.

6.2 Ordering data. Purchasers should select the preferred options permitted herein, and include the following information in procurement documents:

(a) Title, number, and date of this specification.
(b) Level of packaging and packing required (see 5.1).
(c) Size and type of container required (see 5.1).
(d) Marking required (see 5.1).

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6.3 Shelf-life surveillance. For the purpose of shelf-life surveillance, the varnish shall show no skinning, livering, curdling, hard or dry caking, or gummy sediment. In addition, the varnish shall remix to a smooth, homogeneous material, and shall meet the viscosity and dry time requirements in table I and the color requirement in 3.3.2.

Military Coordinating Activity: CIVIL AGENCY COORDINATING ACTIVITY:

Army - MR DOT - FAA

PREPARING ACTIVITY: GSA - FSS

U.S. GOVERNMENT PRINTING OFFICE : 1978 - 261-423/1015

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