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TT-V-121H
January 5, 1978
SUPERSEDING
Fed. Spec. TT-V-121G
March 15, 1968

FEDERAL SPECIFICATION

VARNISH, SPAR, WATER-RESISTING

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

1. SCOPE

1.1 This specification covers one grade of clear, air-drying spar varnish of the oleoresinous type.

2. APPLICABLE DOCUMENTS

2.1 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. St. No. 123 - Marking for Shipment (Civil Agencies).
Fed. Test Method Std. No. 141/GEN - 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, and 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.

(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.)

Code of Federal Regulations:

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

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, DC 20402. Orders should cite the latest edition and supplements thereto.)

FSC 8010

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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 1544 - Color of Transparent Liquids (Gardner Color Scale).
D 1545 - Viscosity of Transparent Liquids by Bubble Time Method.
D 1640 - Drying, Curing or Film Formation of Organic Coatings at Room Temperature.
D 1642 - Elasticity or Toughness of Varnishes.
D 1643 - Gas Checking and Draft Test of Varnish Films.
D 1644 - Nonvolatile Content of Varnishes.
D 3272 - Vacuum Distillation of Solvents from 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 or 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 Solvent. The solvent, when tested as specified in 4.4, shall conform by volume to the requirements controlling the emission of solvents into the atmosphere as called out in (a) through (g):

(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: S percent maximum.

(c) A combination of ethylbenzene or toluene: 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: 0.1 percent maximum.

(g) Halogenated compounds: negative test.

3.2 Quantitative requirements. When tested as specified in 4.4, the varnish shall meet the requirements specified in table I.

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TABLE I. Quantitative requirements

Characteristics	Requirements	
	Minimum	Maximum
Nonvolatile matter, percent by weight	55	-
Set-to-touch, hours	0.5	3
Dry hard, hours	-	8
Free from after tack, hours	-	24
Viscosity, stokes	1.25	2.00
Toughness, rosin-pentaerythritol ester reduction	100	-
Flash point, Setaflash, deg. C (deg. F)	38(100)	-
Lead content, (lead as lead metal) (percent by weight)	-	0.06

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3.3 Qualitative requirements.

3.3.1 Gas checking. When tested as specified in 4.4.4, the dried film of the varnish shall show no dulling, frosting, crow's footing, or other defects.

3.3.2 Draft test. When tested as specified in table III, the dried film of the varnish shall show no pitting, wrinkling, crow's footing, or other defects.

3.3.3 Appearance. When tested as specified in table III, the varnish shall be clear and free for sediment and suspended matter.

3.3.4 Color. When tested as specified in table III, the varnish shall be no darker than the No. 14 tube of the Gardner Color Scale (1953).

3.3.5 Skinning. When tested as specified in table III, the varnish shall show no skinning.

3.3.6 Condition in container. When tested as specified in table III, the varnish shall be free from skinning, grit, lumps, thickening, and gelling.

3.3.7 Brushing properties and appearance of dried film. When tested as specified in table III, the varnish shall be a freely working product with acceptable flowing and leveling properties. The air-dried film shall be clear, smooth, and glossy, and free from streaks, blisters lap marks, and other irregularities.

3.3.8 Water resistance. When tested as specified in 4.4.7, the dried film of the varnish shall show no whitening, dulling, softening, swelling, wrinkling, or loss of adhesion.

3.3.9 Self-lifting properties. When tested as specified in 4.4.8, the film shall be smooth and uniform without such surface irregularities as blisters or pinholes.

3.4 Quantities. The varnish shall be furnished in 1-pint, 1-quart, 1-gallon, 5-gallon, and 55-gallon quantities.

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 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.

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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 Sampling for 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.

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4.3.2 Sampling of the end item. For the purpose 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.

4.4 Test methods. All test shall be conducted in accordance with the methods specified in table III to determine compliance with the requirements of section 3. Unless otherwise specified, all test specimens shall be prepared and tested in a room having a temperature of 23 deg. +/- 1 deg. C (73 deg. +/- 2 deg. F) and a relative humidity of 50 +/- 5 percent. All test reports shall contain the individual values utilized in expressing the final result. Failure to pass any test or noncompliance with any requirement, shall be cause for rejection of the sample.

TABLE III. Test methods

Test	Methods		
	ASTM Standard	Fed. Test Method Std. No. 141	Paragraph reference
Solvent analysis	D 3272	7356, 5132	4.4.1
Nonvolatile matter	D 1644	---	---
Drying time	D 1640	---	---
Viscosity	D 1545	---	---
Toughness	D 1642	---	4.4.2
Flash point	D 3278	---	---
Lead content	---	---	4.4.3
Gas checking	D 1643	---	4.4.4
Draft test	D 1643	---	---
Appearance	---	4261	---
Color	D 1544	---	---
Skinning	---	3021	4.4.5
Condition in container	---	3011	---
Brushing properties and appearance of dried film	---	4321	4.4.6
Water resistance	---	---	4.4.7
Self-lifting properties	---	---	4.4.8

4.4.1 Solvent analysis. The solvent from 100 ml of the varnish shall be extracted in accordance with ASTM method D 3272. The solvent composition shall then be determined in accordance with 4.4.1.1, method 7356 of Fed. Test Method Std. No. 141, 4.4.1.2, and 4.4.1.3 to determine compliance with the requirements of 3.1.1.

4.4.1.1 Aromatic and oxygenated solvents. The 1.8 m (6 ft) column shall be installed and the operating conditions described in method 7356 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 milliliter of internal standard shall be added to 3 milliliters 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 follows:

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

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C x 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 standards. 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).

4.4.1.2 Halogenated compounds. The presence of halogenated compounds shall be determined in accordance with method 5132 of Fed. Test Method Std. No. 141.

4.4.1.3 Benzene. When the solvent is tested in accordance with 4.4.1.1, a trace benzene peak of not more than 0.5 percent of the toluene peak will be allowed.

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4.4.2 Toughness. Method A of ASTM method D 1642 shall be used.

4.4.3 Lead content.

4.4.3.1 Sample preparation. Using a 0.006-inch film applicator and a mechanical applicator plate, duplicate drawdowns for each sample of 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.

4.4.3.2 Procedure. Lead content shall be determined using an X-ray fluorescence spectrometer capable of determining lead content 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	33.93	LiF(200)	Flow S.C.	Fine	60Kv 45Ma
Pb (backgrd I)		33.00	LiF(200)	Flow S.C.	Fine	60Kv 45a
Pb (backgrd II)		35.50	LiF(200)	Flow S.C.	Fine	60Kv 45Ma
MO	K	20.33	LiF(200)	Flow S.C.	Fine	60Kv 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 form the X-ray tube.

4.4.3.1 Calculation.

$$R = \frac{\lfloor I \rfloor Pb - \dfrac{\lfloor I \rfloor Pb\ (\text{Background I}) + \lfloor I \rfloor Pb\ (\text{Background II})}{2}}{\lfloor I \rfloor Mo}$$

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

4.4.4 Gas checking. Method A of ASTM method D 1643 shall be used.

4.4.5 Skinning. The jar shall be filled halfway with the varnish. The varnish shall be examined after 48 hours.

4.4.6 Brushing properties and appearance of dried film. The test panel shall be cold rolled steel.

4.4.7 Water resistance. Two sample panels shall be prepared as specified in ASTM D 1643, Method A, for gas checking and shall be dried for 48 hours. One of the panels shall be placed in a beaker containing approximately 65 mm (2.5 in) of distilled water at room temperature. The end of the panel which was uppermost during the drying period shall be immersed. The panel shall be left immersed in the water for 72 hours. After removal from the water, the panel shall be lightly sponged with a pad of cheese-cloth or cotton to remove excess water and allowed to dry for two hours, and the varnish shall be examined to determine compliance with the requirements of 3.3.8. The second

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panel shall be tested as above except that the distilled water shall be boiling and the immersion time shall be 15 minutes.

4.4.8 Self-lifting properties. Using a film applicator, apply the varnish to a wet-film thickness of .051 mm (.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 examine for compliance with the requirement in 3.3.10.

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

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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-pint metal cans, 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 shipping containers when lined with 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 one pint, one quart, and one 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 pounds 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

6.1 Intended use. Water-resisting spar varnish covered by this specification is intended to meet all the needs for a general utility varnish, suitable for both outside and inside exposure, where durability is the chief requisite and where initial hardness of the film is not required.

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) Selection of applicable levels of packaging and packing required (see 5.1 and 5.2).
(c) Size and type of container required (see 5.1.).

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6.3 Shelf life surveillance. For the purposes of shelf life surveillance, the varnish shall be examined for skinning, livering, curdling, hard caking, and gummy sediment. The varnish should easily remix to a smooth homogeneous state and should meet the viscosity and drying time requirements in table I and the color requirement specified in 3.3.4.

MILITARY CUSTODIANS:

Army - MR
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PREPARING ACTIVITY:

GSA - FSS

CIVIL AGENCY COORDINATING ACTIVITIES:

GSA - FSS, PCD

U.S. GOVERNMENT PRINTING OFFICE: 1978 - 261-423/1007

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