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TT-V-81G
March 7, 1978
SUPERSEDING
Fed. Spec. TT-V-81F
September 25, 1970

FEDERAL SPECIFICATION

VARNISH: MIXING, FOR ALUMINUM PAINT

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

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers a varnish suitable for mixing with aluminum paste to produce aluminum paint. This product is not intended to be used alone as a clear finish.

1.2 Classification.

1.2.1 Types. Aluminum mixing varnish in accordance with this specification shall be of the following types as specified hereinafter.

TYPE I - 120 percent rosin-pentaerythritol ester reduction (for priming wood).
TYPE II - 75 percent rosin-pentaerythritol ester reduction (for general 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 a 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 sub-

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scription 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:

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.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specified 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 1308 - Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
D 1544 - Color of Transparent Liquids (Gardner Color Scale).
D 1545 - Viscosity of Transparent Liquids by Bubble Time Method.
D 1639 - Acid Value of Organic Coating Materials.
D 1642 - Elasticity or Toughness of Varnishes.
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.)

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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 Materials. The materials shall consist of a combination of resinous substances and the necessary oils, together with additives, driers, and thinners, such that the resultant varnishes conform to the requirements stated herein for the type I or type II materials.

3.1.1 Solvent. The solvent, when tested as specified in 4.4.3, shall conform to the following requirements by volume:

(a) The total of solvents with olefinic or cyclo olefinic unsaturation shall not exceed 5 percent.
(b) The total of aromatic compounds with 8 or more carbon atoms in the molecule, except ethylbenzene, methyl benzoate, and phenyl acetate, shall not exceed 8 percent.
(c) The total of ethylbenzene, toluene,and branched-chain ketones shall not exceed 20 percent.
(d) A solvent which may be classified into more than one of the above groups shall be considered a member of the group having the lowest allowable concentration.
(e) The total of (a), (b), and (c) shall not exceed 20 percent.
(f) Benzene shall not exceed 0.5 percent.
(g) Halogenated solvents shall not be present.

3.2 Qualitative requirements.

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

3.2.2 Color. When tested as specified in table III, the varnish shall be no darker in color than the No. 18 tube of the Gardner Color scale.

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

3.2.4 Storage stability (partially full container). The varnish shall show no skinning or gummy sediment when tested as specified in 4.4.4.1, and shall readily remix to a smooth, homogenous state.

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3.2.5 Water resistance (type II only). The film of varnish shall show no whitening, dulling, blistering, or crow's footing when tested as specified in 4.4.5.

3.2.6 Aluminum paint properties. An aluminum paint prepared as specified in 4.4.6.1 shall meet the following requirements:

3.2.6.1 Working properties. When tested as specified in 4.4.6.2, the paint shall flow evenly.

3.2.6.2 Leafing properties and pigment distribution. When tested as specified in 4.4.6.3, the film of paint shall exhibit leafing properties and uniform pigment distribution.

3.2.6.3 Anchorage. When prepared and tested as specified in 4.4.6.4, the paint shall not separate from the substrate.

3.3 Quantitative requirements.

3.3.1 The varnish shall comply with the requirements in table I.

TABLE I. Quantitative requirements

	Requirements			
	Type I		Type II	
	Minimum	Maximum	Minimum	Maximum
Nonvolatile matter,percent by weight	55	---	50	---
Drying time:				
Set-to-touch, hours	1/2	6	1/2	4
Dry hard, hours	---	24	---	18
Viscosity, Gardner-Holdt tubes	C	E	C	E
Toughness, percent rosin-pentaester reduction	120	---	75	---
Acid number of nonvolatile matter	---	10	---	15
Calcium (as CaO), percent by weight of solids	---	0.1	---	0.1
Flash point (Setaflash)	30 deg. C	---	30 deg. C	---

3.4 Quantities. The varnish shall be furnished in 1-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.

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The lot size shall be the number of shipping containers in the end inspection lot. Packaging and packing shall be examined for the defects cited in table II. 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.

4.4 Test procedures.

4.4.1 The varnish shall be tested according to the procedures in table III. Unless otherwise specified, standard testing conditions, which are a temperature of 23 deg. +/- 1 deg. C and a relative humidity of 50 +/- 5 percent, shall be used.

TABLE III.

		Applicable Test Methods		
Characteristics	Required Reference	Fed. Test Method Std. No. 141	ASTM Method	Paragraph Reference
Nonvolatile content	Table I	----	D 1644 method A	-------
Drying time	Table I	4061	--------	-------
Viscosity	Table I	----	D 1545	-------
Toughness	Table I	----	D 1642 method A	-------
Acid number	Table I	----	D 1639	-------
Calcium content	Table I	----	--------	4.4.2
Flash point	Table I	----	D 3278	-------

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TABLE III. (cont'd.)

Characteristics	Required Reference	Applicable Test Methods: Fed. Test Method Std. No. 141	ASTM Method	Paragraph Reference
Solvent analysis	3.1.1	7356, 5132	D 3272	4.4.3
Condition in container	3.2.1	3011	--------	-------
Color	3.2.2	----	D 1544	-------
Appearance	3.2.3	4261	--------	-------
Storage stability: Partially full container	3.2.4	3021	--------	4.4.4
Water resistance	3.2.5	----	D 1308	4.4.5
Aluminum paint properties:				
Working properties	3.2.6.1	----	--------	4.4.6.2
Leafing properties and pigment distribution	3.2.6.2	----	--------	4.4.6.3
Anchorage	3.2.6.3	6304	--------	4.4.6.4

4.4.2 Calcium (as CaO).

4.4.2.1 Sample preparation. Weigh to the nearest mg. 1.0 g of the thoroughly mixed sample into a 50-ml volumetric flask. Dilute the sample to the mark with spectrographic-grade methyl isobutyl ketone (MIBK) [1].

4.4.2.2 Standard preparations. Prepare a 5000 ppm organic calcium standard solution [2]. In addition, prepare the following working standards. Dilutions shall be made using spectrographic-grade MIBK.

(1) Pipette 1.0 ml of the 5000 ppm calcium standard solution into a 100 ml volumetric flask and dilute to the mark to make a 50 ppm standard solution.

(2) Pipette 1.0, 5.0, and 10.0 ml of the 50 ppm standard solution into three separate 50 ml volumetric flasks and dilute to the mark to get standards with concentrations of 1, 5, and 10 ppm of calcium, representing concentrations of 0.00017 percent CaO, 0.00087 percent CaO, and 0.00173 percent CaO, respectively.

4.4.2.3 Equipment. An atomic absorption spectrophotometer with a calcium hollow cathode lamp, nitrous oxide burner, and background correction.

[1] A suggested source for spectrographic MIBK is Burkick and Jackson Laboratories, Inc., 1953 S. Harvey Street, Maskegon, MI 49442.
[2] A suggested source for 5000 ppm organic calcium standard solution is Conostan Division, Continental Oil Company, P.O. Box 1267, Ponca City, OK 74601.

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4.4.2.4 Procedure. Set up the atomic absorption unit to analyze for calcium using background correction. The changes in the method are the atomization of MIBK into the flame to set the zero, and the use of the nitrous oxide burner. After the unit has been set to its optimum, run the samples and standards and take the readings. If any sample has a higher reading than the highest standard, it shall be diluted with MIBK to get it into the range of the standards.

4.4.2.5 Data reduction. Plot the readings from the atomic absorption unit for the standards versus the known concentrations of the standards (see 4.4.2.2) on graph paper, and draw the resulting curve. Using this curve, the reading from the atomic absorption unit for the sample can be used to determine the percent CaO in the diluted sample. The percent by weight of solids of CaO in the original sample can then be determined by the following equation.

$$\text{Percent CaO in original} = \frac{\text{(percent CaO in diluted sample) (dilution factor)}}{\text{(percent solids as a decimal) (sample weight)}}$$

The dilution factor is the weight (in g) of the MIBK needed to dilute the sample. Unless additional MIBK is needed (as noted in 4.4.2.4), the normal amount of MIBK used will be 50 ml and the dilution factor for 50 ml is 40.05.

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, 4.4.3.4, and 4.4.3.5 to determine compliance with the 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 shall be followed. About 3 ul 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 follows:

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

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where: A = Percent of internal standard added (in this case, 20)
B = Areas 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)

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 in order to comply with the requirement of 3.1.1.

4.4.3.5 Benzene. When the solvent is tested in accordance with 4.4.3.3 the benzene peak shall be examined to determine compliance with the requirement of 3.1.1.

4.4.4 Storage stability (partially full container). Determine skinning of the varnish after 48 hours, in accordance with 3021 of Fed. Test Method Std. No. 141, and evaluate for compliance with 3.2.4.

4.4.5 Water resistance. 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. Place the panel in a nearly vertical position, not in the direct rays of the sun, in a well-ventilated room which is free from the products of combustion and laboratory fumes. Condition the panel for 1 week at standard conditions. Immerse the panel in water for 18 hours in accordance with ASTM D 1308, section 5.4. After removing the panel from the water and drying for 2 hours at standard conditions, examine the film for compliance with 3.2.5.

4.4.6 Aluminum paint properties.

4.4.6.1 Preparation of aluminum test paint. Prepare an appropriate quantity of aluminum paint by mixing the ingredients in the proportions given in table IV.

TABLE IV.

TT-P-320 Aluminum Paste	Paste, pounds	Varnish, gallons
Class 1, type II	1.25	1
Class 2, type II	2	1

Add the varnish gradually to aluminum paste conforming to type II (class 1 or 2) of TT-P-320 in the proportions given in table IV. The varnish is added in small amounts with vigorous stirring between additions until a uniform mixture is obtained. Let the mixed paint stand for 10 minutes at standard conditions.

4.4.6.2 Working 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, the 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. Examine for compliance with the requirement in 3.2.6.1.

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4.4.6.3 Leafing properties and pigment distribution. Spray a coat of paint on a clear glass panel cleaned as specified in method 2021 of Fed. Test Method Std. No. 141. Allow the paint film to air-dry for 24 hours at standard conditions and examine for compliance with the requirement in 3.2.6.2.

4.4.6.4 Anchorage. 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 or razor blade, test the coated panel in accordance with method 6304 of Fed. Test Method Std. No. 141 in order to determine compliance with the requirements in 3.2.6.3.

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-gallon metal cans, as specified (see 6.2). The metal cans shall meet or exceed the requirements of DOT Specifications under 49 CFR 178.

5.1.2 Commercial. The varnish shall be packaged in cans, 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. 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 a waterproof barrier material. The barrier material shall be sealed at the edges with waterproof tape or adhesive.

5.2.2 Commercial. The one gallon of 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 truck-load, 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

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6.1 Intended use. This specification covers a varnish suitable for mixing with aluminum paste, on the job, to make aluminum paint. The varnish is not intended to be used alone as a clear finish. It is not necessarily the best vehicle for ready-mixed paint. Type I varnish is intended for use as the vehicle for aluminum paint for the priming of exterior wood. Type II varnish is intended for making a general purpose paint suitable for use on such surfaces as metal, properly cured concrete, and plaster, for exterior and interior use. Aluminum paint made with either type of varnish may be sprayed if the product is adjusted to a suitable consistency. Usually about 1 pint of volatile thinner to the gallon of paint is sufficient for this purpose.

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) Type of aluminum mixing varnish required (see 1.2).
(c) Size and type of container required (see 5.1).
(d) Selection of applicable levels of packaging and packing required (see 5.1).
(e) Marking required (see 5.1).

6.3 Shelf-life surveillance. For the purpose of shelf-life surveillance, the varnish stored in the original, unopened container shall show no skinning, livering, curdling, hard or dry caking, or gummy sediment, and shall readily remix to a smooth, homogeneous state. In addition, it shall meet the viscosity and drying time requirements in table I.

Military Coordinating Activity:

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