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March 30, 1976
SUPERSEDING
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January 24, 1973

FEDERAL SPECIFICATION

THINNER: DOPE AND LACQUER (CELLULOSE-NITRATE)

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. This specification covers one type of thinner for cellulose-nitrate based dopes and lacquers of the spraying type. The thinner is suitable for use where Air Pollution Regulations apply.

2. APPLICABLE DOCUMENTS

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

Federal Specifications:

TT-B-838 - Butyl Acetate; Normal (For Use In Organic Coatings).
TT-B-846 - Butyl Alcohol; Normal (Butanol) (For Use In Organic Coatings).
TT-I-710 - Isobutyl Acetate; (For Use In Organic Coatings).
TT-I-730 - Isobutyl Alcohol, (For Use In Organic Coatings).
TT-I-735 - Isopropyl Alcohol.
TT-L-32 - Lacquer, Cellulose Nitrate, Gloss For Aircraft Use.
TT-M-261 - Methyl Ethyl Ketone, Technical.
TT-N-95 - Naphtha; Aliphatic.
TT-T-548 - Toluene, Technical.
PPP-P-1892 - Paint, Varnish, Lacquer, and Related Materials; Packaging, Packing and Marking of.

Federal Standard:

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, Washington, DC, Atlanta, Chicago, Kansas City, MO, Fort Worth, 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 Specification

MIL-L-19537 - Lacquer, Acrylic-Nitrocellulose, Gloss (For Aircraft Use).

(Copies of Military Specifications and Standards required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

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 56 - Flash Point by Tag Closed Tester
D 233 - Polymerization Residue
D 853 - Hydrogen Sulfide and Sulfur Dioxide
D 1296 - Odor of Volatile Solvents and Diluents
D 1364 - Water in Volatile Solvents
D 1476 - Heptane Miscibility of Lacquer Solvents
D 1616 - Copper Corrosion by Mineral Spirits

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

County of Los Angeles - Air Pollution Control District:

Rule 66 - Organic Solvents

(Application for copies should be addressed to the County of Los Angeles, Air Pollution Control District, 434 South San Pedro Street, Los Angeles, CA 90013.)

3. REQUIREMENTS

3.1 Materials. The thinner shall be formulated from the ingredients specified in table I, and shall comply with the quantative requirements specified in table II.

3.1.1 The manufacturer shall submit the formula of the thinner which complies with all the requirements as specified (see 3.1). A sample thinner shall be supplied for testing (see 6.2).

TABLE I. Composition

Ingredients	Federal Specifications
Butyl Acetate; Normal	TT-B-838
Butyl Alcohol; Normal	TT-B-846
Isobutyl Acetate	TT-I-710
Isobutyl Alcohol	TT-I-730
Methyl Ethyl Ketone	TT-M-261
Isopropyl Alcohol	TT-I-735
Naphtha, Aliphatic	TT-N-95
Toluene, Technical	TT-T-548

3.2 Quantitative requirements.

3.2.1 Composition. The manufacturer is given latitude in the selection of solvents or blend of solvents (see 3.1), provided the material meets the requirements in this specification and the quantitative requirements specified in table II. The thinner shall have a flash point of not less than 27°C (80°F).

TABLE II. Constituents allowable

Constituents	Percent; maximum by volume
1 Compounds with olefinic or cycloolefinic unsaturation	5
2 Aromatic compounds with 8 or more carbon atoms except ethylbenzene	8
3 Ethylbenzene and Toluene	20
4 Total of compounds in 2 plus 3	20
5 Branched-chain ketones	Negative Test

3.3 Qualitative requirements.

3.3.1 Condition in container. A freshly-opened full container of the thinner, when tested as in 4.3.1, shall be clear, free from suspended matter, and shall not show any evidence of corrosion or rust in the container.

3.3.2 Appearance. When examined by transmitted light as specified in 4.3.2, the thinner shall be free from haze, turbidity, hair grain, gel bodies or other insoluble matter.

3.3.3 Color. When tested as in 4.3.3, the color of the thinner shall not be darker than a solution of 0.003 gram reagent-quality potassium dichromate in one liter of distilled water.

3.3.4 Odor. When tested as in 4.3.4, the odor of the thinner shall not be obnoxious, and after drying the thinner shall not leave residual odor.

3.3.5 Storage stability (shelf life). The thinner, when tested as in 4.3.5, shall remain clear and free from any suspended matter.

3.3.6 Aromatic hydrocarbons. When tested as specified in 4.3.6, there shall be no evidence of unpolymerized residue.

3.3.7 Copper corrosion. The thinner shall produce no marked blackening or iridescence when tested as specified in 4.3.7.

3.3.8 Spot test. When tested as specified in 4.3.8, the thinner shall leave no stain or oily spot on the filter paper.

3.3.9 Sulfur test. The thinner shall be free from sulfur in any form when tested as specified in 4.3.9.

3.3.10 Water test. The thinner shall show no turbidity when tested as specified in 4.3.10.

3.3.11 Miscibility and compatibility. When tested as specified in 4.3.11, the thinner shall be miscible and compatible with nitrocellulose lacquer conforming to TT-L-32, and with nitrocellulose-acrylic lacquer conforming to MIL-L-19537.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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 that supplies and services conform to prescribed requirements.

4.1.1 Classification of inspection. Inspection shall be classified as follows:

(a) Production inspection of the thinner.
(b) Inspection of preparation for delivery.

4.2 Sampling and inspection. Sampling and inspection shall be in accordance with method 1031 of Fed. Test Method Std. No. 141.

4.3 Test procedures. The thinner shall be tested in accordance with the following applicable methods of Fed. Test Method Std. No. 141 or as otherwise indicated in table III, and as hereinafter specified. Make the determinations on the samples as received.

TABLE III. Index

Characteristic	Requirement Reference	Fed. Test Method Std. No. 141	ASTM	Paragraph Reference
Condition in container	3.3.1	3011	----	4.3.1
Appearance	3.3.2	----	----	4.3.2
Color	3.3.3	4247	----	4.3.3
Odor	3.3.4	----	D 1296	4.3.4
Storage stability	3.3.5	3022	----	4.3.5
Aromatic hydrocarbons test	3.3.6	----	----	4.3.6
Copper corrosion	3.3.7	----	D 1616	4.3.7
Spot test	3.3.8	4491	----	4.3.8
Sulfur test	3.3.9	----	D 853	4.3.9
Heptane miscibility of Lacquer solvents	3.3.10	----	D 1476	4.3.10
Miscibility and compatibility	3.3.11	4209	----	4.3.11
Composition of the thinner or solvent	Tables I and II	----	----	4.3.12
Flash point	3.2.1	----	D 56	4.3.13

4.3.1 Condition in container. Open the container as received and evaluate for compliance with 3.3.1 in accordance with method 3011, paragraph 4.1.2, of Fed. Test Method Std. No. 141. Also evaluate the container for rusting, etc.

4.3.2 Appearance. Pour a portion of the thinner as received into a clean test tube or graduated cylinder, and evaluate for compliance with 3.3.2.

4.3.3 Color. Determine the color in accordance with method 4247 of Fed. Test Method Std. No. 141, using a solution of 0.003 gram of reagent-grade potassium dichromate. Evaluate for compliance with 3.3.3.

4.3.4 Odor. Observe the odor of the lacquer in a freshly opened can, during application, and of a dried film in accordance with method 4401 of Fed. Test Method Std. No. 141. Evaluate for compliance with 3.3.4.

4.3.5 Storage stability. Store the thinner in a glass jar in accordance with method 3022 of Fed. Test Method Std. No. 141 for 12 months. At the end of the period, examine and evaluate for compliance with 3.3.5.

4.3.6 Aromatic hydrocarbon determination (qualitative). A thinner shall be prepared in accordance with the manufacturer's submitted formula using ingredient materials which conform to specification requirements listed herein. Duplicate determinations of the prepared thinner and sample thinner shall be conducted as follows: Mix a 50-ml portion of the thinner with 50 ml of sulfuric acid (80 ml of concentrated sulfuric acid, specific gravity 1.84, and 20 ml of distilled water) in a 100-ml ground glass stoppered graduated cylinder. (Cool the acid before adding to prevent possible excessive heat of reaction.) Thoroughly mix the thinner and acid in the cylinder and allow to stand overnight, or until the mixture separates into two clear and distinct layers. Sulfonate 5 ml of the top layer using ASTM method D 233. Evaluate for compliance with 3.3.6.

4.3.7 Copper corrosion test. Run the test in accordance with method 5101 of Fed. Test Method Std. No. 141, and evaluate for compliance with 3.3.7.

4.3.8 Spot test. Determine the spotting characteristics of the thinner in accordance with method 4491 of Fed. Test Method Std. No. 141, and evaluate for compliance with 3.3.8.

4.3.9 Sulfur test. In accordance with method 5311 of Fed. Test Method No. 141, determine the presence of sulfur compounds in the thinner, and evaluate for compliance with 3.3.9.

4.3.10 Water test. Determine the water content of the thinner in accordance with method 4083 of Fed. Test Method Std. No. 141, and evaluate for compliance with 3.3.10.

4.3.11 Miscibility and compatibility. Determine the compatibility of the thinner with nitrocellulose lacquer and nitrocellulose-acrylic lacquer in accordance with method 4209 of Fed. Test Method Std. No. 141, and evaluate for compliance with 3.3.11.

4.3.12 Analysis of the thinner or solvent as received for compliance with table I.

4.3.12.1 Determination of aromatic hydrocarbons.

Apparatus: A gas chromatograph equipped with a thermal conductivity detector.

Column preparation: Two lengths of 6.25 mm (1/4-inch) stainless steel tubing, 1.83 m (6 ft) and 5.48 m (18 ft) long, packed with 35 percent N,N-Bis(2-cyanoethyl) formamide on 60- to 80-mesh Chromosorb P.

Operating conditions:

	1.83 m	5.48 m
Detector cell temperature, °C	300	300
Detector cell current, ma.	150	150
Injection port temperature, °C	300	300
Helium flow at exit, cc/minute	175	110
Column temperature, °C	125	70

4.3.12.1.1 Aromatic and oxygenated solvents - procedure A. Install the 1.83 m column and follow the operating conditions described above. Inject about 3 microliters of the isolated distillate and scan the chromatogram. 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, select an internal standard that will be free of interference, such as cyclopentanol or cyclohexanol. Add 0.6 ml of internal standard to 3 ml of the distillate, analyze according to the above procedure. Peaks emerging after 1 minute are aromatic solvents along with any oxygenated solvents that may be present. Calculate the percentage of aromatic and oxygenated solvents as follows:

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

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. The calibration 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).

NOTE: If the above determination exceeds 8 percent, continue with the following procedure:

4.3.12.1.2 Total aromatic content - procedure B. Place 5 ml of the distillate in a 10-ml glass-stoppered graduate. Add 5 ml of 85 percent sulfuric acid slowly while the graduate is being cooled with tap water. After the acid has been added, shake vigorously for 2 minutes, then allow the layer to separate. Remove as much of the top layer as possible and wash with distilled water. Carefully pipet 3 ml of the washed solvent into a small flask, followed by 0.6 ml of the internal standard. Mix and analyze according to procedure A. Calculate the percent of aromatics after acid treatment in the same manner as in procedure A, and the percent of total aromatic solvents as follows:

$$\text{Percent total aromatic solvents, v/v} = \frac{B \times (100-A)}{100-B}$$

where A = percent of aromatic and oxygenated solvents from procedure A.
B = percent of aromatic content of the solvent after acid treatment.

NOTE: If the total aromatic content of the solvent is between 8 percent and 20 percent, continue with the following procedure:

4.3.12.1.3 Toluene and ethylbenzene - procedure C. Install the 5.48 m column and follow the operating conditions described for that column. Add 0.3 ml of high purity benzene to the 3 ml sample used in procedure A. If the results of procedures A and B indicated the presence of oxygenated solvents, treat this sample with 85 percent sulfuric acid (use 3 ml acid) as described in procedure B. Inject about 3 microliters of sample and allow the chromatograph to develop until all of the xylene isomers appear. Purge that column by raising the column temperature to 120° ± 1°C (248° ± 2°F). After the high boiling materials emerge, reset the column temperature to 70° ± 1°C (176° ± 2°F). Calculate the percent of toluene and ethylbenzene as follows:

$$\text{Percent toluene, v/v} = \frac{A \times B \times C}{D}$$

$$\text{Percent ethylbenzene, v/v} = \frac{E \times B \times C}{D}$$

where A = area of the toluene peak.
B = calibration factor for the internal standard. The calibration factor is dependent on the internal standard used and performance of the chromatograph, and should be determined daily.
C = percentage of internal standard added (in this case, 10).
D = area of the internal standard (in this case, benzene).
E = area of the ethylbenzene peak.

NOTE: The sensitivity of the instrument should be adjusted to keep peak from running off the scale. Appropriate corrections must be made for changes in sensitivity when computing the peak area.

4.3.12.1.4 Test for olefinic or cyclo-olefinic compounds. Take 2 test tubes and place 2 drops of the distillate in each. Dissolve the first sample in 1 ml of carbon tetrachloride and add 1 drop of 1 percent bromine in carbon tetrachloride. Shake and allow to sit for 5 minutes. A positive test is indicated by the complete absence of yellow color when observed against a white background. Dissolve the second sample in 1 ml of acetone and add 1 drop of 1 percent permanganate solution (1 gram of potassium permanganate crystals in 95 ml of acetone and 5 ml of water). Shake and allow to sit for 2 minutes. A positive test is indicated by the decolorization of the purple solution. Evaluate for conformance with Table II.

4.3.12.1.5 Test for ketones.

4.3.12.1.5.1 Reagent. Mix carefully two grams of 2,4-dinitrophenylhydrazine, 4 ml of concentrated sulfuric acid, 30 ml methanol, and 10 ml water.

4.3.12.1.5.2 Procedure. Pipet 1 ml of reagent into a small test tube. Add 10 drops of thinner and shake for 30 seconds. A yellow precipitate or cloud in the reagent layer indicates the presence of ketones. Run a blank using 1 ml of reagent and 10 drops of mineral spirits. Evaluate for conformance with 3.1.1.

4.3.13 Flash point. Determine flash point of the thinner in accordance with ASTM D 56, and evaluate for conformance with 3.2.1.

4.3.14 Inspection of preparation for delivery. The packaging, packing, and marking of the thinner or solvent shall be inspected to determine conformance to the requirements of section 5 of this specification and PPP-P-1892.

5. PREPARATION FOR DELIVERY

5.1 The thinner shall be packaged, packed, and marked in accordance with PPP-P-1892. The level of packaging shall be A, B, or C, and the level of packing shall be A, B, or C as specified (see 6.1). The thinner shall be furnished in 1-pint, 1-quart, or 1-gallon metal cans, 5-gallon steel pails, or 55-gallon metal drums, as specified (see 6.1).

5.1.1 Precautionary marking. Each individual container of thinner shall be additionally marked as follows: "This thinner contains highly volatile solvent. Avoid prolonged breathing of vapors. Provide good ventillation when using. Keep thinner away from open flame."

6. NOTES

6.1 Intended use. The thinner described is primarily intended for use with lacquers and dopes. There are many new synthetic resins which are incompatible with this thinner, and compatibility tests before use are recommended.

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) Size of containers in which the thinner is to be furnished.
(c) Level of packaging and packing required.
(e) A sample of thinner shall be supplied to the contracting officer.

6.3 Basis of purchase. The material shall be purchased by volume, the unit being a U.S. Gallon (3.785 liters) at 15°C (60°F).

MILITARY COORDINATING ACTIVITY:

ARMY - MR

Custodians:

Army - MR
Navy - SH
Air Force - 84

Review activity:

GI, ME, DS

User activity:

MC, MI

Civil Agency Coordinating Activity:

GSA-FSS

Preparing activity:

GSA-FSS

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