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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3167A

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Superseding AMS 3167

Submitted for recognition as an American National Standard

Solvents, Cleaning for Cleaning Prior to Application of Primer and Top Coat Materials

1. SCOPE:

1.1 Form:

This specification covers liquid solvent cleaners.

1.2 Application:

These solvent cleaners have been used typically for cleaning aircraft primary and secondary structural surfaces prior to application of primer materials and for cleaning primed surfaces prior to application of top coat materials, but usage is not limited to such applications.

1.3 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2470 Anodic Treatment of Aluminum Alloys, Chromic Acid Process
AMS 2473 Chemical Treatment for Aluminum Alloys, General Purpose Coating

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7161 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS: http://www.sae.org

2.1 (Continued):

AMS 3276	Sealing Compound, Integral Fuel Tanks and General Purpose, Intermittent Use to 360 °F (182 °C)
AMS 3819	Cloths, Cleaning, for Aircraft Primary and Secondary Structural Surfaces
AMS 4037	Aluminum Alloy Sheet and Plate 4.4Cu - 1.5Mg - 0.60Mn (2024; -T3 Flat Sheet, -T351 Plate) Solution Heat Treated
AMS 4045	Aluminum Alloy Sheet and Plate 5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr 7075: (-T6 Sheet, -T651 Plate) Solution and Precipitation Heat Treated
AMS 4101	Aluminum Alloy Plate, 4.4Cu - 1.5Mg - 0.60Mn (2124 -T851) Solution Heat Treated, Stretched, and Precipitation Heat Treated
AMS 4202	Aluminum Alloy Plate, 5.7Zn - 2.2Mg - 1.6Cu - 0.22Cr (7075-T7351) Solution Heat Treated, Stress Relieved by Stretching, and Precipitation Heat Treated
AMS 4911	Titanium Sheet, Strip, and Plate 6A1 - 4V, Annealed
AMS 5046	Sheet, Strip, and Plate Carbon Steel (SAE 1020 and 1025) Annealed
AMS 6419	Steel Bars, Forgings, and Tubing, 1.6Si - 0.82Cr - 1.8Ni - 0.40Mo - 0.08V (0.40-0.45C), Consumable Electrode Vacuum Remelted

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 56	Flash Point by Tag Closed Tester
ASTM D 740	Methyl Ethyl Ketone
ASTM D 1193	Reagent Water
ASTM D 1353	Nonvolatile Matter in Volatile Solvents for Use in Paint, Varnish, Lacquer, and Related Products
ASTM D 1364	Water in Volatile Solvents (Fischer Reagent Titration Method)
ASTM D 1475	Density of Paint, Varnish, Lacquer, and Related Products
ASTM D 1613	Acidity in Volatile Solvents and Chemical Intermediates Used in Paints, Varnish, Lacquer, and Related Products
ASTM D 2344	Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short-Beam Method
ASTM D 3278	Flash Point of Liquids by Setaflash-Closed-Cup Apparatus
ASTM D 3359	Measuring Adhesion by Tape Test
ASTM D 3545	Alcohol Content and Purity of Acetate Esters by Gas Chromatography
ASTM D 3960	Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM F 483	Total Immersion Corrosion Test for Aircraft Maintenance Chemicals
ASTM F 502	Effects of Cleaning and Chemical Maintenance Materials on Painted Aircraft Surfaces
ASTM F 519	Mechanical Hydrogen Embrittlement Testing of Plating Processes and Aircraft Maintenance Chemicals
ASTM F 1110	Sandwich Corrosion Test
ASTM G 38	Making and Using C-Ring Stress-Corrosion Cracking Test Specimens

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-PRF-23377	Primer Coatings: Epoxy, High Solids
MIL-C-22750	Coating, Epoxy, High Solids
MIL-PRF-85285	Coating, Polyurethane, High Solids
MIL-PRF-85582	Primer Coatings: Epoxy, Waterborne
FED-STD-595	Colors Used In Government Procurement
FED-STD-1313	Material Safety Data Sheets, Preparation of
MIL-STD-290	Packaging of Petroleum and Related Products

3. TECHNICAL REQUIREMENTS:

3.1 Material:

The cleaning solvent shall be a liquid formulated to meet the requirements of this specification. The formulation shall not contain halogenated solvents, ozone depleting chemicals, or excessive hazardous air pollutants as defined and regulated by the United States Environmental Protection Agency. Purchaser shall specify requirements for vapor pressure, volatile organic compound (VOC) content, and flash point as required to meet local air quality and use requirements.

3.1.1 The supplier shall state whether or not the cleaner contains any Volatile Organic Compounds (VOC) or Hazardous Air Pollutants (HAP), as defined or listed by the Clean Air Act. If the cleaner contains no VOCs or HAPs, it is not regulated by the Clean Air Act. If it does, the supplier shall state whether the cleaner meets the Composition category definition in the Aerospace NESHAP. If the cleaner is not a Composition category cleaner, but contains some VOCs or HAPs, the supplier shall report the vapor pressure of the cleaner at 68 °F (20 °C).

3.2 Properties:

The cleaning solvent shall conform to the requirements found in Table 1.

TABLE 1 - Properties

Paragraph	Property	Requirement	Test Method
3.2.1	Composition	Same as data determined on preproduction test sample	4.5.5
3.2.2	Density	±0.5% of preproduction test value	ASTM D 1475
3.2.3	Acidity	0.05% maximum, expressed as acetic acid	ASTM D 1613
3.2.4	Vapor Pressure, mm Hg	Report	4.5.6
3.2.5	VOC, grams/L	Report	4.5.7
3.2.6	Flash Point	Report	ASTM D 3278 or ASTM D 56
3.2.7	Visible Dry Residue	No more residual contamination and/or streaking than the control solvent	4.5.8
3.2.8	Nonvolatile Matter	10 mg/100 mL, max	4.5.9
3.2.9	Stress Corrosion	No corrosion	4.5.10
3.2.10	Sandwich Corrosion	Shall not cause a corrosion rating greater than one on any test panel	ASTM F 1110
3.2.11	Total Immersion Corrosion	Weight change no more than 0.03 mg/sq cm/24 hours no pitting, corrosion, or heavy stain	4.5.11
3.2.12	Hydrogen Embrittlement	No rupture of specimens	ASTM F 519, Type 1a notched bars
3.2.13	Cleaning Efficiency	No separation of primer from substrate or separation of top coat from primer	4.5.12
3.2.14	Effects on Painted Surfaces	No more deterioration than with the control solvent	4.5.13
3.2.15	Effects on Fuel Tank Sealants	No more deterioration than with the control solvent	4.5.14
3.2.16	Effects on Carbon/Epoxy Composites	Solvent shall not cause a greater loss in interlaminar shear strength than the control solvent	4.5.15
3.2.17	Appearance	All components shall be miscible	4.5.16

3.3 Quality:

The cleaning solvent, as received by purchaser, shall be uniform in quality and condition, and free from foreign materials and from other contaminants detrimental to usage of the product.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The manufacturer of the cleaning solvent shall supply all samples and shall be responsible for performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the cleaning solvent conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Requirements in Table 2 are acceptance tests and shall be performed on each lot.

TABLE 2 - Acceptance Tests

Requirement	Test Method
Composition	4.5.5
Flash Point	ASTM D 3278 or ASTM D 56
Density	ASTM D 1475
Acidity	ASTM D 1613
Visible Dry Residue	4.5.8
Nonvolatile Matter	ASTM D 1353
Appearance	4.5.16

4.2.2 Preproduction Tests: All technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of cleaning solvent by the manufacturer when a change in ingredients and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 For direct U.S. Military procurement and for procurement for use on U.S. Military contracts, material shall be a product which has been tested, has passed the qualification tests of 4.2.2 (See 8.2), and has been listed or approved for listing on the applicable U.S. Military qualified products list (QPL).

4.3 Sampling and Testing:

Shall be as follows:

4.3.1 For Acceptance Tests: Sufficient cleaning solvent shall be taken at random from each lot to perform all required tests. The number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three.

4.3.1.1 A lot shall be all cleaning solvent produced in a single production run from the same batch of raw materials under the same fixed conditions and presented for manufacturer's inspection at one time. A lot of cleaning solvent shall not exceed 10,000 gallons (37,850 L).

4.3.1.2 A statistical sampling plan acceptable to purchaser and supplier may be used in lieu of sampling as in 4.3.1.

4.3.2 For Preproduction Tests: As agreed upon by purchaser and supplier.

4.4 Approval:

4.4.1 Preproduction sample of cleaning solvent shall be approved by purchaser before cleaning solvent for production use is supplied, unless such approval be waived by purchaser. Results of tests on production cleaning solvent shall be essentially equivalent to those on the approved sample.

4.4.1.1 For direct U.S. Military procurement and for procurement for use on U.S. Military contracts, the material shall be listed, or approved for listing, on the applicable U.S. Military qualified products list (QPL).

4.4.2 Manufacturer shall use ingredients, manufacturing procedures, processes, and methods of inspection on production cleaning solvent which are essentially the same as those used on the approved sample. If necessary to make any change in ingredients, in type of equipment for processing, or in manufacturing procedures, manufacturer shall submit for reapproval a statement of the proposed changes in ingredients and/or processing and, when requested, a sample of cleaning solvent. Production cleaning solvent made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Standard Conditions: Standard laboratory conditions are 77 °F ± 2 (25 °C ± 1) and 50% ± 5 relative humidity. All test specimens shall be prepared and cured under these conditions. Testing shall be conducted at a temperature of 77 °F ± 5 (25 °C ± 3) without humidity control.

4.5.2 Control Cleaning Solvent: The control solvent shall be ASTM D 740 methyl ethyl ketone.

4.5.3 Standard Contaminant: Standard contaminant shall be formulated as shown in Table 3.

TABLE 3 - Standard Contaminant

Ingredient	Parts by Weight
Glycerol Monosterate	3.0
Glycerol Trioleate	9.0
Caprylic Acid	3.0
Lauryl Alcohol	1.3
Cholesterol	1.2
Mineral Oil	2.7
Petrolatum	3.0
Lecithin	0.3
Water	70.0

Notes: Heat and blend and add 0.5% parts by weight lamp black
Do not heat above 200 °F (93 °C)

4.5.4 Test Panels: Test panels shall be 0.020 x 3.00 x 6.00 inches (0.51 x 76 x 152 mm) fabricated from AMS 4037 aluminum alloy. Type A panels shall have chemical film applied in accordance with AMS 2473. Type B panels shall be anodized according to AMS 2470. Type C panels shall be Type A panels primed with MIL-PRF-23377 primer. Type D panels shall be Type A panels primed with MIL-PRF-85582 primer.

4.5.5 Composition: Determine the composition of the cleaning solvent in accordance with ASTM D 3545 modified to apply to the solvent used in the material. Use a 10% FFAP Chromasorb 10 foot (3.05 m) column or equivalent. Determine the water content using method ASTM D 1364.

4.5.6 Vapor Pressure: The vapor pressure of the volatile organic compounds (VOC) in the solvent at 68 °F (20 °C) shall be calculated from Equation 1.

$$P_{VOC} = \frac{\sum_{i=1}^{n} \left(\frac{Pi \times Wi}{Mi}\right)}{\sum_{i=1}^{n} \left(\frac{Wi}{Mi}\right) + \sum_{j=i}^{m} \left(\frac{Wj}{Mj}\right)} \qquad \text{(Eq. 1)}$$

Basis: 68 °F (20 °C), consistent units

where:

P_{voc} = Calculated composite vapor pressure of volatile organic compounds (VOC) in the cleaning solvent at 68 °F (20 °C)
P_i = Vapor pressure of the pure "i" th component at 68 °F (20 °C)
$W_{i,j}$ = Weight in grams of the "i" th or "j" th component
$M_{i,j}$ = Molecular weight of the "i" th or "j" th component
i = Indicates VOC components in the cleaning solvent
j = Indicates exempt components in the cleaning solvent as defined by appropriate Federal, state, and local regulations
n = Number of VOC components
m = Number of exempt components

4.5.7 VOC Content: VOC content shall be calculated in accordance with ASTM D 3960 and expressed in grams per liter.

4.5.8 Visible Dry Residue: Clean two AMS 4037 aluminum alloy panels with the control solvent (4.5.2) using AMS 3819, Grade A, cloth. Apply 5 mL of the solvent cleaner under test to a pad 2 x 2 inches (51 x 51 mm) made with eight layers of AMS 3819, Grade A, cloth. Immediately clean one of the precleaned panels using gentle finger pressure and vigorous wiping speed for 15 seconds. Using the same cleaning technique, clean the second precleaned panel, using a new pad, and the control solvent (4.5.2). Allow both panels to air dry 30 minutes. Examine both panels visually for residual contamination and/or streaking.

4.5.9 Nonvolatile Matter: Nonvolatile matter content shall be determined as specified by ASTM D 1353 except that a hot plate shall be used to boil the sample to near dryness and the sample shall then be dried to constant weight in an oven at 392 °F ± 2 (200 °C ± 1).

4.5.10 Stress Corrosion: C-ring stress corrosion test shall be conducted as specified in ASTM G 38 using AMS 4101 aluminum alloy, AMS 4202 aluminum alloy, and AMS 6419 steel stressed to 75% of yield. Exposure shall be 2000 hours immersed in the cleaning solvent.

4.5.11 Total Immersion Corrosion: Total immersion corrosion tests shall be conducted according to ASTM F 483 on AMS 4037 aluminum, AMS 4045 aluminum, AMS 4911 titanium, and AMS 5046 steel.

4.5.12 Cleaning Efficiency: Apply standard contaminant (4.5.3) to six Type A, Type B, Type C, and Type D test panels (See 4.5.4) and expose to 120 °F ± 2 (49 °C ± 1) for 24 hours ± 2. Cool to room temperature and wipe panel surface to remove gross contaminant with AMS 3819, Grade A cleaning cloth. Wet a clean AMS 3819, Grade A cleaning cloth with cleaning solvent and wipe panel surfaces five times using a clean wet cloth each time. Air dry panels a minimum of 30 minutes at standard conditions. Apply MIL-PRF-23377 and MIL-PRF-85582 primers to three each Type A and Type B panels. Apply MIL-C-22750 and MIL-PRF-85285 (FED-STD-595 color 17925 - gloss white) top coats to three each Type C and Type D panels. Conduct wet tape adhesion test as specified in ASTM D 3359 after four days immersion in ASTM D 1193 Type IV distilled water at 120 °F ± 5 (49 °C ± 3).

4.5.13 Effects on Painted Surfaces: Apply MIL-C-22750 and MIL-PRF-85285 (FED-STD-595 color 17925 - gloss white) top coats to two each Type C and Type D panels (See 4.5.4). Subject one panel each of the top coated panels and one panel each Type C and Type D panels to the test specified in ASTM F 502 using the candidate test cleaner as the test solution. Repeat the test using the control solvent (See 4.5.2) as the test solution.

4.5.14 Effects on Fuel Tank Sealants: Using fuel tank sealant qualified to AMS 3276 B-2, prepare two panels as specified in paragraph 4.5.28 of AMS 3276 except delete primer and top coat application. Allow sealant to cure 14 days ± 2 under standard conditions (See 4.5.1). Immerse one panel in the candidate test cleaner in such a manner that one-half of the panel is exposed to the liquid phase and one-half of the panel is exposed to the air-cleaner vapor phase for 24 hours ± 2 at 75 °F ± 5 (25 °C ± 2). Expose the other panel in like manner using the control solvent (See 4.5.2). After exposure, remove the panels and observe the sealant for any signs of deterioration such as softening, blistering, loss of adhesion, etc.

4.5.15 Effects on Carbon/Epoxy Composites: A sheet of carbon/epoxy laminate with parallel fibers shall be prepared as specified by ASTM D 2344 using standard processing procedures, i.e. press, bag, or autoclave. The sheet shall then be cut into three sets of ten specimens each as specified in ASTM D 2344. Immerse one set of specimens in the test solvent for 24 hours ± 2 at 75 °F ± 5 (25 °C ± 2). Immerse another set of specimens in the control solvent for 24 hours ± 2 at 75 °F ± 5 (25 °C ± 2). Retain the third set for dry controls. Determine shear strengths of the immersed and dry specimens as specified by ASTM D 2344. Compare the loss of interlaminar shear strength by immersion in the test solvent with that of the control solvent.

4.5.16 Appearance: The sample taken from 4.3.1 shall be visually examined and shall be free of separation or colloidal dispersion.