

INCH-POUND  
MIL-C-87937B  
27 Jan 94  
Superseding  
MIL-C-87937A  
16 Oct 1991

## MILITARY SPECIFICATION

### CLEANING COMPOUND, AEROSPACE EQUIPMENT

This specification is approved for use by all  
Departments and Agencies of the Department of Defense

#### 1. SCOPE

1.1 Scope. This specification establishes the requirements for biodegradable, water dilutable, environmentally safe cleaning compounds for use on aerospace equipment to include aircraft, aerospace ground equipment (AGE) and AGE engines.

1.2 Classification. The cleaning compounds covered by this specification shall be of the following types.

Type I - Terpene Based, Solvent Emulsion, Water Dilutable Cleaning Compound

Type II - Water Dilutable Cleaning Compound

Type III - Gel-Type Cleaning Compound

Type IV - Heavy Duty, Water Dilutable Cleaning Compound

#### 2. APPLICABLE DOCUMENTS

##### 2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, noted in the solicitation.

#### SPECIFICATIONS

##### Federal

O-S-642	Sodium Phosphate, Tribasic, Anhydrous, Dodecahydrate, & Monohydrate, Technical
P-D-680	Dry Cleaning and Degreasing Solvent
QQ-A-250/4	Aluminum Alloy 2024, Plate and Sheet
QQ-A-250/5	Aluminum Alloy Alclad 2024, Plate and Sheet
QQ-A-250/12	Aluminum Alloy 7075, Plate and Sheet

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Code (68) SA-ALC/SFSP, 1014 Andrews Rd STE 1, Kelly AFB TX 78241-5603, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 6850

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

## MIL-C-87937B

QQ-P-416 Plating, Cadmium (Electrodeposited)  
 QQ-S-365 Silver Plating, Electrodeposited: General Requirements for  
 TT-E-529 Enamel, Alkyd, Semi-gloss, Low VOC Content  
 TT-E-781 Ethylene Glycol Monoethyl Ether, Technical  
 TT-I-735 Isopropyl Alcohol  
 TT-L-32 Lacquer, Cellulose Nitrate, Gloss, For Aircraft Use  
 TT-P-1757 Primer Coating, Zinc Chromate, Low Moisture Sensitivity  
 PPP-D-729 Drums, Shipping and Storage, Steel, 55 Gallon (208 Liters)  
 PPP-P-704 Pails, Metal: (Shipping, Steel, 1 through 12 gallons)

Military

MIL-L-2104 Lubricating Oil, Internal Combustion Engine, Tactical Service  
 MIL-P-5425 Plastic, Sheet, Acrylic, Heat Resistant  
 MIL-M-3171 Magnesium Alloy, Processes for Pretreatment and Prevention of Corrosion on  
 MIL-S-7952 Steel, Sheet and Strip, Uncoated, Carbon (1020 and 1025) (Aircraft Quality)(ASG)  
 MIL-P-7962 Primer Coating, Cellulose-Nitrate Modified Alkyl Type, Corrosion Inhibiting, Fast-Drying (For  
 Spray Application Over Pretreatment Coating)  
 MIL-C-8514 Coating Compound, Metal Pretreatment, Resin-Acid (ASG)  
 MIL-A-8625 Anodic Coatings, For Aluminum and Aluminum Alloys  
 MIL-S-8802 Sealing Compound, Temperature Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High  
 Adhesion  
 MIL-T-9046 Titanium and Titanium Alloy, Sheet, Strip and Plate  
 MIL-G-21164 Grease, Molybdenum Disulfide, For Low and High Temperatures  
 MIL-C-22750 Coating, Epoxy Polyamide  
 MIL-P-23236 Paint Coating System, Fuel Salt Water Ballast Tanks  
 MIL-P-23377 Primer Coating, Epoxy Polyamide, Chemical and Solvent Resistant  
 MIL-P-25690 Plastic, Sheets And Parts, Modified Acrylic Base, Monolithic, Crack Propagation Resistant  
 MIL-W-81381 Wire, Electric, Polyimide-Insulated, Copper or Copper Alloy  
 MIL-S-81733 Sealing and Coating Compound, Corrosion Inhibitive  
 MIL-C-83286 Coating Urethane, Aliphatic Isocyanate, for Aerospace Application  
 MIL-P-83310 Plastic Sheet, Polycarbonate, Transparent  
 MIL-C-83957 Cleaning and Polishing Pad, Non-metallic (For Aircraft)  
 MIL-C-85285 Coating: Polyurethane, High Solids

## STANDARDS

Federal

EPA-600-4-90-027 Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to  
 Freshwater and Marine Organisms  
 FED-STD-141 Paint, Varnish, Lacquer and Related Materials Methods of Inspection, Sampling and Testing  
 FED-STD-313 Material Safety Data Sheets, Preparation and the Submission of  
 FED-STD-595 Colors

Military

MIL-STD-109 Quality Assurance Terms and Definitions  
 MIL-STD-129 Marking For Shipment And Storage  
 MIL-STD-147 Palletized Unit Loads

## MIL-C-87937B

(Copies of specifications, standards, handbooks, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094)

**2.1.2 Other Government documents, drawings, and publications.** The following other Government documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issue shall be that in effect on the date of the solicitation.

#### CODE OF FEDERAL REGULATIONS

- 29 CFR - Labor
- 40 CFR - Protection of Environment
- 49 CFR - Transportation

(Application for copies should be addressed to Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.)

**2.2 Other publications.** The following non-government documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the non-government documents which is current on the date of the solicitation.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS

##### ASTM Standards

- A 153 Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
- D 56 Test Method for Flash Point by Tag Closed Tester
- D 92 Test Method for Flash and Fire Points by Cleveland Open Cup
- D 93 Standard Test Methods for Flash Point by Pensky-Closed Tester
- D 460 Method for Sampling and Chemical Analysis of Soaps and Soap Products
- D 1193 Specification for Reagent Water
- D 2240 Test Method for Rubber Property - Durometer Hardness
- D 3951 Practice for Commercial Packaging
- E 70 Test Method for pH of Aqueous Solutions with the Glass Electrode
- F 483 Method For Total Immersion Corrosion Test for Aircraft Maintenance Chemicals
- F 484 Test Method for Stress Cracking of Acrylic Plastics in Contact with Liquid or Semi-Liquid Compounds
- F 485 Test Method for Effects of Cleaners on Unpainted Aircraft Surfaces
- F 502 Test Method for Effects of Cleaning and Chemical Maintenance Materials on Painted Aircraft Surfaces
- F 519 Method for Mechanical Hydrogen Embrittlement Testing of Plating Processes and Aircraft Maintenance Chemicals
- F 1104 Test Method for Preparing Aircraft Cleaning Compounds, Liquid Type, Water Base, for Storage Stability Testing
- F 1110 Test Method for Sandwich Corrosion Test
- F 1111 Test Method for Corrosion of Low Embrittling Cadmium Plate by Aircraft Maintenance Chemicals

MIL-C-87937B

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

SOCIETY OF AUTOMOTIVE ENGINEERS

SAE Standards

AMS 3204 Synthetic Rubber, Low-Temperature Resistant 25-35  
AMS 3209 Chloroprene Rubber, Weather Resistant, 65-75  
AMS 4375 Magnesium Alloy, Sheet & Plate, 3.01A-1.0ZN (AZ31B-O)  
AMS 4376 Magnesium Alloy Plate, 3.01A-1.0ZN (AZ31B-H26)  
AMS 4377 Magnesium Alloy, Sheet & Plate, 3.01A-1.0ZN (AZ31B-H24)

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale PA 15096.)

UNIFORM FREIGHT CLASSIFICATION RULES (Current Issue)

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

ALUMINUM ASSOCIATION INCORPORATED

AA Standards

2090-T-83 Aluminum-Lithium Alloy

(Application for copies should be addressed to The Aluminum Association Inc., 900 19th St MW, Washington D.C. 20006.)

AMERICAN IRON AND STEEL INSTITUTE

AISI Standards

AISI 4340 High Strength, Low Alloy Steel

(Application for copies should be addressed to American Iron and Steel Institute, 1133 15th St N.W. Suite 300, Washington DC 20005.)

INTERNATIONAL CIVIL AIR ORGANIZATION (ICAO)

*Technical Instructions for the Safe Transport of Dangerous Goods by Air*

(Application for copies should be addressed to International Civil Aviation Organization, Place de l'Aviation Internationale, 1000 Sherbrooke St., W, Montreal, Quebec, Canada H3A 2R2.)

MIL-C-87937B

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

*Dangerous Goods Regulations*

(Application for copies should be addressed to the International Air Transport Association, 2000 Peel St., Montreal, Quebec, Canada H3A 2R4.)

INTERNATIONAL MARITIME ORGANIZATION (IMO)

*International Maritime Dangerous Goods Code*

(Application for copies should be addressed to the International Maritime Organization, 4 Albert Embankment, London SE1 7SR United Kingdom.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and a reference cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Qualification.

3.1.1 Qualification (Initial). The cleaning compound furnished under this specification shall be a product which has been tested and has passed the qualification tests specified herein and has been listed or approved for listing on the applicable Qualified Products List (QPL).

3.1.2 Qualification (Periodic). The cleaning compound furnished under this specification must be retested or recertified by the qualifying activity at least every three years for the product to remain listed on the QPL. Qualification retesting shall be accomplished on any qualified cleaning compound for which a using activity issues a valid deficiency report. The cleaning compound shall also be subject to qualification retesting for any change in chemical formulation, material, process, or procedure in manufacturing the cleaning compound. Any cleaning compound which does not conform to all the qualification tests specified herein on periodic requalification testing shall be removed from the QPL.

3.2 Materials. The composition and formulation of the cleaning compound shall be optional with the manufacturer within the restrictions specified herein.

3.2.1 Acceptable materials.

3.2.1.1 Type I. Type I shall contain terpene hydrocarbons as specified in Table I. Certification from the manufacturer is required on the percentage of total terpenes contained in the cleaning compound. The terpene hydrocarbons used shall be of a high grade with no extraneous materials.

## MIL-C-87937B

3.2.1.2 Type II, Type III and Type IV. Type II, Type III, and Type IV compounds shall consist of one or more of the following: Surfactants, adjuvant solubilizers for organic soils such as greases and oils, alkaline builders, water conditioning agents and/or corrosion inhibitors.

3.2.2 Unacceptable materials. The cleaning compound shall not contain any hazardous compounds as defined in 40 CFR 261 (see para 4.7) nor shall it contain any chemical listed by the current report of known carcinogens of the National Toxicology Program (NTP). The cleaning compound shall not contain detectable amounts of any of the following: abrasives, chromates, cadmium, lead, mercury, phenols, cresols, ketones, chlorinated compounds or ozone depleting chemicals (ODC), except where specified within this specification. The following materials are unacceptable unless they are being used as an essential active ingredient in the cleaner: sodium chloride, urea, sodium sulfate, nitrites, nitrates, sucrose or any sugars.

3.3 Toxicity. The cleaning compound shall have no adverse effect on the health of personnel or the environment when used for its intended purpose and with proper personal protective equipment (when required). The product shall be evaluated for aquatic toxicity with a 96 hour Fathead minnow (pimephales promelas) bioassay and a 48 hour Ceriodaphnia dubia bioassay in accordance with Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, EPA/600/4-90/027. The percent survival at 1, 10, 50, and 100 ppm must be reported for both organisms.

3.3.1 Formulation. The manufacturer must submit to the qualifying activity, SA-ALC/SFTT, 1014 Andrews Rd STE 1, Kelly AFB TX 78241-5603, a complete formulation including the chemical name, CAS number, and weight percent of each ingredient. Trade names alone are not satisfactory. All proprietary information shall be protected as such.

3.3.1.1 Type I. The manufacturer shall submit to the qualifying activity the chemical name of each terpene used in the formulation including its CAS number and range of values in percent by weight of the formulation. The manufacturer shall also submit test procedures used to verify the terpene percentages within these ranges. All procedures shall be subject to approval by the qualifying activity.

3.3.2 Material safety data sheet. The manufacturer shall submit to the qualifying activity, and to the procuring activity a material safety data sheet (MSDS) for the finished product and for each component in the finished product. The MSDS shall be prepared in accordance with the latest revision of FED-STD-313.

3.3.3 Toxicological data. The manufacturer shall submit to the qualifying activity a copy of pertinent toxicological data/information (see para 4.7) for their product.

3.3.4 Biodegradability. The supplier of the cleaning compound shall furnish certification from the surfactant manufacturers that the surfactants are readily biodegradable in accordance with 40 CFR, Part 796, Subpart D. Biodegradability testing shall be accomplished as specified in paragraph 4.6.22 on the finished product. Biodegradability on the finished product shall be determined over 28 days by the Shake Flask Method monitored by analysis of Total Organic Carbon (TOC). The Type I compound shall meet the requirement of a minimum of 75% biodegradable and the Type II, Type III, and Type IV compound shall meet the requirement of a minimum of 85% biodegradable at the end of the 28 day period.

## MIL-C-87937B

3.4 Compositional assurance. The cleaning compound shall be tested for nonvolatile matter as specified in paragraph 4.6.1. The concentrated cleaning compound and a 10% solution of the cleaning compound in distilled water shall be tested for pH as specified in paragraph 4.6.3. Results of these tests as well as an infrared spectrogram of the nonvolatile matter (See 4.9.2) and a gas chromatogram (See 4.9.1 for Type I only) shall be recorded by the qualifying activity for use in quality conformance inspections (see 4.4). Quality conformance inspection results for nonvolatile matter shall not differ by more than 2 percent absolute from the recorded value. Quality conformance inspection results for pH shall not differ by more than 1 pH unit from the recorded value. Quality conformance inspection infrared spectrograms and gas chromatograms shall show no significant difference when compared to the original qualifying spectrogram.

3.5 Chemical properties.

3.5.1 Chemical requirements. The cleaning compound shall meet the requirements listed in Table I.

3.5.2 Residue rinsibility. When a freshly prepared solution of the cleaning compound is tested in accordance with 4.6.4, it shall not leave any residue or stains. A freshly prepared solution is defined as one being prepared no longer than 30 minutes prior to testing. Weight change shall be no greater than that obtained with standard hard water tested under the same conditions.

3.6 Physical properties (Types I, II, III, and IV unless otherwise noted).

3.6.1 Heat stability (Types II, III, and IV only). The concentrated cleaning compound, when tested in accordance with 4.6.5, shall show no marked color change or precipitation and shall not corrode or stain the MIL-S-7952 (1020) steel strip (a slight darkening of the steel strip shall not be objectionable). Layering or separation will constitute failure if it does not return to its original homogeneous state upon cooling.

3.6.2 Cold stability. The concentrated cleaning compound shall return to its original homogeneous condition when tested in accordance with 4.6.6.

3.6.3 Rheology (Type III only)

3.6.3.1 Consistency. When tested as specified in 4.6.24, the concentrated cleaning compound shall flow between 10 and 20 centimeters in 10 seconds. The product shall also exhibit rheology which enables it to meet the sprayability requirement.

3.6.3.2 Sprayability. The concentrated cleaning compound, when dispensed at 45 psig and tested in accordance with 4.6.25, shall give satisfactory spray characteristics and deposit a uniform layer on a vertical surface 3 feet away from the nozzle. (See 4.6.25).

## MIL-C-87937B

TABLE I. Quantitative Requirements

REQUIREMENT	TYPE I		TYPE II		TYPE III		TYPE IV		TEST METHOD
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Insoluble Matter (WT%)	---	0.05	---	0.05	---	0.05	---	0.05	4.6.2
Flash Point (°F)									
10% Solution	200	---	---	---	---	---	---	---	4.6.7
Concentrated Solution	120	---	None 1/	---	None 1/	---	None 1/	---	
Emulsion Characteristics (ml free water)									
5 min	---	5.0	---	5.0	---	5.0	---	5.0	4.6.8
8 hours	13.0	---	---	---	---	---	---	---	4.6.8
24 hours	---	---	13.0	---	8.0	---	11.0	---	4.6.8
% Cleaning Efficiency	95	---	40	---	65	---	90	---	4.6.21
Terpene Hydrocarbons (% WT)	25	40	---	---	---	---	---	---	4.6.23

1/ No flash point should be observed up to the boiling point of the compound.

### 3.7 Effect on metals (Types I, II, III, and IV unless otherwise noted).

3.7.1 Hydrogen embrittlement. When tested in accordance with 4.6.9, the concentrated cleaner (Types I, II, III, and IV) and a 10% solution of the cleaner (Types I, II and IV only) in distilled water shall not cause hydrogen embrittlement of cadmium plated AISI 4340 steel.

3.7.2 Total immersion corrosion. When tested in accordance with 4.6.10 (ASTM F 483), the concentrated cleaning compound (all types) and a 10% solution of the cleaning compound (Types I, II, and IV only) in distilled water shall not show any indication of staining, etching, pitting, or localized attack on any of the panels, or cause a weight change of an average of three (3) test panels greater than that shown in Table II. A slight discoloration of the panels shall not be objectionable. The cleaning compound shall not layer or separate for the duration of the test.

3.7.3 Low-embrittling cadmium plate corrosion. Steel panels coated with low-embrittling cadmium plate immersed in the concentrated cleaning compound (all types) and a 10% solution of the cleaning compound (Types I, II and IV only) in distilled water shall not show a weight change greater than 0.14 mg/cm<sup>2</sup> for 24 hours when tested in accordance with 4.6.11.

## MIL-C-87937B

3.7.4 Effects on unpainted metal surfaces. The concentrated cleaning compound (Type III only) and a 10% solution (Types I, II, and IV only) of the cleaning compound in distilled water shall not cause streaking, stains or other deposits that cannot be easily removed with water when tested in accordance with 4.6.12.

3.7.5 Sandwich corrosion. When tested in accordance with 4.6.16, the concentrated cleaner (all types) and a 10% solution (Types I, II, and IV only) shall not cause a corrosion rating greater than two (2) on any test panel.

3.8 Effect on painted surfaces. The concentrated cleaning compound (Type III only) and a 25% solution (Types I, II, and IV only) of the cleaning compound in distilled water shall not cause streaking, blistering, discoloration or a permanent decrease in film hardness of more than one (1) pencil hardness level when tested in accordance with 4.6.13. The Type I material shall be tested using only the (F) Enamel Semigloss and (P) Polyurethane Paint Systems.

3.9 Stress crazing of MIL-P-5425 and MIL-P-25690 (Type A and C) acrylic plastics. The concentrated product (Type III only) and a 10% solution (Types I, II, and IV) in distilled water shall not cause stress crazing or staining of acrylic plastics when tested in accordance with 4.6.14.

3.10 Stress crazing of polycarbonate plastic. The concentrated product (Type III only) and a 10% solution (Types I, II, and IV) in distilled water shall not cause stress crazing or staining of polycarbonate plastic conforming to MIL-P-83310 when tested in accordance with 4.6.15.

3.11 Long-term storage stability. After being stored for a period of 12 months, in accordance with 4.6.17, the cleaning compound shall not have corroded the shipping container and shall meet the requirements of paragraphs 3.5.1, 3.7.1, 3.7.2, 3.15, and 3.16 of this specification.

3.12 Hot Dip Galvanizing Corrosion. Steel panels conforming to MIL-S-7952, Grade 1020, Hot Dip Galvanized per ASTM A 153, immersed in the concentrated product (Type III only) and a 10% solution of the cleaning compound (Types I, II and IV) in distilled water shall not show a weight change of an average of three (3) test panels greater than 0.14 mg/cm<sup>2</sup> for 24 hrs when tested in accordance with 4.6.18.

3.13 Workmanship. The cleaning compound shall be a liquid having a uniform and homogenous appearance. The cleaning compound shall be manufactured from materials entirely suitable for the purpose intended and shall be processed in a manner that will produce a product harmless to metal surfaces and humans when used as directed.

3.14 Effect on polysulfide sealants. The concentrated cleaning compound (Type III only) and a 25% solution (Type I, Type II, and Type IV only) of the cleaning compound in distilled water shall not change the durometer hardness of the polysulfide sealant by more than 5 units when tested in accordance with 4.6.19.

3.15 Rubber compatibility. The concentrated cleaning compound (Type III only) and a 25% solution (Types I, II, and IV only) of the cleaning compound in distilled water shall not change the durometer hardness more than 5 units when tested in accordance with 4.6.20.

## MIL-C-87937B

3.16 Effect on polyimide insulated wire. The cleaning compound, when tested according to 4.6.26, shall not cause dissolution, cracking, or dielectric breakdown (leakage) of the polyimide insulated wire in excess of that produced by distilled water.

TABLE II. Total Immersion Corrosion Requirements

Alloy	Average of 3 Panels Weight Loss, Max (mg/cm <sup>2</sup> /168 hrs)
Magnesium (AZ 31B-H24) AMS 4377 surface treated in accordance with Type III of MIL-M-3171	0.70
Aluminum, QQ-A-250/4, T3 surface treated in accordance with Type I, Class I of MIL-A-8625	0.49
Aluminum, QQ-A-250/4, Bare T3 Alloy	0.49
Aluminum, QQ-A-250/12, Bare T6 Alloy	0.49
Titanium, MIL-T-9046, 6AL-4V Class III, Composition C	0.35
Steel, MIL-S-7952, Grade 1020	1.40
Aluminum-Lithium, AA 2090-T-83	0.21
Steel, 410 SS, Silver Plated QQ-S-365, Type II, Grade B.	0.14

## 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, 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. The Government reserves the right to perform any of the inspections set forth in the specification when such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

## MIL-C-87937B

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of tests. The inspection and testing of the cleaning compound shall be as follows. The inspection terms used herein are as defined in MIL-STD-109.

- a. Qualification inspection (4.3).
- b. Quality conformance inspection (4.4).

4.3 Qualification inspection. Qualification inspection shall consist of all inspections and tests specified herein.

4.3.1 Qualification samples. The initial qualification samples shall consist of 8 liters (2 gallons) of the cleaning compound. The cleaning compound shall be furnished in containers of the type to be used in filling contract orders. Samples shall be identified as follows and forwarded to the activity responsible for testing, as designated in the letter of authorization from the activity responsible for qualification (See 6.4):

- Samples for Qualification Tests.
- Cleaning Compound, Aerospace Equipment, (Types I, II, III, and IV).
- MIL-C-87937B.
- (Manufacturers Product and Code Number)
- (Name and Address of Contractor)
- Submitted by (Name), (Date) for Qualification Testing in Accordance with the Requirements of MIL-C-87937B Under Authorization (Reference Authority Letter).
- (Mixing and Other Important Instructions.)
- (Safety Information and Precautions.)

4.3.2 Test reports. In addition to the qualification test samples, the contractor shall furnish a certified test report showing that the material conforms to all the requirements of this specification with the exception of the storage stability test. Additionally, a certified statement shall be furnished to the qualifying activity that specifically identifies each ingredient including solvent, in the cleaning compound by a readily recognizable chemical name, CAS number, source and the percentage by weight contained in the compound. Trade names alone will not be considered satisfactory.

4.3.3 Qualification required. Prior to actual procurement, the cleaning compound shall pass the qualification inspections and requirements specified herein. If the product is later modified in any way, the modified form shall be subjected to and shall pass the same qualification inspections (see 3.1). Any changes or modifications from the formulation used at the initial qualification shall be approved by the qualifying activity and may require requalification. All qualifications will be granted contingent upon compliance with the long term storage stability requirement specified in paragraph 3.11.

## MIL-C-87937B

4.4 Quality conformance tests. Quality conformance tests for acceptance of the cleaning compound shall consist of the following tests.

- A. Workmanship
- B. Cold Stability
- C. Insoluble Matter
- D. Consistency (Type III only)
- E. Immersion Corrosion\*
- F. Emulsion Characteristics
- G. Nonvolatile Matter
- H. pH
- I. Flash Point
- J. Infrared Spectrogram (Types II, III, and IV)
- K. Gas Chromatogram (Type I only)

\*Immersion Corrosion Quality Conformance Test ran on Aluminum QQ-250/4, Bare T3 alloy panel only.

If during quality conformance testing a lot fails any of the above acceptance tests, all tests required for qualification will be reinstated. These qualification tests will be required until two successive lots meet all requirements of the specification, after which quality conformance testing will again be authorized. (See paragraph 4.4.6)

4.4.1 Sampling. Unless otherwise specified, not less than a 3.8 liter (1 gal) container of the cleaning compound shall be selected at random from each lot and subjected to the tests specified in 4.4. The contents of each selected container for sampling shall be thoroughly mixed by rolling and inverting immediately prior to sampling.

4.4.2 Lot. A lot shall consist of one of the following:

- a. The cleaning compound produced in not more than 24 consecutive hours from a continuous process which is used to fill shipping containers directly from the process output. A continuous process shall be the production of product by continuous input of raw materials and output of finished product by one manufacturer in one plant with no change in manufacturing conditions or materials.
- b. The cleaning compound from individual runs of a batch process which is used to fill shipping containers directly from the process output. A batch process shall be the production of product by runs from single additions of raw materials which are mixed, reacted, and/or purified forming the product.
- c. The cleaning compound from either or both the continuous and batch processes which is held in a single storage tank and subsequently withdrawn to fill shipping containers. The product will be homogeneous at the time of withdrawal and shall not be added to while being withdrawn. After each addition to the storage tank, the contents shall constitute a separate lot.

4.4.3 Sampling of product. Unless otherwise specified, quality conformance tests shall be made on the sample of product taken directly from the filled containers. The number of filled containers selected for sampling from each lot shall be in accordance with Table III. The first and last containers to be filled within a given lot shall be sampled. Other containers will be selected at random. The samples may be obtained in any convenient manner that does not compromise the integrity of the sample. The sampled containers shall be subjected to the inspections specified in 4.4.5.

## MIL-C-87937B

TABLE III. Sampling for Tests

Number of Containers in lot	Number of Containers to be sampled
2 to 15	2
16 to 25	3
26 to 90	5
91 to 150	8
151 to 280	13
281 to 500	20
501 to 1200	32
1201 to 3200	50
3201 to 10000	80
10001 to 35000	125
35001 to 150000	200
150001 to 500000	315
500001 and over	500

4.4.4 Inspection of materials. The contractor is responsible for insuring that materials and components used are manufactured, tested and inspected in accordance with the requirements of referenced subsidiary specifications and standards to the extent specified, or, if none, in accordance with this specification. (See 2.3)

4.4.5 Inspection of the end item. Examination of the end item shall be made in accordance with the following classification of defects. The lot size, for purposes of determining the sample size in accordance with Table III, shall be expressed in units of filled primary containers for the examination specified in 4.4.5.1, and 4.4.5.2, and in units of shipping containers for the examinations specified in 4.4.5.3.

4.4.5.1 Examination for container defects. The end item containers shall be examined for defects in appearance, closure, construction, workmanship, and markings in accordance with Table IV.

4.4.5.2 Examination for net contents. The quality of the batch shall be unacceptable if the average net content is less than the specified or indicated quantity.

4.4.5.3 Examination of preparation for delivery. An examination shall be made to determine the packing, palletization, and markings comply with Section 5 and Table V.

4.4.6 Rejection and retest. When any sample of the product examined and tested in accordance with this specification fails to conform to the requirements specified herein, the entire lot represented by the sample

## MIL-C-87937B

shall be rejected. Rejected material shall not be resubmitted for acceptance without prior approval of the qualifying activity. The application for resubmission shall contain full particulars concerning previous rejections and all measures taken to correct those defects. Samples for retest shall be taken from previously unopened product containers.

TABLE IV. Examination for Container Defects

EXAMINATION	DEFECT
-Appearance, construction, and workmanship	Not in container specified, cracked, crushed, or any defect affecting serviceability. Not clean; evidence of dirt, rust, or foreign matter.
-Closure	Any leakage or seepage of contents in either an upright or horizontal position. Closure not as specified.
-Markings	Omitted, illegible, incorrect, or not in accordance with contract requirements.

TABLE V. Examination of Preparation for Delivery

EXAMINATION	DEFECT
-Packing	Container not as specified. Arrangement or number of unit containers per pallet (as applicable) not in accordance with contract requirements. Loose or inadequate strappings, bulged or distorted containers.
-Palletization	Palletization not in accordance with requirements.
-Markings	Data illegible, incorrect, incomplete or not in accordance with contract.

4.5 Testing standards. All laboratory tests shall be conducted at standard conditions unless otherwise specified herein. Standard conditions are defined by FED-STD-141, Section 9. Unless otherwise specified, all chemical tests shall be made with ACS specification reagent grade chemicals. Unless otherwise specified, all product dilutions will be made with distilled water which conforms to the requirements of ASTM D 1193, Type IV, reagent water. The term "concentrated" cleaner or compound refers to that concentration of the cleaner/compound as received from the manufacturer. No further dilution or concentration shall be performed on the product.

## MIL-C-87937B

4.6 Test methods.

4.6.1 Nonvolatile matter. Weigh  $5.00 \pm 0.01$  g of the sample in a porcelain or glass dish about 6 to 8 cm in diameter and about 2 to 4 cm in depth. Dry to constant weight in an air oven at a temperature of  $105 \pm 2^\circ\text{C}$ . Constant weight is attained when successive heating for 1-hour periods shows a loss (or gain) of not more than 0.1%. Nonvolatile matter determinations shall be made on a minimum of two samples and the average shall be reported. If the two weights differ by more than 0.5% (absolute) the procedure shall be repeated. The nonvolatile content of the each sample shall be calculated as follows:

$$\%NVM = \left( \frac{A}{B} \right) \times 100$$

Where: A = Weight of residue

B = Weight of sample

%NVM = Percent nonvolatile matter

4.6.2 Insoluble matter. The concentrated cleaning compound shall be thoroughly agitated and a 200 ml test sample withdrawn. The insoluble matter shall be collected with the aid of a vacuum filtering apparatus consisting of a water tap filter pump, a 2,000 ml Erlenmeyer flask, a size 4 (126 mm ID) Buchner funnel and a piece of 126 mm diameter Whatman No 5 filter paper, or equivalent. The filter paper shall be dried at  $60^\circ\text{C}$  ( $140^\circ\text{F}$ ) for 30 minutes in a gravity convection oven, cooled for 3 minutes in a desiccator, and weighed to the nearest 0.1 mg. The filter paper shall be placed in the Buchner funnel so that its circumference coincides with the circumference of the funnel. The vacuum shall be started and the filter paper wetted with approximately 10 ml of distilled water in order to secure it properly in place. The test sample shall be filtered. The sides of the beaker which contained the test sample shall be rinsed with 25 ml of distilled water from a wash bottle, and the rinse transferred to the funnel, insuring that any remaining insoluble matter is completely transferred with the rinse. When all the initial liquid and the rinse have been transferred through the filter, the sides of the funnel shall be washed with 25 ml of distilled water from a wash bottle and the rinse allowed to filter. The vacuum on the flask shall be relieved and the filter paper removed from the funnel. The filter paper shall be dried for 1 hour at  $60^\circ\text{C}$  ( $140^\circ\text{F}$ ) in a gravity convection oven, cooled for 3 minutes in a desiccator, and weighed to the nearest 0.1 mg. The percent insolubles shall be calculated as follows:

$$I = \left[ \frac{A - B}{W} \right] \times 100$$

Where: A = Final filter paper weight

B = Initial filter paper weight

W = Weight of sample

I = % wt Insoluble matter

Care should be exercised throughout the final drying and weighing cycle to maintain the flat surface of the filter paper in a horizontal position in order that none of the insoluble matter will be lost. Insoluble matter

## MIL-C-87937B

determinations shall be made on a minimum of two samples and the average shall be reported. If the two results differ by more than 0.5% (absolute) the procedure shall be repeated.

4.6.3 pH value. The pH value of the concentrated cleaning compound and a 10 percent solution of the cleaning compound in freshly boiled distilled water shall be measured in accordance with ASTM E-70.

4.6.4 Residue rinsibility. Six smooth aluminum dishes, containing no creases or crevices, shall be cleaned in a solution of Brite-Boy, (from 3D Inc., or equivalent), rinsed, and dried to constant weight. Ten ml of a 25% by volume solution of the cleaning compound in standard hard water (See 4.6.4.1) shall be placed in three of the precleaned dishes and tested according to the procedure in 4.6.4.2.

4.6.4.1 Preparation of standard hard water. A 20-grain (as  $\text{CaCO}_3$ ) hard-water stock solution shall be prepared by dissolving  $0.40 \pm 0.005$  g of reagent grade Calcium Acetate,  $\text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$  and  $0.28 \pm 0.005$  g of reagent grade Magnesium Sulfate,  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ , in 1 liter of boiled distilled water.

4.6.4.2 Procedure. Dry three dishes each containing 10.0 ml of a 25% cleaning solution for 7 1/2 hours in a circulating oven at  $68 \pm 2$  °C with full draft. Cool in desiccator overnight and weigh. Rinse with running distilled water for 1 minute. Brush with a sash-type brush containing long-fiber bristles (2.5 cm diameter by 3.8 cm to 6.4 cm long) for 1 minute using distilled water. Rinse for 30 seconds with running distilled water. Dry in oven as before, cool and reweigh. Standard hard water (4.6.4.1) shall be tested as control for weight change comparison in the remaining three precleaned dishes, using the same procedure as above.

4.6.5 Heat stability. A 141.75 g sample of the well mixed concentrated cleaning compound shall be placed into each of two clean 255 ml (12 oz) clear glass bottles having approximate dimensions of 24 cm in height by 6.35 cm in diameter (9.5 in x 2.5 in). One bottle containing the concentrated cleaning compound shall be sealed with a screw type cap and stored in a dark place at standard conditions for 6 days (144 hrs) for reference purposes. Place into the second bottle of concentrated cleaning compound a strip of steel, 15.24 cm by 1.27 cm by 0.05 cm (6 in x 0.5 in x 0.02 in) conforming to MIL-S-7952. Clean the steel strip by abrasively polishing to remove surface scale and corrosion followed by immersion for one minute in P-D-680 followed by immersion for one minute in isopropyl alcohol (TT-I-735, grade A) at standard conditions. Seal the bottle containing the concentrated cleaning compound and the cleaned steel strip with a screw type cover and shake thoroughly for 1 minute. Place the bottle in a bath maintained at  $46 \pm 2$  °C ( $115 \pm 3$  °F) for 5 hours, then remove and allow to cool to ambient conditions for 19 hours. This heating/cooling cycle will be repeated 5 times. After completion of the test period, remove the test strip and inspect the portion of the strip which was immersed in the cleaning compound and the portion exposed to the vapor. Any corrosion, pitting or discoloration constitutes failure. The bottle is resealed and along with the control bottle, that has been maintained in the dark, is shaken thoroughly for 1 minute, then allowed to remain undisturbed for 1 hour at room temperature. The bottles are then examined. Any marked change in color, precipitation, layering or separation constitutes failure.

4.6.6 Cold stability. A 50 ml sample of the cleaning compound shall be poured into a suitable test tube and cooled to 0°C. This temperature shall be maintained for one hour. The compound shall then be allowed to reach room temperature. After 5 (five) complete temperature inversion cycles of the test tube, the compound shall be examined for homogeneity. A slight turbidity shall not be objectionable provided no precipitation is present.

## MIL-C-87937B

4.6.7 Flash point. The flash point of the concentrated cleaning compound (Type I, II, III, and IV) shall be determined in accordance with ASTM D 56 (Tag Closed Cup) and for materials that have a tendency to form a surface film under the test conditions, use ASTM D 93. The flash point of the 10% solution in distilled water (Type I only) shall be determined in accordance with ASTM D 92.

4.6.8 Emulsion characteristics. Twenty ml of a 25% by volume solution (Types I and II) of the cleaning compound (12.5% by volume solution for Types III and IV) shall be placed in a 50 ml glass stoppered graduated cylinder. Twenty ml of lubricating oil conforming to MIL-L-2104, grade 10W, shall be added. An emulsion shall be formed by 10 inversions of the graduated cylinder followed by a vigorous 15 second shake. After the emulsion has stood for 5 minutes, the 15 second shake shall be repeated. At 5 minutes and 8 hours for the Type I and at 5 minutes and 24 hours for the Types II, III and IV cleaner, the amount of free water and cleaner which separates from the lubricating oil shall conform to the requirements of Table I.

4.6.9 Hydrogen embrittlement. The hydrogen embrittlement properties of the cleaning compound shall be determined in accordance with ASTM F 519 using either Type 1a, 1b, or 1c, Treatment B AISI 4340 steel specimens.

4.6.10 Total immersion corrosion. The total immersion corrosion effects of the cleaning compound on the new, unused metals and metal alloys listed in Table II shall be determined in accordance with ASTM F 483. Conformance to the requirements in Table II shall be for weight loss after 168 hours. In order to obtain the best results on test panels in this very low weight category, the panels must be handled with gloves, cleaned in a very careful manner and dried in an oven. They are cooled and dried in a desiccator both before and after each weighing.

4.6.11 Low embrittling cadmium plate corrosion. The cleaning compound shall be evaluated for corrosion on low-embrittling cadmium plate in accordance with ASTM F 1111.

4.6.12 Effects on unpainted metal surfaces. The cleaning compound shall be evaluated for effects on unpainted metal surfaces in accordance with ASTM F 485.

4.6.13 Effect on painted surfaces. The concentrated cleaning compound (Type III only) and a 25% solution (Type I, II, and IV only) with distilled water shall be tested in accordance with ASTM F502 except that the panels used for testing shall be coated with the paint systems listed in Table VI. For all paint systems tested, a separate panel will be required for both 25% solution and concentrate. For Type II, Type III, and Type IV compound, conduct the test on all paint systems listed in Table VI. For Type I compound, conduct the test only on the enamel semigloss (F) and polyurethane (P) paint systems.

4.6.14 Stress crazing of MIL-P-5425 and MIL-P-25690 (type A and C) acrylic plastics. The cleaning compound shall be evaluated for stress crazing of stretch (Type A and C) acrylic plastics in accordance with ASTM F 484.

4.6.15 Stress crazing of polycarbonate plastic. The cleaning compound shall be evaluated for stress crazing of polycarbonate plastics using the test procedure outlined in ASTM F 484 with the exception that the acrylic plastics called for in the procedure be replaced with polycarbonate plastic conforming to MIL-P-83310 of the same dimensions and the polycarbonate specimens shall be stressed for  $30 \pm 2$  minutes to an outer fiber stress of 2000 psi.

## MIL-C-87937B

4.6.16 Sandwich corrosion. The cleaning compound shall be tested in accordance with ASTM F 1110 except that non-conformance shall be determined by the requirements specified in paragraph 3.7.5.

4.6.17 Long term storage stability. The cleaning compound shall be prepared and stored for long term storage stability in accordance with ASTM F 1104 using two (2) 3.8 liter (one-gallon) DOT Specification cans conforming to PPP-P-704; or the non-metallic specification DOT 34-1 (or the polyethylene UN 1H1 plastic container which may be substituted for the DOT 34-1). Manufacturers using both types material in production packaging shall test each type container with their product.

4.6.18 Hot Dip Galvanizing Corrosion. The total immersion corrosion effect of the concentrated product (Type III only) and a 10% solution of (Types I, II and IV) cleaning compound and distilled water on Steel, MIL-S-7952, Grade 1020, Hot Dip Galvanized per ASTM A 153 shall be evaluated per ASTM F 483.

4.6.19 Effects on polysulfide sealant.

4.6.19.1 Preparation of test specimens. MIL-S-81733, Type I, and MIL-S-8802, Type I, sealants shall be mixed as specified by their respective manufacturers and each pressed into a 1/8 inch thick sheet mold until cured (this will be the sheet stock for each sealant). The sealants will be cured for 7 days at 49°C. The specimens shall be cut from the sheet stock.

4.6.19.2 Test procedures. Immerse two specimens of each sealant in the concentrated product (Type III only) and a 25% solution of the cleaning compound (Types I, II, and IV) at room temperature for 30 minutes. Remove from the solution, rinse with cool tap water, and test within 30 minutes for Shore A hardness in accordance with ASTM D 2240.

4.6.20 Test on rubber compatibility. Tests will be conducted on AMS 3204 and AMS 3209 rubbers for compatibility with the cleaning compounds.

4.6.20.1 Preparation of test specimens. Three (3) test specimens will be used for each type rubber specified. Test specimens shall be cut from 1/8 inch sheet stock.

4.6.20.2 Test procedure. Test and record the Shore A hardness of each test specimen in accordance with ASTM D 2240. Immerse each specimen in the concentrated product (Type III only) and a 25% solution of the cleaning compound (Types I, II, and IV) at room temperature for 30 minutes. Remove from the solution, rinse with cool tap water, and test within 30 minutes for a Shore A hardness in accordance with ASTM D 2240.

4.6.21 Cleaning efficiency (all Types). The cleaning efficiency of the cleaning compound shall be reported as the average of three test results and shall conform to the Quantitative Requirements of Table I.

4.6.21.1 Preparation of control formula. The control formula shall be prepared by the testing laboratory in accordance with Table VII and subjected to the cleaning test (4.6.21.5) and evaluation (4.6.21.6). Valid control formula preparations shall produce denominator values greater than 0.95 during testing.

## MIL-C-87937B

4.6.21.2 Panel preparation. Bare aluminum alloy panels 40.6 x 12.7 x 0.05 cm (16 x 5 x .02 in) shall be used.

4.6.21.3 Soil preparation. Molybdenum disulfide grease soil shall be prepared by blending 50 grams of carbon black and 500 grams MIL-G-21164 grease with a mechanical grease worker for 15 minutes.

TABLE VI. Test Panel Finishes

Primer Coatings				
Panel Set No.	Primer Material Specification	Dry Film Thickness Per Coat/ mm (inches)	No. of Coats	Drying Time Before Topcoating
L	MIL-C-8514, Coating Compound Metal Pretreatment Resin-Acid (First Coat)	0.0051 - 0.0102 (0.0002 - 0.0004)	1	2 - 8 hours
	MIL-P-7962, Lacquer Primer (Second Coat)	0.0076 - 0.0127 (0.0003 - 0.0005)	1	2 - 8 hours
FEPH	MIL-P-23377, Primer, Coating Epoxy-Polyamide	0.0178 - 0.0229 (0.0007 - 0.0009)	1	2 - 8 hours

Top Coats, Color Number 17925 per FED-STD-595						
Panel Set	Topcoat Material	Dry Film Thickness Per Coat/ mm (inches)	No. of Coats	Drying Time Between Coats	Dry Film Thickness mm (inches)	Days to Dry Before Testing
L	TT-L-32 Lacquer, Acrylic Gloss	0.0102 - 0.0127 (0.0004 - 0.0005)	2	1 hour	0.0203 - 0.0254 (0.0008 - 0.0010)	7
E	MIL-C-22750 Coating, Epoxy Topcoat	0.0102 - 0.0127 (0.0004 - 0.0005)	2	1 hour	0.0203 - 0.0254 (0.0008 - 0.0010)	7
P	MIL-C-83286 Polyurethane	0.0203 - 0.0305 (0.0008 - 0.0012)	2	1 hour	0.0457 - 0.0610 (0.0018 - 0.0024)	7
H	MIL-C-85285	same as P				
F	TT-E-529 Enamel Semigloss	0.0203 - 0.0305 (0.0008 - 0.0012)	2	1 hour	0.0457 - 0.0610 (0.0018 - 0.0024)	7
D	MIL-P-23236 Paint Coating Requires No Primer	0.0457 - 0.0610 (0.0018 - 0.0024)	1			7

## MIL-C-87937B

4.6.21.4 Application of grease soil. Panels shall be wiped with clean tissue soaked in reagent grade acetone then dried to a constant weight. Record the weight to the nearest 0.1 mg. Apply approximately 200 mg grease soil using a soft bristle brush over an area approximately 2" x 7" in the center of the panel. Remove excess grease soil by covering the test panel with a folded absorbent tissue and exerting pressure by rolling a five pound rubber cylinder over the tissue. Repeat this blotting procedure twice. Each freshly soiled panel shall be baked at  $105 \pm 5$  °C for 60 minutes then cooled to room temperature and weighed to the nearest 0.1 mg. Only use panels with more than 50 mg of grease soil. Panels shall be used within 4 hours.

TABLE VII. Control Formula for the Cleaning Efficiency Test

Component	Control Formula Composition (% by weight) 1/
d-limonene	30.0
diethanolamine	5.0
nonionic surfactant (Triton X-100)	5.0
distilled water (ASTM D 1193, type IV)	60.0

1/. This formulation is corrosive and intended solely for use as the control for the cleaning efficiency test. It will not qualify to the requirements in this specification.

4.6.21.5 Cleaning test. The test panels shall be cleaned using a Gardner heavy duty wear tester, or equivalent, fitted with a cellulose sponge. The sponge shall be cut such that the dimension parallel to the cleaning stroke is 9 cm (3.5 in) and the width is 7 cm (2.75 in). The cleaning head with the dry sponge attached shall be weighed to a mass of 495 to 505 grams. The cleaning stroke of the scrub tester shall be 12 inches. The cleaning compound (including Type III) and the control formula shall be diluted 1 part cleaner with 9 parts distilled water. After placing a soiled test panel in the template 100 ml of the cleaning solution shall be applied to the sponge then applied to the soiled test panel so that it is completely covered. After allowing a 30 seconds dwell time, the test panel shall be cleaned using 5 cycles of the wear tester. The panel shall then be adequately rinsed with sufficient amounts of distilled water.

4.6.21.6 Evaluation. The rinsed panel shall be heated to  $105^{\circ}\text{C} \pm 5^{\circ}\text{C}$  for 10 minutes, cooled to room temperature, then weigh to the nearest 0.1 mg. Report the % Cleaning Efficiency as the average of three (3) tests using the following:

$$\% \text{Cleaning Efficiency} = \frac{\left[ \frac{A - B}{A - C} \right]}{\left[ \frac{X - Y}{X - Z} \right]} \times 100$$

## MIL-C-87937B

where: A = weight of the soiled panel before cleaning with product  
 B = weight of the soiled panel after cleaning with product  
 C = weight of the unsoiled panel used in the product cleaning test  
 X = weight of the soiled panel before cleaning with the control formula  
 Y = weight of the soiled panel after cleaning with the control formula  
 Z = weight of the unsoiled panel used in the control formula cleaning test

4.6.22 Biodegradability. Biodegradation will be determined by the "Shake Flask Biodegradation Tests" for measuring ultimate or ready degradation potential, as found in EPA Chemical Fate Test Guidelines 40 CFR Method 796.3100 (Aerobic Aquatic Biodegradation Test) or 40 CFR Method 796.3240 (OECD Screening Test for Ready Biodegradability). Biodegradability will be shown as carbon transformation by both soluble organic carbon reduction and CO<sub>2</sub> evolution.

4.6.23 Terpenes hydrocarbons (Type I only). An approved test procedure shall be used. See 3.3.1.1.

4.6.24 Consistency (Type III only). A consistometer (Central Scientific Company, Chicago, IL; Catalog No. 24925 or equivalent) shall be used as follows: Shake the container of cleaning compound by hand for 10 seconds. Pour the material into the well of the consistometer completely filling it. Release the gate and determine the extent of flow in ten seconds.

4.6.25 Sprayability (Type III only). Fill the reservoir of the application test equipment with Type III compound, as supplied. Release the compound flow valve and gradually increase the nozzle tip pressure to not more than 8 psi pressure, observing the discharge spray characteristics. Report the following:

- a. The maximum pressure at which no bubbles are released into the surrounding air.
- b. The distance the gel can be satisfactorily projected.

4.6.25.1 Technique: Under these optimized conditions apply with a sideways sweeping motion the compound to a vertical surface and examine the deposited film and record assessment. The product should display uniformity with absence of large and entrained air bubbles or a consistency which would not inhibit effective cleaning.

4.6.25.2 Application test equipment.

- a. Reservoir: Hand pump pressure sprayer (modified), or pressure pot with air pressure applied from external compressor.
- b. Nozzle: Fan jet with an equivalent orifice diameter 1.1 mm and spray angle 65°C. (Spraying Systems Co., Wheaton Illinois, Item Number H-VV 6503)

4.6.26 Effect on polyimide insulated wire. Coil two segments of MIL-W-81381/11-20 wire approximately 61 cm (24 in) and place into separate 118 ml (4 oz) wide mouth jars. To one jar add sufficient concentrate cleaning compound to completely cover the wire coil. To the other jar (control sample) add sufficient distilled water to cover the wire coil. Cap both jars and store at room temperature (20 - 25 °C) for 14 days. At the end of the

## MIL-C-87937B

storage period remove both coils, rinse thoroughly with distilled water and suspend to allow complete draining and drying. Uncoil the wires, examine each closely for dissolution, and report the results. The wire immersed in the cleaner shall perform as well as the wire immersed in distilled water. Both wires shall then be subjected to a double reverse wrap on a 0.3 cm (0.125 in) mandrel and examined for cracking. (Note: Failure of the control sample here voids the test and must be repeated using new MIL-W-81381/11-20 material). Wire immersed in the cleaner shall then be examined for cracking. If cracking occurs results shall be reported and the test ended. Passing wire shall then withstand a one minute dielectric test of 2,500 volts (rms), using a Hypot model number 4045 or equivalent, and examined for breakdown and/or leakage. Wire immersed in the cleaner shall perform equally well as the control wire immersed in distilled water.

4.7 Toxicity and waste disposal characteristics. The supplier shall furnish the toxicological data or formulations required (See 3.3) to evaluate the safety of the material proposed for use. The manufacturer will provide current procedures for disposal per federal EPA regulations. The supplier shall also furnish certification of the percent activity and percent biodegradability of the cleaner. The data will be forwarded to SA-ALC/SFTT 1014 Andrews Rd STE 1, Kelly AFB TX 78241-5603.

4.8 Filler materials. The contractor shall furnish certification that the cleaning compound contains only the materials allowed and does not contain any filler materials disallowed per paragraph 3.2.

4.9 Qualitative Identification of Components (Types I, II, III, and IV).

4.9.1 Gas Chromatogram (Type I only). A gas chromatogram of the Type I product shall be provided by the Government approved qualification laboratory (See 3.4). The chromatogram shall report all salient instrumental parameters (column type and dimensions, temperature(s), carrier gas and flow rate, detector type, sample dilution(s), etc.) required to produce it.

4.9.2 Infrared spectrogram. (Types II, III, and IV). Infrared spectrograms of the nonvolatile matter shall be prepared by the Government approved qualification laboratory (See 3.4). The spectrogram, including method for sample preparation, shall be provided to the qualifying activity by the qualification laboratory.

## 5. PACKAGING

5.1 Packing. Packing shall be Level A, or Industrial for required net fill, as specified.

5.1.1 Level A. The cleaning compound shall be furnished in following packages which shall, as a minimum, meet the specifications of 49 CFR Parts 100 - 190:

5.1.1.1 55 Gallon Drums. The cleaning compound shall be available in 208 liter (55 gallon) Specification DOT 17E drums conforming to PPP-D-729, Type II, or UN 1A1 drums qualified to the Packing Group II level and which meet the minimum specifications for a Type II drum in accordance with PPP-D-729.

## MIL-C-87937B

5.1.1.2 5 Gallon Containers. The cleaning compound shall be available in 18.9 liter (5 gallon) DOT Specification metal containers conforming to PPP-P-704, Type I, Class 4, or non-metallic Specification DOT 34-5 (or the 18.9 liter capacity UN 1H1 polyethylene container which may be substituted for the DOT 34-5).

5.1.2 Industrial. The cleaning compound shall be packed in accordance with ASTM D 3951. Containers shall be in accordance with Uniform Freight Classification rules or regulations of other carriers applicable to the mode of transportation.

5.1.3 Compatibility of materials. The container, closure, lining, or sealing compound shall not interact physically or chemically with the contents so as to corrode, be altered, or to alter the strength, quality or purity of the contents.

5.2 Palletization. When specified, the cleaning compound, shall be palletized in accordance with Load Type III (strapped) of MIL-STD-147 except that for overseas shipment the overall height of the load shall not exceed 109.2 cm (43 inches).

5.3 Marking. Containers shall be marked in accordance with MIL-STD-129 and 49 CFR. For international shipments, containers shall also be marked in accordance with ICAO, IATA, and IMO as applicable for mode of transportation. The shipment marking nomenclature for Type I, Type II and Type IV shall be:

#### CLEANING COMPOUND, AEROSPACE EQUIPMENT, TYPES (I, II, OR IV)

##### DIP TANK IMMERSION METHOD:

Dilute the concentrate with a minimum of two parts water unless otherwise specified in Technical Order (TO). Normal dilution ratios are 1:4 for heavy soils, 1:10 for light soils.

##### EXTERIOR CLEANING METHOD:

Aircraft: Dilute the concentrate 1:10 to 1:20 with water depending on the amount of soil to be removed. For spot cleaning, dilute the concentrate with 4 to 10 parts water depending on the amount of soil to be removed. After cleaning, rinse off with water. Ensure engines are properly blocked and sealed to preclude contact with internal jet engine components. Not recommended for cleaning canopies.

Aerospace Ground Equipment (AGE): Dilute the concentrate 1:10 to 1:20 with water depending on the amount of soil to be removed. For spot cleaning, dilute the concentrate with 4 to 10 parts water depending on the amount of soil to be removed. After cleaning, rinse off with water.

Motor Vehicle Engines: Dilute the concentrate with 3 to 10 parts water depending on the amount of soil to be removed. After cleaning, rinse off with water. Not recommended as a spot cleaner for engines.

The shipment marking nomenclature for Type III shall be:

MIL-C-87937B

CLEANING COMPOUND, AEROSPACE EQUIPMENT, TYPE III, GEL TYPE DEGREASER

Directions: Apply full strength with brush or pump spray. Allow 5 to 15 minutes dwell time. Brush, if necessary, then spray with fresh water to rinse. Brush then rinse again to completely remove the cleaner.

5.3.1 Storage temperature. The markings on the container shall include a caution statement stating the temperature range within which the product can be stored without compromising the performance of the product.

5.4 Material safety data sheet. Contractor shall comply with the requirements of the latest revision of FED-STD-313.

5.5 Hazardous material warning labels. A hazardous warning label shall be developed in accordance with the requirements of the OSHA Hazardous Communication Standard (29 CFR 1910.1200) and MIL-STD-129.

6. NOTES

6.1 Intended use. The four types of cleaning compound covered by this specification are intended to be used for cleaning Aerospace Equipment including aircraft, aerospace ground equipment (AGE) and AGE engines. The cleaners shall be used in place of other cleaners when approved by the System Program Manager of the equipment being cleaned. Type I should be used only on polyurethane and enamel coatings as it may attack acrylic nitrocellulose lacquer coatings found in numerous aircraft. Type I and IV materials are intended for light to heavy duty removal of greases, oils, hydraulic fluid, and carbon. Type II is intended for light to medium cleaning and is not intended to remove heavy soils. Type III is intended for light to heavy duty removal of greases, oils, hydraulic fluid, and carbon in wheel wells, wing butts and other areas where complete rinsing with water can be tolerated. After cleaning, rinse off with water. These cleaners are not intended to be used as canopy cleaners.

6.2 Material safety data sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313.

6.3 Ordering data. Procurement documents should specify the following:

- a. Title, number and date of this specification.
- b. Type I, Type II, Type III or Type IV.
- c. Size containers required.
- d. QPL reference or test number.
- e. Level of packing required.
- f. Palletization, when applicable.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the contractors is

MIL-C-87937B

called to this requirement, and contractors are urged to arrange to have their products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded *contracts or orders* for the products covered by this specification. The activity responsible for the Qualified Products List is San Antonio Air Logistics Center, Attention SFTT, 1014 Andrews Rd Suite 1, Kelly AFB TX 78241-5603; and information pertaining to qualification of products may be obtained from that activity (See 4.3.1).

6.5 Key words.

AGE

Biodegradable

Gel-type

QPL

Terpenes

**CUSTODIANS:**  
Air Force - 68

**PREPARING ACTIVITY:**  
Air Force - 68

**REVIEW ACTIVITIES:**  
Air Force - 11  
Navy - AS  
DLA - GS

**PROJECT NO. 6850-1121**

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

## INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

**I RECOMMEND A CHANGE:**

1. DOCUMENT NUMBER

MIL-C-87937B

2. DOCUMENT DATE (YYMMDD)

940127

3. DOCUMENT TITLE

CLEANING COMPOUND, AEROSPACE EQUIPMENT

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)

7. DATE SUBMITTED (YYMMDD)

(1) Commercial

(2) AUTOVON  
(if applicable)

8. PREPARING ACTIVITY

a. NAME

b. TELEPHONE (Include Area Code)

(2) AUTOVON

(1) Commercial  
(512) 925-7847

945-7847

c. ADDRESS (Include Zip Code)

1014 ANDREWS RD STE 1  
KELLY AFB, TX 78241-5603

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:  
Defense Quality and Standardization Office  
5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466  
Telephone (703) 756-2340 AUTOVON 289-2340