

METRIC

MIL-PRF-32359

23 August 2012

PERFORMANCE SPECIFICATION

CLEANER, GENERAL, FOR GROUND VEHICLES AND GROUND SUPPORT EQUIPMENT,
HAP-FREE

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

1. SCOPE

1.1 Scope. This specification covers general cleaners (excludes petroleum products) that are hazardous air pollutant (HAP) free and many of which contain either a low content of volatile organic compounds (VOC) or are composed entirely of exempt VOC's, for use on military systems. The word 'cleaners' throughout the specification means both 'general cleaners' and 'cleaning compounds' (more than one component). All classifications and requirements refer to the cleaner at the concentration for which it is to be used.

1.2 Classification. The cleaners are of the following classes, types, and grades, as specified (see 6.2).

1.2.1 Classes. The classes of cleaners are based on containing or not containing water and are as follows:

Class 1 - Aqueous (contains water).

Class 2 - Non-aqueous (does not contain water).

1.2.2 Types. The types of cleaners are based on VOC and vapor pressures and are as follows:

Type I - VOC exempt/VOC free.

Type II - A maximum vapor pressure ≤ 1 mm Hg at 20 °C (68 °F).

Comments, suggestions, or questions on this document should be addressed to: Director, U.S. Army Research Laboratory, Weapons and Materials Research Directorate, Materials and Manufacturing Technology Branch, Specifications and Standards Office, Attn: RDRL-WMM-D, Aberdeen Proving Ground, MD 21005-5069 or emailed to richard.j.squillaciotti.civ@mail.mil . Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil .

AMSC N/A

FSC 6850

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Type III - A maximum vapor pressure ≤ 7 mm Hg at 20 °C (68 °F).

Type IV - A VOC level ≤ 25 g/L and a maximum vapor pressure ≤ 7 mm Hg at 20°C (68 °F).

Type V - No limit on VOC level or vapor pressure.

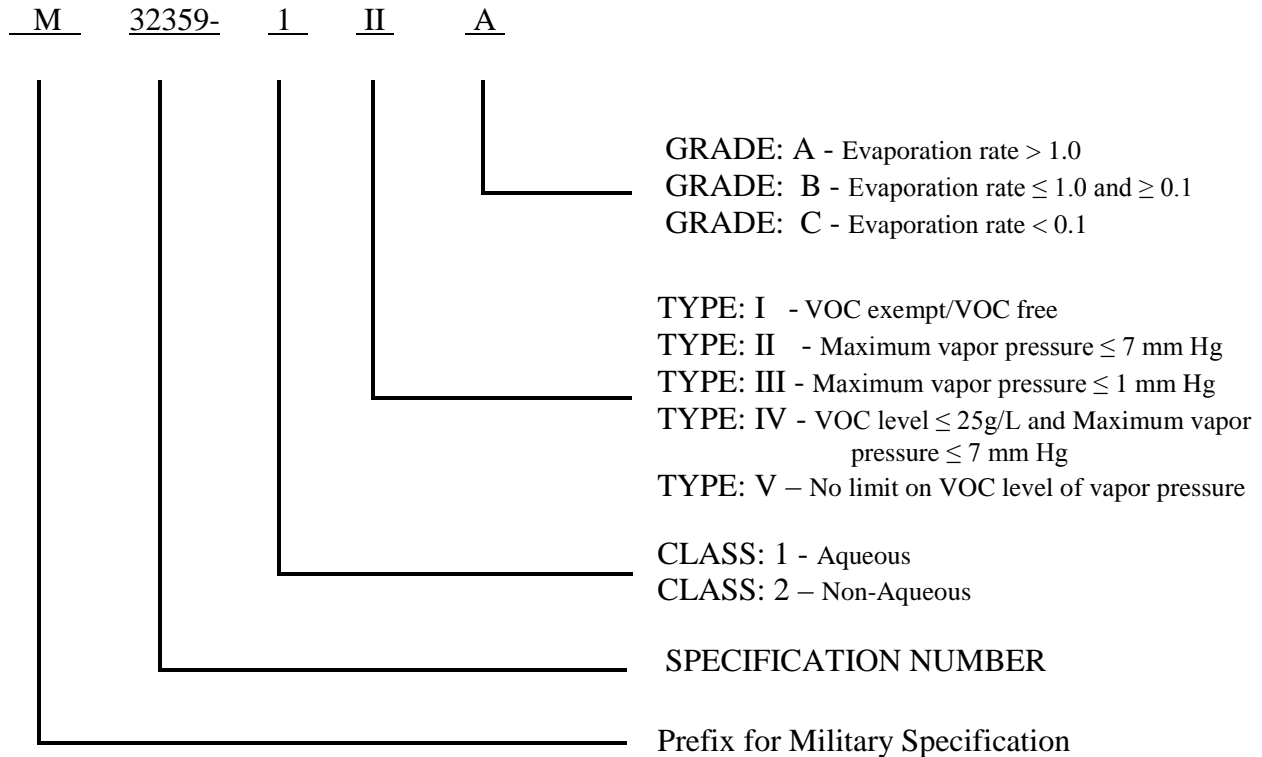
1.2.3 Grades. The cleaners and cleaning compounds are of the following grades based on evaporation rate.

Grade A - An evaporation rate > 1.0 (where n-butyl acetate = 1.0).

Grade B - An evaporation rate ≤ 1.0 and ≥ 0.1 (where n-butyl acetate = 1.0).

Grade C - An evaporation rate < 0.1 (where n-butyl acetate = 1.0).

1.3 Part or Identifying Number (PIN). PINs to be used for cleaners acquired by this specification are created as follows:



2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

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2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified (see 6.2), the issues of these documents are those cited in the solicitation or contract.

FEDERAL SPECIFICATIONS

- TT-C-490 - Chemical Conversion Coatings and Pretreatments for Ferrous Surfaces (Base for Organic Coatings)

FEDERAL STANDARDS

- FED-STD-791 - Testing Method of Lubricants, Liquid Fuels, and Related Products

DEPARTMENT OF DEFENSE SPECIFICATIONS

- MIL-A-8625 - Anodic Coatings for Aluminum and Aluminum Alloys
 MIL-PRF-10924 - Grease, Automotive and Artillery
 DOD-P-15328 - Primer (Wash), Pretreatment (Formula No. 117 for Metals)
 MIL-DTL-53022 - Primer, Epoxy Coating, Corrosion Inhibiting, Lead and Chromate Free
 MIL-DTL-53030 - Primer Coating, Epoxy, Water Based, Lead and Chromate Free
 MIL-DTL-53039 - Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant
 MIL-DTL-64159 - Camouflage Coating, Water Dispersible Aliphatic Polyurethane, Chemical Agent Resistant

(Copies of these documents are available online at <https://assist.dla.mil/quicksearch/> or <https://assist.dla.mil> from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified (see 6.2), the issues of these documents are those cited in the solicitation or contract

CODE OF FEDERAL REGULATIONS (CFR)

- 40 CFR 63 - National Emission Standards for Hazardous Air Pollutants for Source Categories
 40 CFR 63-.750 - Test methods and procedures.
 40 CFR 261 - Identification and Listing of Hazardous Waste
 40 CFR 401.15 - Protection of Environment (Toxic pollutants)

(Copies of this document are available online at <http://www.gpoaccess.gov/cfr/> or from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-0001.)

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SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Method 313 - Determination of Volatile Organic Compounds (VOC) by Gas Chromatography/Mass Spectrometry (GC/MS)

(Copies of these documents are available online at <http://www.aqmd.gov/> or from South Coast Air Quality Management District, 21865 Copley Drive, Diamond Bar, CA 91765.)

2.3 Non-Government publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated (see 6.2), the issue in effect on date of invitation for bids or request for proposal should apply.

ASTM INTERNATIONAL

ASTM B209	-	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM D56	-	Standard Test Method for Flash Point by Tag Closed Cup Tester
ASTM D130	-	Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
ASTM D471	-	Standard Test Method for Rubber Property—Effect of Liquids
ASTM D1353	-	Standard Test Method for Nonvolatile Matter in Volatile Solvents for Use in Paint, Varnish, Lacquer, and Related Products
ASTM E70	-	Standard Test Method for pH of Aqueous Solutions with the Glass Electrode
ASTM E2008	-	Standard Test Method for Volatility Rate by Thermogravimetry
ASTM F483	-	Standard Test Method for Total Immersion Corrosion Test for Aircraft Maintenance Chemicals
ASTM F484	-	Standard Test Method for Stress Cracking of Acrylic Plastics in Contact with Liquid or Semi-liquid Compounds
ASTM F485	-	Standard Practice for Effects of Cleaners on Unpainted Aircraft Surfaces
ASTM F502	-	Standard Test Method for Effects of Cleaning and Chemical Maintenance Materials on Painted Aircraft Surfaces
ASTM F519	-	Standard Test Method for Mechanical Hydrogen Embrittlement Evaluation of Plating/Coating Processes and Service Environments
ASTM F945	-	Standard Test Method for Stress-Corrosion of Titanium Alloys by Aircraft Engine Cleaning Materials
ASTM F1110	-	Standard Test Method for Sandwich Corrosion Test
ASTM F1111	-	Standard Test Method for Corrosion of Low-Embrittling Cadmium Plate by Aircraft Maintenance Chemicals

(Copies of these documents are available from www.astm.org or ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959.)

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SAE INTERNATIONAL

AMS 2470	-	Anodic Treatment of Aluminum Alloys, Chromic Acid Process
AMS 4377	-	Magnesium Alloy, Sheet and Plate, 3.0Al - 1.0Zn - 0.20Mn (AZ31B-H24), Cold Rolled, Partially Annealed
AMS 4911	-	Titanium Alloy, Sheet, Strip, and Plate, 6Al - 4V, Annealed
AMS 5046	-	Carbon Steel, Sheet, Strip, and Plate, (SAE 1020 and 1025), Annealed
AMS-M-3171	-	Magnesium Alloy, Processes for Pretreatment and Prevention of Corrosion

(Copies of these documents are available from <http://www.sae.org> or SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. The cleaning compound furnished under this specification shall be a product which has been tested by a certified 3rd party testing facility approved by the qualifying activity and has passed the qualification tests specified herein and has been listed or approved for listing on the applicable Qualified Products Database (QPD) by the qualifying activity (see 3.1.1, 3.1.2, 4.2, 4.3, 4.4 and 6.3) before contract award. Any change in the chemical formulation, the material, the process, or the procedure in manufacturing the cleaning compound shall necessitate its being qualified again. Any change requires a complete requalification. The material supplied under contract shall be identical, within manufacturing tolerances, to the products receiving qualification. Any cleaning compound that does not conform to all the qualification tests specified herein shall be removed from the QPD.

3.1.1 Retention of qualification. To retain qualification approval of products listed on the Qualified Products Database (QPD), the manufacturer shall be required to verify by certification to the qualifying activity that its product(s) comply with the requirements of this specification. Unless otherwise specified by the qualifying activity (see 6.2), the time of periodic verification by certification shall be in two-year intervals from the date of original qualification (see 4.3). The certification action is initiated by the qualifying activity.

3.1.2 Qualifying activity. The activity responsible for the collection and storage of cleaning compounds certifications that are required to be furnished under this specification for qualification and conformance testing is the Specifications & Standards Office, Materials Manufacturing Technologies Branch, Material & Manufacturing Science Division, ATTN: RDRL-WMM-D, Army Research Laboratory located at Aberdeen Proving Ground, MD, 21005-5069.

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3.2. Material. The materials used in the cleaning compound that are supplied under this specification shall be as specified herein. The materials not specified shall be selected by the contractor and shall be subjected to all the provisions of this specification.

3.2.1 Composition. The composition of the cleaning compound shall be the same as that of the sample furnished for qualification testing. Any change in the formulation of a qualified product shall require requalification. A document specifying the composition shall be forwarded to the Commander, US Army Public Health Command, 5158 Blackhawk Road, Aberdeen Proving Ground, MD 21010-5403.

3.2.2 Prohibited materials. The cleaning compound shall not contain any hazardous ingredients as defined in 40 CFR 261, toxic pollutants as defined in 40 CFR 401.15, nor hazardous air pollutants as defined in 40 CFR 63.

3.2.2.1 Toxicity. The cleaning compound shall not contain any chemical listed by the current report of known carcinogens of the National Toxicology Program (NTP) (see 6.4.1). Any carcinogenic components in the cleaner in a concentration of 0.1 percent or greater by weight or volume will be regarded as sufficient for the presence of a carcinogen in the cleaner. The cleaners supplied under this specification shall have no adverse effect on human health (see 6.5) when used for their intended purpose (see 6.1). Army toxicity questions and/or a toxicity clearance request should be addressed to: Commander, US Army Public Health Command.

3.2.2.2 Hazardous Air Pollutants. The cleaner shall contain no chemicals listed as Hazardous Air Pollutants (HAPs) (see 6.4.2). Any HAP components in the cleaner in a concentration of 1.0 percent or greater by weight or volume will be regarded as sufficient for the presence of HAP in the cleaner. The product containing less than 1% of HAP shall be considered as a HAP-free cleaner. For carcinogenic HAPs see 3.2.2.1.

3.2.2.3 Documentation. A certified letter from the U.S. Army Public Health Command (USAPHC), confirming the requirements of this section (3.2.2) shall be sent to the Specifications & Standards Office, Materials Manufacturing Technologies Branch, Material & Manufacturing Science Division, ATTN: RDRL-WMM-D, Army Research Laboratory located at Aberdeen Proving Ground, MD, 21005-5069, in accordance with paragraph 3.2.2.1 and 3.2.2.2.

3.3 Performance and physical requirements. The cleaning compound shall meet all the requirements listed in Table I when tested in accordance with Table V.

3.4 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable (biodegraded) materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

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TABLE I. Performance and physical requirements.

PROPERTY	TEST METHODS	REQUIREMENTS	
		CLASS 1	CLASS 2
Total Immersion Corrosion Test	ASTM F483	There shall be no indication of staining, etching, pitting, or localized corrosion, or cause weight change greater than that shown in Table II (see 4.9.1)	
Corrosion of Low-Embrittling Cadmium Plate	ASTM F1111	Weight change < 0.14 mg/cm ² per day	
Sandwich Corrosion Test	ASTM F1110	Rating ≤ 1	
Hydrogen Embrittlement	ASTM F519	No failures before 200 hours for Cd coated 4340 steel, Type 1a specimens	N/A
Effect of Cleaners on Unpainted Surfaces	ASTM F485	No streaking, staining not easily removed by hand pressure and water	
Stress Corrosion of Titanium Alloys	ASTM F945	No cracking of Ti-6Al-4V	
Effects on Painted Surfaces	ASTM F502	Coatings to be tested in accordance with Table VI with no softening in excess of 1 pencil hardness change compared to an equivalent untested, unexposed specimen	
Stress Cracking of Acrylic Plastics, Types A & C	ASTM F484	No crazing or staining	
Rubber Property - Effect of Liquids	ASTM D471	Materials are to be tested by the requirements given in Table III.	
Flash Point	ASTM D56	> 60°C (140° F)	
pH of Aqueous Solutions	ASTM E70	> 3.0 and < 10.0	N/A
VOC content, g/L	SCAQMD Method 313	See type classifications for requirements (see 1.2.2).	
Vapor pressure, mm Hg	40 CFR 63.750	See type classifications for requirements (see 1.2.2).	
Nonvolatile Matter in Volatile Solvents	ASTM D1353	< 8 mg/100 mL	
Cleaning Efficiency	4.9.3	The cleaning efficiency shall be greater than 75%.	
Low Temperature Stability	4.9.4	The undiluted cleaning compound shall be homogeneous and shall not separate, layer, or visibly deteriorate.	
Accelerated Storage Stability	4.9.5	No separation or effect on steel strip. Cleaning efficiency shall be no less than freshly made control formula.	
Shelf-life	See 6.2 & 6.6	Specific shelf-life requirements should be specified in the contract or purchase order	
Copper Strip Corrosion	ASTM D130	Copper Strip Classifications of maximum 1b	
Evaporation rate	ASTM E2008	In conformance with the grade of the cleaner.	

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TABLE II. Allowable loss for Total Immersion Corrosion Test

ALLOYS	ALLOWABLE LOSS (mg/cm ²)
Magnesium - AZ 31B-H24, AMS 4377, AMS-M-3171 surface treatment	0.5
Aluminum - 2024, T3, AMS 2470 surface treatment	0.15
Titanium - 6Al-4V, AMS 4911	0.1
Steel - Grade 1020, AMS 5046	0.25
Aluminum - 6061, T6, ASTM B 209	0.2

Table III. Rubber Property - Effect of Liquids after 22 hour immersion at 23°C ± 2°C (73°F ± 4°F).

RUBBER	<u>DUROMETER HARDNESS</u> (CHANGE IN UNITS) ^{1/}	<u>VOLUME</u> (CHANGE IN UNITS) ^{1/}
Buna-N	10 IRHD ^{2/}	5%
Buna-S	10 IRHD	5%
Polychloroprene	10 IRHD	5%
Hypalon-40	10 IRHD	5%
Ethylene Propylene	10 IRHD	5%
KEL-F	10 IRHD	5%
Thiokol FA	10 IRHD	5%
Adiprene	10 IRHD	5%
Viton - 75DH	10 IRHD	5%
Viton - 90DH	10 IRHD	5%
Silicone, Class VMQ	10 IRHD	5%

^{1/} Data compared to equivalent untested, unexposed specimen.

^{2/} IRHD: International Rubber Hardness Degrees. For highly elastic materials, IRHD and Shore A are comparable.

4. VERIFICATION

4.1 Classification of inspection. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Retention qualification (see 4.3).
- c. Conformance inspection (see 4.4).

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4.2 Qualification inspection. Qualification inspection shall consist of all inspections and tests specified in Table V. Failure of any test shall be cause for rejection.

4.2.1 Qualification samples. The initial qualification samples shall consist of the required amount of the cleaning compound that is needed by the testing facilities (see 6.3.2). The cleaning compound shall be of the class, type, and grade to be used in filling contract orders. Samples shall be identified (see 6.3.1.1) and forwarded to the appropriate testing facility, and the subsequent testing reports (see 4.2.2) shall be forwarded to the qualifying activity (see 3.1.2) for retention.

4.2.2 Test reports. The manufacturer shall provide certified test reports showing that the material conforms to all the requirements of this specification (see 6.3.1).

4.3 Retention qualification. To ensure compliance with all the requirements of this specification the manufacturer shall complete DD Form 1718 (Certification of Qualified Products) for each plant location and certify that the statements listed on the DD Form 1718 are true. Unless otherwise specified by the qualifying activity (see 6.2), the time of periodic verification by certification shall be in two-year intervals from the date of original qualification (see 3.1.1).

4.4 Conformance inspection. Conformance inspection shall consist of the satisfaction of all of the requirements identified as conformance in Table V. If a lot fails any of the above acceptance tests during conformance testing, all required qualification tests shall be reinstated. These qualification tests shall be required until two successive lots meet all requirements of the specification, after which conformance testing shall again be authorized.

4.5 Lot. A lot shall consist of one of the following.

4.5.1 Lot 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.

4.5.2 Lot 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, or purified forming the product.

4.5.3 Lot C. The cleaning compound from either or both the continuous and batch processes shall be held in a single storage tank and subsequently withdrawn to fill shipping containers. The product shall 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.

4.6 Sampling of product. Unless otherwise specified in the contract or purchase order (see 6.2), conformance inspection (4.4) 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 IV. The first and last containers to be filled within a given lot shall be sampled. Other containers shall be selected at random. The samples may be obtained in any convenient manner that does not compromise the integrity of the sample.

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TABLE IV. Number of Containers to be sampled.

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

4.7 Inspection of materials. The manufacturer is responsible for ensuring 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 2.4)

4.8 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 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 only from a sealed container.

4.9 Test methods. The tests of this specification shall be conducted in accordance with the applicable methods specified in Table V and paragraphs 4.9.1 through 4.9.7. The cleaning compound that is required to satisfy all the tests specified in 4.9 shall be selected at random from each lot. The contents of each selected container for sampling shall be thoroughly mixed by rolling and inverting immediately prior to sampling.

4.9.1 Total immersion corrosion. The cleaners shall be tested in accordance with ASTM F 483. The results shall be recorded as an average of three (3) test panels (see Table 1).

4.9.2 Rubber Property-Effect of Liquids. The cleaners shall be tested in accordance with ASTM D471. The test temperature shall be $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($73^{\circ}\text{F} \pm 4^{\circ}\text{F}$) and the test time shall be 22 hours in accordance with Table III.

4.9.3 Soil cleaning test (cleaning efficiency). The test shall be conducted according to the solvent soil test method described in FED-STD-791, Method 7502 (Solvent Cleaning Power by a Soil Test Method), modified by limits on the ultrasonic device. These limits are: The ultrasonic cleaner shall

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have a frequency of 40 kHz \pm 5 kHz and a bath power of 120 watt/gal \pm 10 watt/gal. The soil used in this evaluation is MIL-PRF-10924 grease. The acceptable limits for each class of cleaner are defined in Table I.

TABLE V. Properties and test methods.

PROPERTY	TEST METHOD	REFERENCE PARAGRAPH	TESTING	
			QUALIFICATION	COMFORMANCE
Total Immersion Corrosion Test	ASTM F483	4.9.1 & Table I	X	X
Corrosion of Low-Embrittling Cadmium Plate	ASTM F1111	Table I	X	
Sandwich Corrosion Test	ASTM F1110	Table I	X	
Hydrogen Embrittlement	ASTM F519	Table I	X	
Effect of Cleaners on Unpainted Aircraft Surfaces	ASTM F485	Table I	X	
Stress Corrosion of Titanium Alloys	ASTM F945	Table I	X	
Effects of Cleaning and Chemical Maintenance Materials on Painted Aircraft Surfaces	ASTM F502	Table VI	X	
Stress Cracking of Acrylic Plastics	ASTM F484	Table I	X	X
Rubber Property - Effect of Liquids	ASTM D471	4.9.2 & Table III	X	
Flash Point	ASTM D56	Table I	X	X
pH of Aqueous Solutions	ASTM E70	Table I	X	X
VOC content, g/l	SCAQMD Method 313	Table I	X	X
Vapor pressure, mm Hg	40 CFR 63.750	Table I	X	
Nonvolatile Matter in Volatile Solvents	ASTM D1353	Table I	X	
Cleaning Efficiency	4.9.3 and Table I		X	X
Shelf-life	See 6.2 & 6.6		Specific shelf-life requirements should be specified in the contract or purchase order	
Low Temperature Stability	4.9.4 and Table I		X	
Accelerated Storage Stability	4.9.5 and Table I		X	
Copper Strip Corrosion	ASTM D130	4.9.6	X	X
Evaporation rate	ASTM E2008	4.9.7	X	

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TABLE VI. Effects on Painted Surfaces ASTM F 502

COATINGS TO BE TESTED		SURFACE TREATMENT
PRIMER	TOPCOAT	
MIL-DTL-53022	MIL-DTL-64159 or MIL-DTL-53039	MIL-A-8625 Type I
MIL-DTL-53022	MIL-DTL-64159 or MIL-DTL-53039	TT-C-490
MIL-DTL-53022	MIL-DTL-64159 or MIL-DTL-53039	DOD-P-15328
MIL-DTL-53030	MIL-DTL-64159 or MIL-DTL-53039	MIL-A-8625 Type I
MIL-DTL-53030	MIL-DTL-64159 or MIL-DTL-53039	TT-C-490
MIL-DTL-53030	MIL-DTL-64159 or MIL-DTL-53039	DOD-P-15328

4.9.4 Low temperature stability Approximately 50 mL of the sample shall be poured into a suitable size test tube and cooled to $-18^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ($0^{\circ}\text{F} \pm 9^{\circ}\text{F}$). This temperature shall be maintained for one hour. The compound shall then be allowed to reach room temperature. After five inversions of the test tube, the compound shall be examined for homogeneity.

4.9.5 Accelerated Storage Stability.

4.9.5.1 Preparation of test sample. A 20.4 oz (600 mL) portion of a well-shaken cleaning compound shall be poured into a clean pressure resistant clear glass bottle that is of sufficient size to contain all of the cleaner and to allow insertion of the steel coupon. A strip of steel 6.0 x 0.50 x 0.20 in (15.2 x 1.30 x 0.05 cm) conforming to SAE-AMS 5046 shall be polished with 280-grit silicon carbide paper to remove surface contamination and then cleaned by boiling for one minute in mineral spirits and one minute in isopropyl alcohol. The steel strip shall be placed in the test bottle and the bottle capped. The bottle shall then be inverted to completely coat the steel strip.

4.9.5.2 Procedure. The capped bottle containing the steel strip shall be placed in a hot water bath held at $60^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($140^{\circ}\text{F} \pm 4^{\circ}\text{F}$) for 8 hours. The bath and the bottle shall then be allowed to cool for 16 hours and the 24 hour cycle repeated each day for a total of seven days. On the eighth day, the bottle shall be removed from the bath, uncapped, examined for separation, and the steel strip withdrawn and examined for corrosion. The aged sample shall be tested for cleaning efficiency in accordance with 4.9.3.

4.9.6 Copper corrosion. The test shall be performed in accordance with ASTM D130 for 3 hours at 100°C (212°F).

4.9.7 Evaporation rate. The average volatility rate of the cleaner and of a control sample of n-butyl acetate shall be measured in accordance with ASTM E2008. The volatility rates shall each be the average of three measurements, each measurement performed at a constant temperature of 50°C (122°F). Divide the average volatility rate of the cleaner by the average volatility rate of n-butyl acetate to obtain comparative volatility ratio.

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5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel components are to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The general cleaners specified by this specification can be used in military ground and support vehicles/equipment, if applicable. In addition, the cleaners specified in this specification were not tested for parts washer cleaning applications. The cleaning method should be identified as either immersion, spray, or hand wipe.

6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number, and date of this specification.
- b. Specify class, type, and grade of the cleaner (see 1.2).
- c. If issues of documents are different (see 2.2.1, 2.2.2, and 2.3).
- d. If the time of periodic verification is different (see 3.1.1 and 4.3).
- e. Specify shelf life requirements (see Table I, Table V, and 6.6).
- f. If conformance tests are to be made on different samples than those specified (see 4.6).
- g. If packaging requirements are different (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products Database (QPD) -32359, whether or not such products have actually been so listed by that date. The attention of manufacturers is called to this requirement and manufacturers are urged to arrange to have the 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 purchase orders for the products covered by this specification. Information (questions, etc.) pertaining to qualification and testing of products and the certified test results from the approved testing facility for the qualified products database (QPD) testing (see 4.2) and for the conformance program (see 4.4) should be submitted to the Specifications & Standards Office, Materials Manufacturing Technologies Branch, Material & Manufacturing Science Division, Attn: RDRL-WMM-D, Army Research Laboratory located at Aberdeen Proving Ground, MD, 21005-5069.

6.3.1 Inspection, and other information. In addition to the qualification test samples, the qualifying activity will request the manufacturer to submit to the qualification activity: (a) a certified test report showing that the material conforms to the requirements of this specification (see 4.2.2); (b) one copy

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of the MSDS (see 6.5); (c) certification that the manufacturer's material meets the HAP and VOC content requirement (see Table I, 1.2.2 and 3.2.2).

6.3.1.1 Qualification inspection sample identification. Qualification inspection samples are to be forwarded to the laboratory designated in the letter of authorization (see 6.3) and identified as follows:

QUALIFICATION TEST SAMPLES

Specification MIL-PRF-32359; Class 1 or 2; Type I, II, III, IV, or V; Grade A, B, or C (as applicable)

CLEANER, GENERAL, FOR GROUND VEHICLES AND GROUND SUPPORT EQUIPMENT,
HAP-FREE

Manufacturer's name and product number
Submitted by (name and date) for qualification testing in accordance with authorization
(reference authorizing letter)

6.3.2 Testing facilities. The testing facilities identified below can each do some of the required tests, however, all the tests can be performed by a combination of those facilities listed below. Please note that this list is not an exclusive list. The list was prepared for your convenience only. There are other facilities that are capable of performing the required tests. The South Coast Air Quality Management District (SCAQMD) can perform only the combined VOC Content and Vapor Pressure tests.

SMI, Inc.
12219 SW 131 Avenue
Miami, FL 33186-6401 USA
Ph: 305-971-7047
Attn: Patricia D. Viani, President

Petro-Lube Test Labs.
116 Sunset Inn Road
P.O. Box 300
Lafayette, NJ 07848
Ph: 973-579-3448
Attn: Josiah Wintermute

South Coast Air Quality Management District
21865 Copley Dr.
Diamond Bar, CA 91765
Ph: 909-396-2000

6.3.2.1 Test methods' estimated quantity and costs. The quantity and costs for the specific tests required by this document are given below in Table VII. These costs are typical and may be somewhat different from those found in new quotes. The approximate time to complete all tests is ten weeks.

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TABLE VII. Quantity and costs for required tests

SPECIFIC TEST	TEST METHOD	QUANTITY (mL)	APPROXIMATE COST
Total Immersion Corrosion Test	ASTM F483 (5 specimens)	1000	\$900
Corrosion of Low-Embrittling Cadmium Plate	ASTM F1111	400	\$200
Sandwich Corrosion Test	ASTM F1110	200	\$500
Hydrogen Embrittlement	ASTM F519 (type 1a specimens)	400	\$600
Effect of Cleaners on Unpainted Surfaces	ASTM F485	800	\$200
Stress Corrosion of Titanium Alloys	ASTM F945	400	\$500
Effects on Painted Surfaces	ASTM F502 (6 specimens)	400	\$800
Stress Cracking of Acrylic Plastics	ASTM F484 (types A and C)	200	\$300
Rubber Property - Effect of Liquids	ASTM D471 (11 specimens)	800	\$1,500
Flash Point	ASTM D56	100	\$300
pH of Aqueous Solutions	ASTM E70	100	\$100
VOC content, g/L	SCAQMD Method 313	200	\$800
Vapor pressure, mm Hg	40 CFR 63.750		
Nonvolatile Matter in Volatile Solvents	ASTM D1353	200	\$300
Cleaning Efficiency	FED-STD-791, Method 7502 (MIL-PRF-680, App A)	1200	\$300
Low Temperature Stability	MIL-PRF-85570D, section 4.5.8	100	\$100
Accelerated Storage Stability	MIL-PRF-85570D, section 4.5.2	1200	\$400
Copper Strip Corrosion	ASTM D130	200	\$200
Evaporation Rate	ASTM E2008	100	\$400

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6.4 Definitions.

6.4.1 Carcinogens. The Occupational Safety and Health Administration (OSHA) definition of carcinogens is those chemicals / processes appearing in lists 1, 2A, and 2B of the International Agency for Research on Cancer (IARC)^{1/}; substances known to be carcinogenic and occupational exposures associated with a technological process known to be carcinogenic by the National Toxicology Program (NTP) Report on Carcinogens (latest annual report)^{2/}; and OSHA regulated carcinogens^{3/}.

^{1/} Copies of these volumes may be found in medical libraries or through the World Health Organization, 1211 Geneva 27, Switzerland.

^{2/} Copies may be obtained from the Public Health Service, National Toxicology Program, Public Information Office, P.O. Box 12233, MD B2-04, Research Triangle Park, NC 27709 or at <http://ntp-server.niehs.nih.gov>.

^{3/} Copies may be found in 29 CFR part 1910 Subpart Z.

6.4.2 Hazardous Air Pollutant (HAP). HAP is defined as any substance listed under Section 112 of the Clean Air Act or its modifications. The text of the Clean Air Act, listed pollutants and modifications are kept by the Environmental Protection Agency (EPA) and are accessible through the website: <http://www.epa.gov>.

6.4.3 Volatile organic compound (VOC). VOC is defined in 40 CFR Part 51.100 (s). Volatile organic compounds (VOC) means any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. For the latest complete definition of VOC see: http://www.epa.gov/ttn/naaqs/ozone/ozonetech/def_voc.htm.

6.4.3.1 Exempt VOC. A list of exempt VOC is listed in 40 CFR Part 51.100 (s). For the current list of exempt organic compounds see: http://www.epa.gov/ttn/naaqs/ozone/ozonetech/def_voc.htm. Compounds that are explicitly exempted from regulation by the EPA as VOCs are those compounds of carbon that have negligible photochemical reactivity (they do not produce ozone in atmospheric reactions).

6.4.4 Hand-wipe cleaning. Hand-wipe cleaning operation means the removal of contaminants such as dirt, grease, oil, and coatings from a substrate by physically rubbing with a material such as a rag, paper, or cotton swab that has been moistened with a cleaning solvent.

6.5 Material Safety Data Sheet (MSDS). An MSDS must be prepared and submitted in accordance with FED-STD-313. The MSDS must also meet the requirements of 29 CFR 1910.1200. The 29 CFR 1910.1200 requires that the MSDS for each hazardous chemical used in an operation must be readily available to personnel using the material. Questions pertinent to the effect(s) of these cleaners on the health of personnel using them should be referred by the procuring activity to the appropriate medical service, who will act as its adviser. Contracting officers will identify the activities requiring copies of the MSDS.

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6.6 Shelf-life. This specification covers items where the assignment of a Federal shelf-life code is a consideration. Specific shelf-life requirements should be specified in the contract or purchase order, and should include, as a minimum, shelf-life code, shelf-life package markings in accordance with MIL-STD-129 or FED-STD-123, preparation of a materiel quality storage standard for type II (extendible) shelf-life items, and a minimum of 85 percent shelf-life remaining at time of receipt by the Government. These and other requirements, if necessary, are in DoD 4140.27-M, Shelf-life Management Manual. The shelf-life codes are in the Federal Logistics Information System Total Item Record. Additive information for shelf-life management may be obtained from DoD 4140.27-M, or the designated shelf-life Points of Contact (POC). The POC should be contacted in the following order:

- (1) the Inventory Control Points that manage the item and
- (2) the DoD Service and Agency administrators for the DoD Shelf-Life Program.

Appropriate POCs for the DoD Shelf-Life Program can be contacted through the DoD Shelf-Life Management website: <https://www.shelflife.hq.dla.mil/>

6.7 Subject term (key word) listing.

Aqueous
Environmental
Non-aqueous
Non-aviation
Non-hazardous

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CONCLUDING MATERIAL

Custodians:

Army - MR
Navy - SH
Air Force - 68

Preparing activity:

Army – MR
(Project 6850-2008-003)

Review activities:

Army - AT, EA, GL
Navy - AS, CG, MC
Air Force - 03, 50, 84, 99
DLA - GS, GS3
GSA - FAS
MISC – MP

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.