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MIL-PRF-680C
25 March 2010
SUPERSEDING
MIL-PRF-680B
26 October 2006

PERFORMANCE SPECIFICATION

DEGREASING SOLVENT

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

1. SCOPE

1.1 Scope. This specification covers degreasing solvent that consists of five types of petroleum distillates. The different types are referred to as "Stoddard solvent", "141 degrees Fahrenheit (°F) (60.6 degrees Celsius (°C)) solvent", "200°F (93.3°C) solvent", "141°F d-limonene blended solvent" and "Low Volatile Organic Compound (VOC) solvent". They are used for degreasing of machine parts in equipment maintenance.

1.2 Classification. Degreasing solvents are of the following types (see 6.2).

Type I	- Low flash point (Stoddard solvent) (Military Symbol SD-1)
Type II	- High flash point (Military Symbol SD-2)
Type III	- Very high flash point (200°F) (Military Symbol SD-3)
Type IV	- High flash point with citrus odor (Military Symbol SD-4)
Type V	- Low VOC solvent (Military Symbol SD-5)

1.2.1 NATO classification:

Type I	- S-752
Type II	- S-753
Type III	- S-760
Type IV	- None
Type V	- None

2. APPLICABLE DOCUMENTS

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: U.S. Army Tank-Automotive Research & Development Center, ATTN: RDTA-EN/ STND/TRANS, Warren, MI 48397-5000, or email dami_standardization@conus.army.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.daps.dla.mil .

AMSC N/A FSC 6850

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2.1 General. The documents listed in this section are specified in sections 3, 4, and 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 requirement documents cited in sections 3, 4, and 5 of this specification, whether or not they are listed.

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, the issues of these documents are those cited in the solicitation or contract.

STANDARD

FEDERAL

FED-STD-791 - Lubricants, Liquid Fuels and Related Products; Methods of Testing.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Service, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094 or at https://assist.daps.dla.mil.

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, the issues of these documents are those cited in the solicitation or contract.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA Method 420.1 - Methods for Phenolics, Total Recoverable (Spectrophotometric, Manual 4-AAP with Distillation)
EPA Method 3585 - Method for Waste Dilution for Volatile Organics.
EPA Method 8260B - Method for Volatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS).

(Application for copies should be addressed to the US EPA Headquarters, 401 M Street SW, mail code 3204, Washington, DC 20460 or at http://www.epa.gov).

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

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

(Application for copies should be addressed to the South Coast Air Quality Management District, 21865 Copley Drive, Diamond Bar, CA 91765 or at http://www.aqmd.gov)

2.3 Non-Government publications. The following document forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation.

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Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN SOCIETY FOR QUALITY (ASQ)

Z1.4	- Sampling Procedures and Tables for Inspection by Attributes (DoD adopted).

(Application for copies should be addressed to the American Society for Quality, P.O. Box 3005, Milwaukee, WI 53201-3005 or at http://www.asq.org).

ASTM INTERNATIONAL

D 56	- Standard Test Method for Flash Point by Tag Closed Cup Tester
D 86	- Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure
D 130	- Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
D 156	- Standard Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method)
D 235	- Standard Test Method for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry-Cleaning Solvent)
D 847	- Standard Test Method for Acidity of Benzene, Toluene, Xylenes, Solvent Naphthas, and Similar Industrial Aromatic Hydrocarbons
D 1133	- Standard Test Method for Kauri-Butanol Value of Hydrocarbon Solvents
D 1296	- Standard Test Method for Odor of Volatile Solvents and Diluents
D 1298	- Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
D 1353	- Standard Test Method for Nonvolatile Matter in Volatile Solvents for Use in Paint, Varnish, Lacquer, and Related Products
D 2879	- Standard Test Method for Vapor Pressure-Temperature Relationship and Initial Decomposition Temperature of Liquids by Isoteniscope
D 3257	- Standard Test Method for Aromatics in Mineral Spirits by Gas Chromatography
D 4057	- Standard Practice for Manual Sampling of Petroleum and Petroleum Products
D 4177	- Standard Practice for Automatic Sampling of Petroleum and Petroleum Products

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F 483	- Standard Practice for Total Immersion Corrosion Test for Aircraft Maintenance Chemicals
F 945	- Standard Test Method for Stress-Corrosion of Titanium Alloys by Aircraft Engine Cleaning Materials
F 1110	- Standard Test Method for Sandwich Corrosion Test

(Application for copies should be addressed to ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or at http://www.astm.org).

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) INTERNATIONAL

AMS-QQ-A-250	- Aluminum and Aluminum Alloy, Plate and Sheet, General Specification for (DoD adopted).
AMS 2470	- Anodic Treatment of Aluminum Alloys Chrome Acid Process (DoD adopted).
AMS M 3171	- Magnesium Alloy, Processes for Pretreatment and Prevention of Corrosion on (DoD adopted).
AMS 4377	- Magnesium Alloy, Sheet and Plate 3.0A1-1.0Zn-0.20Mn (AZ31B-H24) Cold Rolled, Partially Annealed
AMS 4911	- Titanium Alloy Sheet, Strip, and Plate, 6AI-4V Annealed
AMS 5046	- Carbon Steel Sheet, Strip, and Plate, (SAE 1020 and 1025) Annealed

(Application for copies should be addressed to 400 Commonwealth Drive, Warrendale, PA 15096-0001 or at http://www.sae.org).

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

3. REQUIREMENTS

3.1 Qualification. Solvents furnished under this specification shall be products that are authorized by the qualifying activity for listing on applicable qualified products list before contract award (see 4.2 and 6.3). Any change in the formulation of a qualified product will necessitate its requalification.

3.2 Materials. The hydrocarbon solvent shall be a virgin grade or recycled solvent derived from petroleum distillates, fraction from reclaiming and re-refining processes, or a mixture of these fractions. The d-limonene and hydrocarbon blended solvent is permitted as a Type IV solvent. The EPA exempt materials and hydrocarbon blended solvent is also permitted as a Type V solvent. The resultant solvent must be produced in such a manner as is necessary to meet the specified requirements.

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3.3 Appearance. The solvent shall be clear and free from suspended matter and undissolved water when observed at a temperature between 60.1 and 78.1°F (15.6 and 25.6 °C).

3.4 Toxicity. The solvent shall have no adverse effects on human health when used as intended (see 6.1 and 6.6).

3.5 Carcinogenicity. The solvent shall contain no chemicals listed as carcinogens (see 6.7). Any carcinogenic components in the solvent in a concentration of 0.1 percent (%) or greater by weight (wt) or volume (vol) will be regarded as the presence of a carcinogen in the solvent.

3.6 Hazardous Air Pollutants. The solvent shall contain no chemicals listed as Hazardous Air Pollutants (HAPs) (see 6.7). Any HAP components in the solvent in a concentration of 1.0 percent (%) or greater by weight (wt) or volume (vol) will be regarded as the presence of a HAP in the solvent. The product containing less than 1 % of HAP shall be considered as a HAP free solvent. For carcinogenic HAPs see 3.5.

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3.7 Physical and chemical property requirements. The solvents shall conform to the physical and chemical requirements in Table I when tested as specified in Table II.

TABLE I. Degreasing solvent properties.

Characteristics	Type I	Type II	Type III	Type IV	Type V
Flash point (pt), °C (°F)	38-60	61–92	93-116	61–92	61-92
	(100-140)	(141-198)	(200-241)	(141-198)	(141-198)
Distillation, °C:					
Initial boiling pt., minimum (min)	149	177	220	171	177
Dry point, °C, maximum (max)	208	212	300	240	212
Kauri-Butanol value	27 to 45	27 to 45	27 to 45	27 to 45	NR 4/
Aromatic content, vol %, max	1	1	1	1	1
Total phenol content, parts per million (ppm), max	0.5	0.5	0.5	0.5	0.5
Dichlorobenzene, milligrams per liter (mg/L), max	0.5	0.5	0.5	0.5	0.5
Benzene, mg/L, max	0.5	0.5	0.5	0.5	0.5
Tetrachloroethylene, mg/L, max	0.7	0.7	0.7	0.7	0.7
Trichloroethylene, mg/L, max	0.5	0.5	0.5	0.5	0.5
Apparent specific gravity, 60/60°F	0.754 to 0.820	0.754 to 0.820	0.754 to 0.840	0.754 to 0.820	0.754 to 0.980
Total chlorine content (ppm), Max	100	100	100	100	100
Non-volatile residue, (mg/100 mL), max	8	8	8	8	8
Color, min	25	25	25	25	25
Odor 1/	Low & non-residual	Low & non-residual	Low & non-residual	Citrus & non-residual	Low & non-residual
Corrosion, copper, max 2/	1b	1b	1b	1b	1b
Sandwich corrosion, max	1	1	1	1	1
Total immersion	Pass	Pass	Pass	Pass	Pass

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corrosion 3/					
Titanium stress corrosion	No cracking	No cracking	No cracking	No cracking	No cracking
Acidity	Neutral	Neutral	Neutral	Neutral	Neutral
Doctor test	Negative	Negative	Negative	Negative	Negative
Vapor pressure, millimeters of Mercury (mm Hg) @ 20ºC, max	7.0	2.0	0.4	2.0	1.0
Soil cleaning test, %, min	85	85	85	88	85
VOC, g/l, max	NR	NR	NR	NR	25

1/ Samples of MIL-PRF-680C, Type III, having satisfactory low odor characteristics shall be used as reference standards.
2/ Test for three hours at 100 °C (212ºF).
3/ See 4.4.2
4/ Not required

4. VERIFICATION

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

a. Qualification inspection (see 4.2)
b. Conformance inspection (see 4.3).

4.1.1 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance the test conditions specified in 4.4.

4.2 Qualification inspection. The qualification inspection shall consist of all tests specified herein. Failure of any test shall be cause for rejection.

4.3 Conformance inspection. Conformance inspection shall consist of a sample for tests (see 4.3.2), samples for examination of filled containers (see 4.3.3), and the tests specified in Table II except for sandwich corrosion, total immersion corrosion, and titanium stress corrosion.

4.3.1 Lot. A lot shall consist of solvents from one batch or tank offered for delivery at one time. If material cannot be identified by batch or lot, a lot shall consist of not more than 10 000 gallons offered for delivery at one time (see 6.2).

4.3.2 Sampling for tests. Sampling of a lot for test purposes shall be in accordance with ASTM D 4057 or D 4177.

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4.3.3 Sample for examination of filled containers. A random sample of filled unit containers and a sample of shipping containers fully prepared for delivery shall be selected from each lot of solvent in accordance with ASQ Z1.4.

4.4 Methods of inspection.

4.4.1 Tests. Tests shall be performed in accordance with the applicable methods specified in Table II and 4.4.2 through 4.4.3 to determine conformance with the requirements specified in 3.6.

TABLE II. Test methods for inspections.

Characteristic	ASTM methods	Other methods
Flash point	D 56	
Distillation	D 86	
Kauri-Butanol value	D 1133	
Aromatic content	D 3257	
Apparent specific gravity	D 1298	
Color	D 156	
Odor	D 1296	
Non-volatile residue	D 1353	
Copper corrosion	D 130	
Sandwich corrosion	F 1110	
Total immersion corrosion	F 483	
Titanium stress corrosion	F 945	
Acidity	D 847	
Doctor test	D 235	
Vapor pressure	D 2879	
Total phenol content		EPA 420.1
Total dichlorobenzene content		EPA 3585 and 8260B
Total benzene content		EPA 3585, 8260B
Total trichloroethylene		EPA 3585, 8260B
Total tetrachloroethylene		EPA 3585, 8260B
Soil cleaning test		FED-STD-791 Method,7502
VOC test		SCAQMD 313

4.4.2 Total immersion corrosion. The solvents shall not show any indication of staining, etching, pitting, or localized, or cause weight change to an average of three (3) test panels greater than that shown in Table III.

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TABLE III. Alloy and maximum average weight loss.

Alloy	Average of 3 panels wt. loss, max milligrams per square centimeter (mg/cm^2/168 hrs)
Magnesium (AZ 31B-H24) AMS 4377 surface treated in accordance with AMS-M-3171, Type III	0.50
Aluminum, AMS-QQ-A-250, T3 surface, treatment in accordance with AMS 2470	0.15
Titanium, AMS 4911, 6AL-4V	0.10
Steel, AMS 5046, Grade 1020	0.25

4.4.3 Soil cleaning test. The test shall be conducted according to the solvent soil test method described in FED-STD-791D, Method 7502. The ultrasonic cleaner mentioned in this test method should be selected using two chemical materials (i.e., toluene and water). The cleaning power of water is found zero percent while toluene is 92-96 %. If the test results obtain the outside of these values when test with these chemical materials, the ultrasonic cleaner is not applicable to be used as a test apparatus mentioned in FED-STD-791D, Method 7502. The acceptable limit for each type of solvent is defined in Table I.

4.4.4 Total chlorine content. The total chlorine content of the solvent shall be determined by a gas chromatographic method, microcoulometric or by the use of a portable test kit for the quantitative analysis of chlorine (see 6.6). Nonconformance to Table I shall constitute failure of this test.

5. PACKAGING

5.1 Packaging. For acquisition purpose, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity with the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contracting 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. These solvents are hydrocarbon-based solvents and are used as degreasers and cleaners for painted or unpainted metal parts. However, the compatibility between existing paints and solvents should be verified prior to use. It is recommended that these solvents should be used with an appropriate recirculated parts washer. No other commercial specification is available to cover these military applications.

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6.1.1 Type I. Type I (Stoddard solvent) is intended for use where a low odor solvent with fast drying characteristics is desired. This solvent is currently defined as a flammable material due to its low flash point. It is recommended that the alternative solvents for Type I are Types II, III and IV. When Type I solvent is used indoors, ventilation should be sufficient to prevent the accumulation of vapors above allowable limits.

6.1.2 Type II. Type II (low odor with high flash point solvent) is intended for use where a solvent with a higher flash point is desired. It is recommended over Type I for safety and regulatory reasons. When Type II solvent is used indoors, ventilation should be sufficient to prevent the accumulation of vapors above allowable exposure limits.

6.1.3 Type III. Type III (low odor with very high flash point solvent) is intended to be used where confined atmospheric conditions require a cleaner that conforms to the Federal Government's directives for reduced hazardous materials.

6.1.4 Type IV. Type IV (citrus odor with high flash point) is intended for use where a solvent with a high flash point and strong solvency is desired. This solvent is formulated with petroleum based hydrocarbon solvents and d-limonene additive. When Type IV solvent is used indoors, ventilation should be sufficient to prevent the accumulation of vapors above allowable exposure limits.

6.1.5 Type V. Type V (Low VOC solvent) is intended for use where solvent confined atmospheric conditions require a cleaner that conforms to the Federal and Local Government's directives for reducing VOC of solvent.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number and date of this specification.
b. Type and quantity (see 1.2. and 4.3.1).
c. Issue of ASSIST to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
d. Packaging requirements (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 Product List QPL No. 680 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, 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.

6.3.1 Specification preparing activity. Information and instructions regarding qualification inspection under this specification may be obtained from the Department of the Army, TACOM-TARDEC, ATTN: AMSRD-TAR-E/268, 6501 E. 11 Mile Road, Warren, MI 48397-5000.

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6.4 International standardization. Certain provisions of this specification are the subject of international standardization agreement (NATO STANAG 1135, ANNEX C). When amendment, revision, or cancellation of this specification is proposed which would affect or violate the international agreement concerned, the preparing activity will take appropriate reconciliation action through international channels, including departmental standardization offices, if required.

6.5 Disposal actions. Disposal of this product should be in accordance with local, state and Federal regulations. Care should be taken to avoid mixing used MIL-PRF-680 with other waste materials, especially those containing halogenated solvents. However, these solvents can be recycled instead of disposal.

6.6 Material Safety Data Sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets (MSDSs) prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313; and 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. Contracting officers will identify the activities requiring copies of the MSDS (see 3.4 and 4.4.4).

6.7 Definitions.

6.7.1 Carcinogens. The Occupational Safety and Health Administration (OSHA) definition of carcinogens are 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.

6.7.2. 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

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

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6.8 Subject term (key word) listing.

d-limonene
d-limonene/hydrocarbon blended solvent (type IV)
Mineral Spirits
Naphtha
Petroleum Spirits (USA)
Stoddard Solvent (type I)
141 F Solvent (type II)
200 F Solvent (type III)
Low VOC Solvent (type V)

6.9 Changes from previous issues. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:
Army - AT
Air Force - 68
Navy – AS

Preparing Activity:
Army - AT

(Project 6850-2010-007)

Review Activities:
Army - AV, EA, MD1, MI, MR, SM
Air Force - 03, 11, 50
Navy - MC, SH
DLA - GS, GS3, DP
DTRA - DS
GSA/GSS - 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.daps.dla.mil.