

NOT MEASUREMENT SENSITIVE

MIL-PRF-680

13 December 1999

SUPERSEDING

P-D-680B

October 29, 1992

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 four types of petroleum distillates. The different types are referred to as "Stoddard solvent", "141°F solvent", "200°F solvent", and "141°F d-limonene blended solvent". They are used for degreasing of machine parts in equipment maintenance.

1.2 Classification. Degreasing solvent are of the following types:

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)

1.2.1 NATO classification.

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

Beneficial comments (recommendations, deletions) and any pertinent data which may be of use in improving this document should be addressed to: U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/IE, Warren, MI 48397-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 6850

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2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 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 and 4 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 listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

- QQ-A-250/4 - Aluminum Alloy 2024, Plate and Sheet.
- QQ-A-250/12 - Aluminum Alloy 7075, Plate and Sheet.

DEPARTMENT OF DEFENSE

- MIL-PRF-10924 - Grease, Automotive and Artillery.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Documents 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, the issues are those cited in the solicitation.

CODE OF FEDERAL REGULATIONS

- OSHA 29 CFR 1910.1200 - Federal Register, Part IV, Department of Labor, OSHA Hazardous Communication: Final Rule

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, DC, 20402.)

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ENVIRONMENTAL PROTECTION AGENCY (EPA)

- EPA Method 420.1 - Methods for Chemical Analysis of Water and Wastes Total Recoverable.
- EPA Method 3585 - Method for Waste Dilution for Volatile Organic
- EPA Method 8260B - Method for Volatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS)

(Application for copies should be addressed to the USEPA, Environmental Monitoring and Support Laboratory, 26 West Martin Luther King Drive, Cincinnati, OH 45268.)

2.3 Non-Government publications. The following document(s) form 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. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

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, 611E, Wisconsin Ave. Milwaukee, WI 53201-3005.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- D 56 - Flash Point by Tag Closed Tester, Test Method (DoD adopted).
- D 86 - Distillation of Petroleum Products, Test Method (DoD adopted).
- D 130 - Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test, Method (DoD adopted.)
- D 156 - Saybolt Color of Petroleum Products (Saybolt Chromometer Method), Test Method (DoD adopted).
- D 235 - Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry-Cleaning Solvent), Standard Specification (DoD adopted).
- F 483 - Total Immersion Corrosion Test for Aircraft Maintenance Chemicals (DoD adopted).
- D 847 - Acidity of Benzene, Toluene, Xylene, Solvent Naphthas, and Similar Industrial Aromatic Hydrocarbon Solvents, Test Method (DoD adopted).

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- F 945 - Stress-Corrosion of Titanium Alloys by Aircraft Engine Cleaning Materials(DoD adopted).
- F 1110 - Sandwich Corrosion Test (DoD adopted).
- D 1133 - Kauri-Butanol Value of Hydrocarbon Solvents, Test Method (DoD adopted).
- D 1296 - Odor of Volatile Solvents and Diluents, Test Method (DoD adopted).
- D 1298 - Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method (DoD adopted).
- D 1353 - Standard Test Method for Nonvolatile Matter in Volatile Solvents for use in Paint, Varnish, Lacquer, and Related Products (DoD adopted).
- D 2879 - Vapor Pressure-Temperature Relationships and Initial Decomposition Temperature of Liquids by Isoteniscope, Test Method (DoD adopted).
- D 3257 - Aromatics in Mineral Spirits by Gas Chromatography (DoD adopted).
- D 4057 - Manual Sampling of Petroleum Products, Practice (DoD adopted).
- D 4177 - Automatic Sampling of Petroleum and Petroleum Products, Methods (DoD adopted).

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

- AMS 2470 - Anodic Treatment of Aluminum Alloys Chrome Acid Process.
- AMS M 3171 - Magnesium Alloy Process for Pretreatment and Prevention of Corrosion.
- AMS 4377 - Sheet and Plate, Magnesium Alloy, 3.01A-1.0Zn-0.20Mn (AZ31B-H24) Cold Rolled, Partially Annealed (DoD adopted).
- AMS 4911 - Sheet, Strip, and Plate, Titanium Alloy.
- AMS 5046 - Sheet, Strip, and Plate, Carbon Steel (SAE 1020 and 1025) Annealed.

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

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2.4 Order of precedence. 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 First article. Unless otherwise specified (see 6.2), a sample shall be subjected to first article inspection (see 6.3) in accordance with 4.2.

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 resultant solvent must be produced in such a manner as is necessary to meet the specified requirements.

3.3 Appearance. The solvent shall be clear and free from suspended matter and undissolved water when observed at a temperature between 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). A Material Safety Data Sheet (MSDS) must be prepared and submitted in accordance with FED-STD-313; additionally, it must conform to 29 CFR 1910.1200 (see 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 or volume will be regarded as the presence of a carcinogen in the solvent.

3.6 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
Flash point, °C, (°F)	38-60 (100-140)	61-92 (141-198)	93-116 (200-241)	61-92 (141-198)
Distillation, °C:				
Initial boiling pt., min	149	177	220	171
Dry point, °C, max	208	212	300	240
Kauri-butanol value	27 to 45	27 to 45	27 to 45	27 to 45
Aromatic content, vol %, max	1	1	1	1
Total phenol content, ppm, max	0.5	0.5	0.5	0.5

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TABLE I. Degreasing solvent properties - Continued.

Characteristics	Type I	Type II	Type III	Type IV
Dichlorobenzene, mg/L, max	0.5	0.5	0.5	0.5
Benzene, mg/L, max	0.5	0.5	0.5	0.5
Tetrachloroethylene, mg/L, max	0.7	0.7	0.7	0.7
Trichloroethylene, mg/L, max	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
Total chlorine content (ppm), max	100	100	100	100
Non-volatile residue, (mg/100 mL), max	8	8	8	8
Color, min	25	25	25	25
Odor <u>1/</u>	Low & non-residual	Low & non-residual	Low & non-residual	Citrus & non-residual
Corrosion, copper, max <u>2/</u>	1b	1b	1b	1b
Sandwich corrosion, max	1	1	1	1
Total immersion corrosion <u>3/</u>	Pass	Pass	Pass	Pass
Titanium stress corrosion	Nocracking	No cracking	No cracking	Nocracking
Acidity	Neutral	Neutral	Neutral	Neutral
Doctor test	Negative	Negative	Negative	Negative
Vapor pressure, mm Hg @ 20°C, max	7.0	2.0	0.4	2.0
Soil cleaning test, %, min	85	85	85	88

1/ Samples of MIL-PRF-680, type III having satisfactory low odor characteristics shall be used as reference standards.

2/ Test for three hours at 100 °C.

3/ See 4.4.2

4. VERIFICATION

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

- a. First article 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 with the test conditions specified in 4.2.

4.2 First article inspection. First article inspection shall consist of tests for all the requirements of this specification. Failure of any test shall be cause for rejection.

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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.

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

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, 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, 8260B
Total Benzene content		EPA 3585, 8260B
Total Trichloroethylene		EPA 3585, 8260B
Total Tetrachloroethylene		EPA 3585, 8260B
Soil cleaning test		APPENDIX

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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.

TABLE III. Alloy and maximum average weight loss.

Alloy	Average of 3 Panels Weight Loss, Max (mg/cm ² /168 hrs)
Magnesium (AZ 31B-H24) AMS 4377 surface treated in accordance with AMS-M-3171, type III	0.50
Aluminum, QQ-A-250/4, T3 surface treatment in accordance with AMS 2470	0.15
Aluminum, QQ-A250/4, Bare T3 Alloy	0.15
Aluminum, QQ-A-250/12, Bare T6 Alloy	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 the appendix. The soil used in this evaluation is MIL-PRF-10924 grease . The acceptable limits for each type of solvent is defined in table I.

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 material 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 a 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 required exposure.

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 required 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 used indoors, ventilation should be sufficient to prevent the accumulation of vapors above required exposure limits.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number and date of this specification.
- b. Type and quantity.
- c. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
- d. Whether a first article sample is required (see 3.1 and 4.2).
- e. Packaging requirements (see 5.1)

6.3 First article inspection. When first article inspection is required, the contracting officer should provide specific guidance to offerors concerning the requirements for testing of the pre-production sample of the offered product. Testing should be performed in the contractor's plant, in a Government laboratory, or in a Government approved laboratory. When testing is performed by the contractor or by an independent laboratory, written certification, signed by a responsible officer of the supplier involved, should be furnished stating that the pre-production samples have met all of the requirements of this specification. In addition, a laboratory report should be furnished listing all of the tests performed and the data obtained.

6.3.1 Specification preparing activity. Information and instructions regarding first article inspection under this specification may be obtained from the Department of the Army, TACOM-TARDEC, ATTN: AMSTA TR-D/210, Warren, MI 48397-5000.

6.4 International standardization. Certain provisions of this specification are the subject of international standardization agreement (NATO STANAG 1135, annex C). When

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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. 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 those activities requiring copies of the MSDS.

6.7 Definitions. 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.

6.8. Lot. A lot should 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 should consist of not more than 10,000 gallons offered for delivery at one time.

6.9 Subject term (key word) listing.

- d-limonen
- d-limonen/hydrocarbon blended solvent (type IV)
- Mineral Spirits
- Naphtha
- Petroleum Spirits (USA)
- Stoddard Solvent (type I)
- 141 F Solvent (type II)
- 200 F Solvent (type II)

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

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.

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APPENDIX

SOLVENT CLEANING POWER BY U.S. ARMY SOIL TEST METHOD

1. SCOPE.

1.1 This test method is used for determining the cleaning power of solvents that have been subjected to soiled mechanical parts. This Appendix is a mandatory part of the specification. The information contained herein is intended for guidance only.

2. Referenced Documents:

2.1 Military Standards:

MIL-PRF-10924, Grease, Automotive, Artillery (GAA)

FEDERAL

STANDARDS

Test Method 791C, Method 5308.7 - Corrosiveness and Oxidation
Stability of Light Oils
(Metal Squares).

3. Summary of Method

3.1 A small amount of grease applied to a steel coupon is immersed in the test solvent and then placed in an ultrasonic cleaner maintained at 50°C. The grease is dissolved by the solvent and removed from the steel coupon by the propagation of sonic sound. The solvent power is determined based on the time to completely remove grease from the coupon.

4. Significance and Use

4.1 This test method measures the solvency of all types of cleaners and differentiates their cleaning powers.

5. Apparatus

5.1 Ultrasonic Cleaner

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5.2 Beaker, 200ml

5.3 Test specimen assembly

5.3.1 Steel metal square 0.081 cm thick by 2.5 cm square with holding wire (figure 1.). This specimen has been used in Federal Standard Test Method 791C Method 5308.7.
(NOTE: Paper clips have been successfully used for holding metal square)

5.4 Timer

5.5 Thermometer, having a range of 50 °C.

6. Materials

6.1 Toluene, CP, at least 99 % (Caution- Flammable, vapor harmful)

7. Procedure

7.1 Wash the test assembly with toluene until free from any soil or oil film. Dry the test assembly using laboratory air system. Weight the test assembly to the nearest 0.1 g. Approximately 0.4 g of MIL-PRF-10924 grease is uniformly applied to both sides of the metal coupon. The test assembly is placed in a beaker using a holder. Add the test solvent into the beaker until the test assembly is completely immersed.

7.2 Place the beaker in the ultrasonic cleaner that is maintained water temperatures of 50 C. Start the test using a timer. Observe the test assembly until all grease is removed from metal coupon. Record the time in minutes. If the portion of grease still remains on the metal coupon after 100 minutes, the test is immediately terminated with the testing time being recorded as 100 minutes.

7.3 Repeat two more tests in accordance with 7.1 and 7.2.

8. Calculation

8.1 Calculate the cleaning power as follows:

$$\text{Solvent cleaning power, \%} = ((100-A)/100) * 100$$

Where A is average time of three runs obtained from the tests

(NOTE 2. The cleaning power of water is found as zero percent while toluene is 92-96 %.)

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9. Report

9.1 Report the calculated solvent cleaning power in percentages to the nearest 0.1.

10. Precision

10.1 Precision data have not yet been developed for the method.

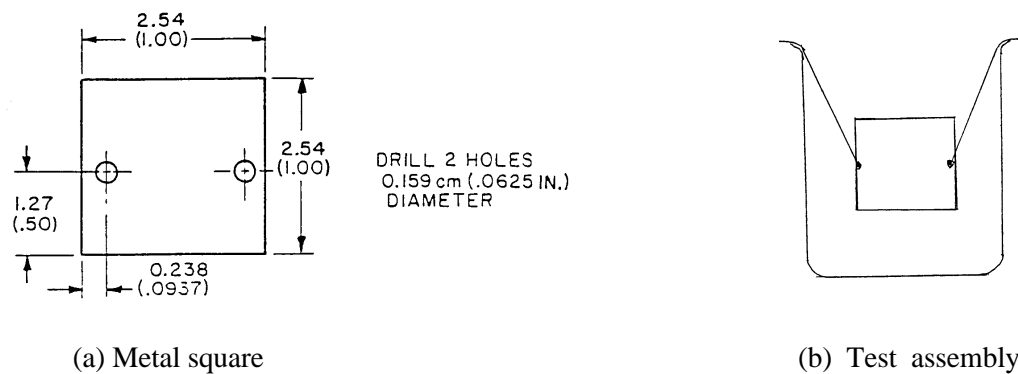


FIGURE 1. Metal square dimensions and test assembly.

Custodians:

Army - AT
Air Force - 68
Navy - AS

Preparing Activity:
Army - AT

(Project 6850-1424)

Review Activities:

Army - AV, MD1, MI, SM
Navy - MC, SH
DLA - GS, DP, DS

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.
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I RECOMMEND A CHANGE:
1. DOCUMENT NUMBER
MIL-PRF-680

2. DOCUMENT DATE (YYYYMMDD)
991213

3. DOCUMENT TITLE

DEGREASING SOLVENT

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)
 (1) Commercial
 (2) DSN
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