

METRIC

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SUPERSEDING

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PERFORMANCE SPECIFICATION

GREASE, AIRCRAFT AND INSTRUMENT, FUEL AND OXIDIZER RESISTANT



Comments, suggestions, or questions on this document should be addressed to AFPA/PTPT, 2430 C Street, Bldg. 70, Area B, WPAFB, OH 45433-7632 or emailed to AFPET.AFTT@wpafb.af.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

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

1. SCOPE

1.1 Scope. This specification covers the requirements for greases resistant to hydrocarbon fuel and liquid oxygen and for use as lubricants in aircraft, aerospace vehicles, and supporting equipment (see 6.1).

1.2 Classification. Greases will be of the following types and are identified by NATO code numbers as follow (see 6.6):

Type	Operating Temperature Range	NATO NUMBER
I	-54°C to 149°C (-65°F to 300°F)	G-397
II	-40°C to 204°C (-40°F to 400°F)	G-398
III	-34°C to 204°C (-30°F to 400°F)	G-399
IV	-73°C to 204°C (-100°F to 400°F)	G-1350
V	-73°C to 232°C (-100°F to 450°F)	

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.

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.

FEDERAL SPECIFICATIONS

O-E-751 Ether, Petroleum, Technical-Grade

FEDERAL STANDARDS

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

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-680 Degreasing Solvent

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

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2.3 Non-Government publications. The following documents 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.

ASTM International

ASTM D130	Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test (DoD Adopted)
ASTM D942	Standard Test Method for Oxidation Stability of Lubricating Greases by the Oxygen Pressure Vessel Method (DoD Adopted)
ASTM D1264	Standard Test Method for Determining the Water Washout Characteristics of Lubricating Greases (DoD Adopted)
ASTM D1403	Standard Test Methods for Cone Penetration of Lubricating Grease Using One-Quarter and One-Half Scale Cone Equipment (DoD Adopted)
ASTM D1478	Standard Test Method for Low-Temperature Torque of Ball Bearing Grease (DoD Adopted)
ASTM D2266	Standard Test Method for Wear Preventive Characteristics of Lubricating Grease (Four-Ball Method) (DoD Adopted)
ASTM D2512	Standard Test Method for Compatibility of Materials with Liquid Oxygen (Impact Sensitivity Threshold and Pass-Fail Techniques) (DoD Adopted)
ASTM D2595	Standard Test Method for Evaporation Loss of Lubricating Greases Over Wide-Temperature Range (DoD Adopted)
ASTM D2596	Standard Test Method for Measurement of Extreme-Pressure Properties of Lubricating Grease (Four-Ball Method) (DoD Adopted)
ASTM D3336	Standard Test Method for Life of Lubricating Greases in Ball Bearings at Elevated Temperatures (DoD Adopted)
ASTM D4057	Standard Practice for Manual Sampling of Petroleum and Petroleum Products (DoD Adopted)
ASTM D6184	Standard Test Method for Oil Separation from Lubricating Grease (Conical Sieve Method) (DoD Adopted)

(Copies of these documents are available online at <http://www.astm.org> or from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

SAE International

AMSM-7866	Molybdenum Disulfide, Technical, Lubrication Grade (DoD Adopted)
AMS-5046	Carbon Steel, Sheet, Strip, and Plate, (SAE 1020 and 1025), Annealed (DoD Adopted)

(Copies of these documents are available online at <http://www.sae.org> or from SAE International, 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.

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3. REQUIREMENTS

3.1 Qualification. Grease furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Materials. The grease shall be a smooth, homogeneous compound that consists essentially of a gelling agent and a suitable liquid lubricant. Type V may be formulated with a sufficient concentration of additional additive(s), such as molybdenum disulfide as specified in SAE AMSM-7866, to enhance the extreme pressure and antiwear properties and shall not contain graphite.

3.3 Chemical and physical requirements. Products shall conform to the requirements as specified in Table I and 3.4 through 3.7.

3.4 Resistance to fuel

3.4.1 Solubility in fuel. When tested as specified in 4.4.1, the grease solubility in fuel shall be not greater than 20 percent by weight for type II, type III, and type IV.

3.4.2 Resistance to fuel. When tested as specified in 4.4.1, a layer of grease on an aluminum test panel shall not be visibly affected by immersion in fuel. The fuel shall not cause swelling, blistering, or cracking of the grease, nor shall the adhesion of the grease to the metal be weakened.

3.5 Resistance to aqueous solutions. When tested as specified in 4.4.1, the grease shall not disintegrate nor dissolve in distilled water or in a 50-percent solution of alcohol in distilled water.

3.6 Film stability and corrosion on steel. When tested as specified in 4.4.4, a film of the grease shall withstand exposure to 100°C (212°F) for one week without forming a hard, resinous deposit and there shall be no evidence of corrosion on the steel panels.

3.7 Storage stability. When stored for eight months as specified in 4.4.1, penetration requirements shall comply with Table II. Slight separation of oil from thickener shall not be cause for rejection.

3.8 Workmanship. The grease shall be a smooth and homogenous mixture and of a uniform consistency. It shall be free from lumps and extraneous materials and essentially free of separated fluid when examined visually (see 4.4.3).

4. VERIFICATION

4.1 Classification of inspections. The examination and testing of the grease shall be classified as follows:

- a. Qualification inspection (see 4.2).
- b. Periodic qualification re-evaluation (see 4.2.4).
- c. Conformance inspection (see 4.3).

4.2 Qualification inspection.

4.2.1 Qualification inspection. The qualification inspection performed by the qualification laboratory shall consist of a review for approval of the submitted manufacturer's report and subjecting the qualification sample to examination and testing to determine conformance to this specification.

4.2.2 Qualification sample. The qualification sample shall consist of a minimum of three pounds of grease. The sample shall be properly identified and forwarded to the activity responsible for inspection as specified in the letter of authorization from that activity (see 6.3).

4.2.3 Retention of qualification. In order to retain qualification of approval for listing on the QPL, the manufacturer shall verify, by certification, to the Qualifying Activity that the manufacturer's product complies with the requirements of this specification. The time of periodic verification by certification shall be in five-year intervals from the date of original qualification. The Government reserves the right to re-examine the qualified product whenever deemed necessary to determine the product continues to meet any or all of the specification requirements.

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TABLE I. Chemical and Physical Requirements.

REQUIREMENTS	TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V
Unworked penetration	290 min	200 min	200 min	225 min	260-310
Worked penetration	290-340	265-310	265-310	235-310	270-300
Corrosion on copper (max)	2b ^{1/}	2b ^{1/}	2b ^{1/}	2b ^{1/}	2e ^{1/}
High temperature bearing performance	500 hours ^{2/}	500 hours ^{2/}	500 hours ^{2/}	500 hours ^{2/}	600 hours ^{3/}
Evaporation, percent (max)	25.0 ^{4/}	15.0 ^{5/}	12.0 ^{5/}	15.0 ^{5/}	3.0 ^{6/}
Oil separation at 204°C (400°F) 30 hours percent (max)	-	15	20	20	12
Antiwear, scar diameter mm (maximum) 40 Kg load 52100, 75°C (167°F) 52100, 204°C (400°F)	- - -	- - -	- - -	1.0 1.3	1.25 3.0
Extreme pressure weld, Kg (min)	-	-	-	500	600
Solubility in fuel, percent (max)	-	20	20	20	-
Liquid oxygen impact sensitivity 20 impacts at 1100 mm (43.3 inches)	No reaction	No reaction	No reaction	No reaction	No reaction
Water washout characteristics	-	20% max	-	-	-
Oxidation stability - pressure drop, psi (max)	-	5	-	-	-
Low temperature torque gm-cm at -62°C (-80°F) (max)	-	-	-	Start 800 Run 300	-
Low temperature torque gm-cm at -73°C (-100°F) (max)	-	-	-	Start 2800 Run 800	Start 3000 Run 2000
Molybdenum disulfide content, % (min)	-	-	-	-	5.0
Dirt count 25-74 micron diameter, max 75 micron diameter and over	1000 0	1000 0	1000 0	1000 0	1000 0
Notes: 1/ ASTM D130 rating, no pitting or etching under minimum 30 × magnification 2/ 10,000 revolutions per minute at 204°C (400°F) 3/ 10,000 revolutions per minute at 232°C (450°F) 4/ Test conditions: 22 hours at 149°C (300°F) 5/ Test conditions: 22 hours at 204°C (400°F) 6/ Test conditions: 72 hours at 232°C (450°F)					

TABLE II. Penetration requirements.

REQUIREMENTS	TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V
Unworked penetration (min)	290	200	200	225	280
Change in worked penetration (units max)	30	30	30	30	30

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4.2.4 Periodic qualification re-evaluation. The grease shall pass a qualification re-evaluation of a one-pound sample taken from the first lot of grease processed under a contract or order after the product has passed the qualification inspection, and at intervals as considered necessary to verify the consistency of production quality.

4.3 Conformance inspection. Quality conformance inspection shall consist of examination of the sample-filled containers (see 4.4.3) and testing the sample against all requirements specified in section 3 except for high temperature performance, storage stability, and shock sensitivity with liquid oxygen. Samples shall be labeled completely with information that identifies the purposes of the sample, name of the product, specification number, lot and batch number (either a bulk lot or packaged lot - see 6.4), date of sampling, and contract number.

4.3.1 Sampling. Sampling shall be in accordance with ASTM D4057.

4.3.2 Ozone depleting chemicals (ODCs). The contractor shall certify that ODCs were not used in the production or processing of the grease.

4.4 Method of inspection and tests.

4.4.1 Inspection. Unless otherwise specified, inspection testing shall be performed in accordance with 4.4.2 and the contractual requirements.

4.4.2 Physicochemical values. Testing shall be performed in accordance with the applicable methods specified in Table III and 3.4 through 3.7. Values for the physicochemical properties specified in section 3 apply to the arithmetic average of the determinations made on the samples for those values that fall within any stated repeatability or reproducibility limits of the applicable test methods.

4.4.3 Workmanship. The sample grease shall be inspected visually and a suitable portion shall be worked with a spatula on a glass surface. After working, the grease shall be spread with a straight edge and observed for uniformity as indicated by a smooth surface.

4.4.4 Film stability and corrosion on steel. Surface ground test panels of 1020 steel which conform to SAE AMS-5046 and measure 0.32 cm x 5.08 cm x 10.16 cm (1/8 in. x 2 in. x 4 in.) shall be employed. Aluminum shims that measure 0.04 cm x 2.54 cm x 5.08 cm (1/64 in. x 1 in. x 2 in.) shall be employed as spacers. The test panels shall be cleaned in hot, dry cleaning solvent that conforms to Type I of MIL-PRF-680, followed by immersion in petroleum ether (ligroine) that conforms to O-E-751. One of the shims shall be placed at each end of a panel to provide a test area that measures approximately 5 cm x 5 cm. Approximately 2 gm of the grease shall be placed in the center of the test panel. Another panel shall be placed on top and two panels shall be pressed together and clamped to form the test assembly. Grease that exudes from the test assembly shall be cleaned off with a spatula. The test assembly shall then be placed in an oven maintained at 100°C (212°F) for one week. Upon removal from the oven, the test assembly shall be dismantled and the grease shall be examined for indications of hardening, separation, and evident changes other than color. The area of the test panels that were in contact with the grease shall be examined for evidence of corrosion.

MIL-PRF-27617G**TABLE III. Test methods.**

TEST	TEST METHOD NUMBER	
	FED-STD-791	ASTM
Penetration		D1403
Corrosion in copper	5309 ^{1/}	
High temperature performance		D3336
Evaporation		D2595
Oil separation		D6184
Resistance to fuel, fuel solubility	5414	
Resistance to aqueous solutions	5415	
Storage stability	3467 ^{2/}	
Water resistance		D1264 ^{2/}
Oxidation stability		D942 ^{3/}
Shock sensitivity with liquid oxygen		D2512 ^{4/}
Wear preventive characteristics		D2266
Extreme pressure properties of lubricating grease		D2596
Low temperature torque of ball bearing greases		D1478
Molybdenum disulfide analysis	3722	
Dirt count	3005	
Notes: 1/ Except the copper strip shall be prepared and polished in accordance with ASTM D130 method. 2/ Test temperature shall be 38°C ± 3°C (100°F ± 5°F). 3/ Test conditions shall be 100 hours at 121°C (250°F). 4/ Use perchloroethylene instead of trichlorotrifluoroethane.		

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 is 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 fuel resistant grease is intended for use in the lubrication of taper plug valves, gaskets, and bearings in fuel systems of military aircraft and ground support equipment. It is also suitable for use in the presence of liquid oxygen as a lubricant for valves, threads, and bearings in aerospace vehicles and supporting equipment. This material may not be suitable for aluminum or magnesium dynamic bearing lubrication because of possible ignition hazards.

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6.2 Acquisition data. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Quantity desired.
- c. Packaging requirements (see 5.1)
- d. Type (see 2.1).

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 List QPL No. 27617 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 orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from AFPA/PTPT, 2430 C Street Bldg 70 Area B, Wright-Patterson AFB, OH 45433-7632, or AFPET.AFTT@WPAFB.AF.MIL. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.daps.dla.mil>.

6.3.1 Qualification information. It is understood the material furnished under this specification to final approval will be of the same composition and will be equal to products upon which approval was originally granted. In the event the fluid furnished under contract is found to deviate from the composition of the approval product, or that the product fails to perform satisfactorily, approval of such products will be subjected to immediate withdrawal from the QPL.

6.3.2 Data to accompany qualification samples. Qualification samples must be submitted with a Material Safety Data Sheet (MSDS) and the following information:

- a. A certified test report containing complete information as to the source and type of base stock and additive materials used for the test.
- b. The detailed formulation and composition of the finished product.
- c. Laboratory data showing quantitative results of all tests required by this specification. The samples and reports will be forwarded to AFPA/PTPT, 2430 C Street Bldg 70 Area B, Wright-Patterson AFB, OH 45433-7632.
- d. The samples will be plainly identified by securely attached durable tags or labels marked with the following information:
 1. Sample for qualification inspection with grade identity: Grease, Aircraft and Instrument, Fuel and Oxidizer Resistant
 2. Specification MIL-PRF-27617
 3. Name of ingredient (for ingredient materials)
 4. Name of manufacturer
 5. Product code number
 6. Date of manufacture

6.3.2.1 Formulation sheets. An example of a satisfactory form for the formulation sheet, indicating the percent by weight and purpose of each ingredient, is as follows:

Base oil(s) percent	(composition and source)
Antiwear additive percent	(composition and source)
Oxidization inhibitor percent	(composition and source)
Other additives percent	(composition and source)

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6.4 Definitions

6.4.1 Bulk lot. By definition, a bulk lot is an indefinite quantity of a homogeneous mixture of material offered for acceptance in a single, isolated container; or manufactured by a single plant run not to exceed 24 hours through the same processing equipment, with no change in ingredient material.

6.4.2 Packaged lot. By definition, a packaged lot is an indefinite number of 55-gallon drums, or smaller unit packages of identical size and type, offered for acceptance and filled with a homogeneous mixture of material from one isolated container; or filled with a homogeneous mixture of material manufactured by a single plant run through the same processing equipment with no change in ingredient material.

6.5 Subject term (key word) listing.

corrosion
liquid oxygen resistant
lubricant
oxidation

6.6 International standardization agreement implementation. This specification implements (STANAG 1135, Interchangeability of Fuels, Lubricants and Associated Products Used by the Armed Forces of the North Atlantic Treaty Nations, and AIR STD 15/09, Interchangeability Chart of Standardized Aviation Fuels, Lubricants and Associated Products). When amendment, revision, or cancellation of this specification is proposed, the preparing activity must coordinate the action with the U.S. National Point of Contact for the international standardization agreement, as identified in the ASSIST database at <https://assist.daps.dla.mil>.

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

Custodians:
Army – AT
Navy – AS
Air Force – 68
DLA – GS

Preparing activity:
Air Force – 68
(Project 9150-2011-011)

Review activities:
Army – AR, EA, MI, MR, SM
Navy – SH
Air Force – 11

Civil Agency
NASA – NA

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>.