

METRIC

MIL-PRF-32014
29 September 1997

PERFORMANCE SPECIFICATION

GREASE, WATER RESISTANT, HIGH SPEED, AIRCRAFT AND MISSILE

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 general requirements for a multipurpose grease for use in the -54°C to +175°C temperature range in aircraft and missile systems.

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 lists, document users are cautioned that they must meet all specified requirements documents cited in *sections 3 and 4* of this specification, whether or not they are listed.

2.2 Governments Documents.

2.2.1 Specifications, standards and handbooks. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the *Department of Defense Index of Specifications and Standards (DoDISS)* and supplement thereto, cited in the solicitation (see 6.2).

STANDARDS

FEDERAL

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: ASC/ENSI, 2530 Loop Road W, Wright-Patterson AFB OH 45433-7101, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

AMSC:NA

FSC 9150

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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 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 TESTING AND MATERIALS (ASTM)

- ASTM D 217 - Cone Penetration of Lubricating Grease
- ASTM D 445 - Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
- ASTM D 972 - Evaporation Loss of Lubricating Greases and Oils
- ASTM D 1264 - Water Washout Characteristic of Lubricating Greases
- ASTM D 1478 - Low Temperature Torque of Ball Bearing Greases
- ASTM D 1742 - Separation, Oil, From Lubricating Grease During Storage
- ASTM D 1743 - Corrosion Preventative Properties of Lubricating Greases
- ASTM D 2265 - Dropping Point of Lubricating Grease Over a Wide Temperature Range
- ASTM D 2596 - Extreme-Pressure Properties of Lubricating Grease (Four-Ball Method), Measurement of
- ASTM D 3336 - Performance Characteristic of Lubricating Greases at Elevated Temperatures
- ASTM D 4057 - Manual Sampling of Petroleum and Petroleum Products
- ASTM D 4048 - Copper Corrosion
- ASTM D 4170 - Fretting Corrosion
- ASTM D 5483 - Oxidation Induction Time of Lubricating Greases by Pressure Differential Scanning Calorimetry
- ASTM D 5969 - Properties of Lubricating Greases in the Presence of Dilute Synthetic Sea Water

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

2.4 Order of precedence. 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 the document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. Items 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. and 6.).

3.2 Materials. The materials used in formulating this grease shall consist of a base oil conforming to requirements in *table I* and suitable additives. A polyalphaolefin, lithium formulation is recommended, but is not mandatory.

Table I. Properties of base oil

Viscosity @	
40°C, cSt, max	140
100°C, cSt, min	16

3.3 Finished grease. The properties of the finished grease shall be as specified in *table II* and 3.3.1.

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Table II. Properties of finished grease

Characteristic	Limit
Odor	No odor of rancidity, perfume or free alcohol
Dirt, particles per millimeter of grease, max	
25-125 micrometers, diameter	1000
>125 micrometers, diameter	None
Worked penetration	265-320
Dropping point, °C, min	200
Corrosiveness (copper strip), max	1b
Oxidation induction time, minute, min	20.0
Water resistance, percent, max	15
High temperature spindle performance, hours, min	500
Evaporation weight loss, percent, max	5
Oil separation, percent weight loss, percent, max	8
Low temperature torque, start/run, gm/cm, max	14,000/2800
Steel on steel wear, wear scar average mm, max	0.65
Corrosion prevention	
Distilled water	Pass
Synthetic sea water	Pass
Fretting wear, mg, max	6
Storage stability, penetration	
Worked (change from original), max	30
Optimol SRV, N, min	
50 °C	800
80 °C	500
Dynamic grease stability, percent penetration increase, max	20

3.3.1 Panel separation test. When tested in accordance with 4.3, the grease shall maintain its texture and pliability, be free from cracking, oil bleeding and slumping and shall still have adhered to the panel.

4. VERIFICATION

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of *sections 3* and *5*. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility to ensure all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain

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conformance to requirements; however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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

- a. Qualification inspection (see 4.3).
- b. Conformance inspection (see 4.4).

4.2.1 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in 4.3.

4.3 Qualification inspection

4.3.1 Qualification sample. Qualification samples shall consist of two one pound containers of grease, one pint of base oil and one ounce each of additives. In the event additives are supplied as concentrated solutions, an equivalent quantity of the solution shall be furnished.

4.3.2 Qualification tests. Qualification sample(s) shall be subject to all the test specified under 4.5, methods of inspection. All tests shall be conducted in a clean room environment.

4.3.3 Retention of qualification. In order to retain qualification of a product approved 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 two-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.

4.4 Conformance inspection. The quality conformance inspection shall consist of examination of the sample of filled containers and all of the required tests except for low temperature torque, high temperature spindle performance, storage stability and the SRV test. Samples shall be labeled completely with information that identifies the purposes of the sample, name of product, specification number, lot and batch number (see 6.4), date of sampling, and contract number.

4.5 Methods of inspection

4.5.1 Inspection. Inspection shall be in accordance with *method 9601* of *FED-STD 791*.

4.5.2 Grease. The grease shall conform to the requirements for base oil and finished grease which shall be determined by appropriate examination and testing in accordance with 4.5.3.

4.5.3 Physical and chemical values. Tests shall be performed in accordance with the applicable methods specified in *table III* and 4.5.4 through 4.5.6. Physical and chemical values specified in *section 3* apply to the arithmetic average of the determinations made on the samples for those values which fall within any stated repeatability or reproducibility limits of the applicable test method.

4.5.4 Dynamic grease stability

4.5.4.1 Apparatus. The dynamic grease stability shall be determined using a suitable electric motor capable of operating at 1750 rpm, MRC 405 double shielded, single row, deep grooved super-conrad type S bearing or equivalent and a clamping device to hold the bearing outer face stationary during the test.

4.5.4.2 Procedure. Determine and record the worked 60 stroke penetration of the grease to be tested. Pack the grease using the full pack technique into the test bearing that has been ultrasonically cleaned using ASTM precipitation naphtha. Install the bearing shields, one of which shall have a 1.59 millimeter vent hole. Place the bearing on the motor spindle and secure the holding clamp. Start the motor and run at 1750 rpm for 20 hours. After the 20 hour test period, allow the bearing and grease to cool to room temperature. Determine the ¼ scale penetration on the grease. Report the percent penetration change as follows:

$$\% \text{ change} = C(A-B)/A$$

where A = Worked penetration of grease before test.

B = Worked penetration of grease after test.

C = 100

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Table III Methods of testing

Test	Method	
	FED STD 791	ASTM
Dirt count	3005.4	
Dropping point		D2265
Worked penetration		D217
Viscosity		D445
Corrosiveness (copper strip) ^{1/}		D4048
Oxidation Induction ^{2/}		D5483
Water resistance ^{3/}		D1264
Evaporation ^{4/}		D2595
Low temperature torque ^{5/}		D1478
Oil Separation		D1742
Steel on steel wear		D2266
Corrosion prevention		D1743
High temperature spindle performance		D3336
Fretting wear		D4170
Storage stability	3467	

^{1/} The grease shall show no green color in that portion contacting the copper strip. The copper strip shall not tarnish more than a classification of 1b when compared with the ASTM copper strip corrosion standards.

^{2/} Ramp rate shall be 60°C/min to 210°C.

^{3/} Test temperature of 41 ± 1°C

^{4/} Test temperature of 100 ± 3°C for 22 hours

^{5/} Test temperature of -54 ± 1°C

4.5.5 Extreme Pressure Performance

4.5.5.1 Apparatus. The apparatus shall consist of an Optimol SRV testing machine, or equivalent, which uses a 10 mm steel ball oscillating under load on a lapped steel disk. The steel balls shall be of aircraft bearing quality of grade 52100 steel with a hardness of HRC 60 to 63.

4.5.5.2 Procedure. Clean the test specimens using a solvent mixture of equal proportions of hexane, toluene, and isopropyl alcohol. Preheat the test specimens to 50 ± 1°C and maintain during the test. Using the Optimol SRV test machine at an oscillating frequency of 50 cycles per second, apply a 50 N force break-in for 30 seconds. After break-in, increase the load to 100 N force for two minutes. Continue increasing the load in 100 N increments, holding at each loading until the metal specimens seize. Report the highest load prior to seizure. Repeat the procedure using 80 ± 1°C as the test temperature.

4.5.6 High Temperature Bearing Performance

4.5.6.1 Apparatus. Performance shall be determined in a Marlin Rockwell 538 C grease testing unit developed for the CRC L-54 research technique, or equivalent, using *ASTM D 3336* test method with the following modifications: A variable-speed electric drive motor installed with a large balanced pulley and a light-weight flat belt to rotate a spindle supported by two ball bearings. The rig shall be modified to accommodate a 17 mm bore size 203 test ball bearing located at the opposite end of the spindle from the drive pulley. This bearing shall be made of M-50 tool steel and phenolic resin with aluminum side plates fastened with rivets. Dished side shields shall be used to retain additional lubricant. The spindle support bearing located next to the pulley shall be Marlin Rockwell type 204 S-17 or equivalent with races and balls made of M-50 tool steel and bore diameters of 20 mm or

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equivalent. The ball retainer shall be a stamped ribbon type made of silver plated beryllium copper. A thermocouple in contact with the outer race of the test bearing shall be connected to a temperature controller, a recorder, and a data logger. An oven capable of maintaining the test temperature is required. An air cylinder connected to a steel cable is required to apply thrust load to the test bearing housing.

4.5.6.2 Procedure. Prior to testing, the side shields of the 203 test bearing shall be removed and all the bearing components cleaned thoroughly with mineral spirits and heptane. The bearing shall be packed with 0.535 ± 0.050 grams of test grease and 0.625 ± 0.050 grams of grease in each of the two shields. The shields shall then be replaced carefully. After installing on the tester, the test bearing shall be run at 30,000 rpm, thrust loading at 1762 ± 9 N and at a temperature of $115.5 \pm 2^\circ\text{C}$. A running time of 25 hours minimum is required.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2) When actual packaging 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 contacting the responsible packaging activity.

6. NOTES

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

6.1 Intended use. The grease covered by the specification is intended to lubricate main shaft bearings in missile engines and provide water resistance and corrosion protection for aircraft and missiles over an extended period of time. It will be operational between -54 and 175°C .

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of the specification.
- b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.3).
- c. Packaging requirements (see 5.1).
- d. Quantity desired.
- e. Type and capacity of container (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 List QPL-32014* 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. Information pertaining to qualification of products may be obtained from WL/MLSE, Bldg 652, 2179 Twelfth St., Rm. 122, WPAFB, OH 45433-7718.

6.3.1 Data to accompany qualification samples. The samples will be accompanied by a Material Safety Data Sheet and a test report from the manufacturer or a commercial laboratory that contains complete information about the source and type of base stock and additive materials used, the formulation and composition of the finished grease, and laboratory data that show quantitative results of all the tests required by this specification except

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storage stability. Separate qualification inspection will be required for each base stock used. The samples will be plainly identified by securely attached, durable tags or labels marked with the following information:

Sample for Qualification Inspection

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Name of ingredient (for ingredient material)

Name of manufacturer

Product code number

Date of manufacture.

6.3.2 Formulation sheet. An example of a satisfactory form for the formulation sheet, indicating the weight percentage and nature of each ingredient is as follows:

Base stock (composition)	percentage
Thickener	percentage

6.4 Definitions

6.4.1 Bulk lot. A bulk lot (batch) is an indefinite quantity of a homogeneous material mixture offered for acceptance in a single, isolated container or manufactured in a single-plant run (not to exceed 48 hours), through the same processing equipment, with no change in ingredient material.

6.4.2 Packaged lot. A packaged lot is an indefinite number of 55-gallon drums or smaller unit containers of identical size and type, offered for acceptance, and filled with a homogeneous material mixture from one isolated container or filled with a homogeneous material mixture manufactured in a single-plant run (not to exceed 48 hours), through the same processing equipment, with no change in ingredient material.

6.5 Subject term (key word) listing.

General purpose grease
Missile engine grease
Water resistant grease

Custodians

Army - CR4
Navy - AS
Air Force - 11

Preparing Activity

Air Force 11

(Project No. 9150-1206)

Review activities

Army - AV, MI, AR, EA
Navy - SH
DLA - PS

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.
NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER

MIL-PRF-32014

2. DOCUMENT DATE (YYMMDD)

97/09/29

3. DOCUMENT TITLE

GREASE, WATER RESISTANT, HIGH SPEED, AIRCRAFT AND MISSILE4. 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)*e. DATE SUBMITTED
(YYMMDD)

(1) Commercial

(2) AUTOVON

(If applicable)
8. PREPARING ACTIVITY

a. NAME

ASC/ENSI

Air Force Code 11

b. TELEPHONE *(Include Area Code)*

(1) Commercial

(2) AUTOVON

(937) 255-0175

785-0175

c. ADDRESS *(Include Zip Code)*

2530 Loop Road West

Wright-Patterson AFB OH 45433-7101

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:

Defense Quality and Standardization Office

5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466

Telephone (703) 756-2340 AUTOVON 289-2340