

19 September 1974

MILITARY SPECIFICATION

GREASE, INSTRUMENT, ULTRA CLEAN

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

1. SCOPE

1.1 This specification covers an ultra clean instrument grease with characteristics which permit its use from -65°F (-54°C) to 250°F (121°C).

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids, or request for proposal, form a part of this specification to the extent specified herein:

STANDARDS

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-290	Packaging, Packing, and Marking of Petroleum and Related Products

Federal

FED-STD-209	Clean Room and Work Station Requirements, Controlled Environment
FED-STD-791	Lubricants, Liquid Fuels, and Related Products; Methods of Testing

(Copies of specifications and standards required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the Contracting Officer.)

2.2 Other publications - The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply:

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AMERICAN SOCIETY FOR TESTING AND MATERIAL PUBLICATIONS

ASTM Standards on Petroleum Products and Lubricants

(Copies of ASTM Publications may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

3. REQUIREMENTS

3.1 Qualification - The grease furnished under this specification shall be a product which has been qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.2.1, and 6.3). In addition, the retention of qualification for grease on the applicable qualified products list shall be dependent on periodic verification of continued compliance with the requirements of this specification (see 4.2.1.2).

3.1.1 Periodic qualification reevaluation - The grease shall pass a qualification reevaluation of samples 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 by the qualification laboratory or procuring activity to verify the consistency of production quality.

3.2 Materials - The grease shall consist essentially of a gelling agent and a low temperature liquid lubricant. Certain esters of the dibasic organic acids containing 6 to 10 carbon atoms are known to be suitable as the oil component. The composition of the lubricant shall exclude silicone oils and extreme pressure additives, but is not otherwise limited.

3.3 Odor - The grease shall not have an unusual or objectionable odor, or odor of rancidity, perfume, or free alcohol.

3.4 Dropping point - The dropping point of the grease shall be not less than 350°F (177°C) when the grease is tested as specified in 4.4.2.

3.5 Penetration -

3.5.1 Unworked penetration - The unworked penetration of the grease shall be not less than 200 when determined as specified in 4.4.2.

3.5.2 Worked penetration - The worked penetration of the grease shall be not less than 265 nor more than 300 when tested as specified in 4.4.2.

3.6 Particulate contamination - The grease, when tested as specified in 4.4.2 shall not contain dirt, crystals, lumps, or particles of gelling agent exceeding the following limits:

1000 particles per cm^3 of grease of 10 microns or larger.

No particles 35 microns diameter or larger.

Particle size is measured along the largest dimension of the particle.

3.7 Oxidation stability -

3.7.1 Bomb oxidation - The grease shall not cause a pressure drop exceeding 3 psi in 100 hours and 10 psi in 500 hours when the grease is tested as specified in 4.4.2.

3.7.2 Bomb copper corrosion - When tested as specified in 4.4.2 the grease shall not cause a pressure drop exceeding 1.0 psi in 20 hours and there shall be no decomposition of the grease as evidenced by a green discoloration in the vicinity of the copper strip, or slight stain or corrosion of the copper strip beyond that obtained in a blank test under the same conditions without grease.

3.8 Water resistance - Not more than 20 percent of the grease shall be washed from the bearing when tested as specified in 4.4.2 except that the temperature shall be $105 \pm 2^\circ\text{F}$ ($41 \pm 1^\circ\text{C}$). After the water washout period the grease on the bearing shall remain homogeneous without visual evidence of degradation.

3.9 Evaporation - The grease, when tested as specified in 4.4.2 shall not lose more than 2.5 percent of its weight in 22 hours at $250 \pm 1^\circ\text{F}$ ($121 \pm 0.6^\circ\text{C}$).

3.10 Oil separation - The grease, when tested as specified in 4.4.2 shall not lose more than 5 percent of its weight in 30 hours.

3.11 Low temperature torque - A 204K Conrad-type 8-ball bearing lubricated with the grease shall give a starting torque of not more than 3000 g-cm and a running torque of not more than 500 g-cm after 60 minutes when tested at -65°F (-54°C) as specified in 4.4.2. There shall be no skidding or ball sliding during the test run.

3.12 High temperature performance - The grease shall lubricate an R-4 bearing satisfactorily for a minimum of 65 hours at $260 \pm 2^\circ\text{F}$ ($127 \pm 1^\circ\text{C}$) when tested as specified in 4.4.5.

3.13 Gear wear - The grease coated brass gear of a helical gear set shall not wear more than 2.5 mg per thousand cycles under a 5-pound load nor more than 3.5 mg per thousand cycles under a 10-pound load when tested as specified in 4.4.2.

3.14 Penetration after mechanical working - The penetration of the grease tested as specified in 4.4.2 shall be not more than 375 after 100,000 double strokes.

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3.15 Rust preventive properties - Bearings when tested as specified in 4.4.2 shall show no discoloration or corrosion in excess of three spots of a size just sufficient to be visible to the naked eye. More than three spots or pitting, or etching shall be cause for rejection. Bearing areas in contact with the glass adapter shall be discounted.

3.16 Storage stability - After the grease has been stored as specified in 4.4.3 the unworked penetration shall be not less than 200 and the worked penetration shall not have changed from the original worked penetration by more than 30 points.

3.17 Workmanship - The grease, when examined visually, shall be a smooth and homogeneous mixture, free from lumps, abrasive materials, crystals, and extraneous material.

3.18 Environment - The grease shall be formulated, processed, and packaged in a Class 10,000 environment conforming to the requirements of FED-STD-209.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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 assure supplies and services conform to prescribed requirements.

4.2 Compliance - Determination of compliance with provisions of this specification shall include the following:

(a) Qualification inspection (4.2.1 through 4.2.1.2)

(b) Quality conformance 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 (4.3.1) to examination and testing for all the requirements of this specification.

4.2.1.1 Periodic qualification reevaluation - The periodic qualification reevaluation inspection performed by the qualification laboratory shall consist of examining and testing the periodic qualification reevaluation sample (4.3.2) for all the requirements of this specification. Delivery

of the grease will not be delayed pending completion of the periodic qualification reevaluation. If the results of the periodic qualification reevaluation inspection are in accordance with the requirements of this specification, the consistency of production quality will be thereby verified. Failure of the grease to pass a periodic qualification reevaluation inspection shall require that the acceptance and further shipment of the grease to be withheld until the contractor has corrected the conditions which led to the failure (see 6.3.1). Further failure will constitute cause for rejection and removal from the Qualified Products List.

4.2.1.2 Retention of qualification - The retention of qualification of products approved for listing in the Qualified Products List (QPL) shall be maintained by periodic verification to determine compliance of qualified grease with the requirements of this specification. Periodic verification may be made by certification unless otherwise specified by the activity responsible for Qualified Products List and shall be at intervals of no more than 2 years.

4.2.2 Quality conformance (lot by lot) inspection - The quality conformance inspection shall include the following:

- (a) Examining and testing the quality conformance samples for conformance to all Section 3 requirements except oxidation stability (500 hours), high temperature performance, rust preventive properties, penetration after mechanical working, gear wear, and storage stability.
- (b) Examining the samples of filled containers (4.3.3.3) and conformance to Section 5, packaging, packing and marking requirements.

4.3 Sampling and acceptability criteria -

4.3.1 Qualification samples - The qualification sample shall consist of 5 pounds of the grease for which qualification is desired. The sample shall be accompanied by a report from the manufacturer or a commercial laboratory. The report shall show individual and average results for all requirements of this specification except high temperature performance and shall refer specifically to the applicable paragraphs in the specification. The samples and reports shall be forwarded to Vehicle Technology Department, Naval Air Development Center, Warminster, Pa. 18974. The samples shall be plainly identified by securely attached durable tags or labels marked with the following information.

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Sample for qualification inspection
 GREASE, INSTRUMENT, ULTRA CLEAN
 Name of manufacturer
 Product code number
 Date of manufacture
 Submitted by (name) (date) for qualification inspection
 in accordance with the requirements of Specification
 MIL-G-81937 under authorization of reference authorizing
 letter) (see 6.3).

4.3.2 Periodic qualification reevaluation - The periodic qualification reevaluation sample shall consist of 3 pounds of grease selected at random from the first lot of grease processed under the first contract or order after the product has passed the qualification inspection. Additional qualification reevaluation samples may be taken at such intervals as considered necessary to verify the consistency of production quality. Periodic qualification reevaluation samples may be forwarded to the laboratory responsible for qualification (see 4.3.1). The samples shall be plainly identified by securely attached durable tags or labels marked with the following information:

Sample for qualification reevaluation
 GREASE, INSTRUMENT, ULTRA CLEAN
 Specification MIL-G-81937
 Name of manufacturer
 Product code number
 Date of manufacture
 Contract or order number
 Batch number

4.3.3 Quality conformance samples - The quality conformance sample shall consist of a sample for tests (4.3.3.2) and a sample for examination of filled containers (4.3.3.3). Samples shall be labeled completely with information identifying the purpose of the sample, name of product, specification number, lot and batch number, date of sampling, and contract number.

4.3.3.1 Inspection lot - An indefinite number of small cans or collapsible tubes offered for acceptance, and filled with a homogeneous mixture of material manufactured by a single plant run through the same processing equipment, with no change in ingredient materials.

4.3.3.2 Sample for tests - The sample for tests shall consist of a one-pound sample of grease taken at random from each lot of grease to be offered or processed for delivery under a contract or order. The lot shall be rejected if a sample fails to meet any one of the test requirements specified.

4.3.3.3 Sample for examination of filled containers - A random sample of filled containers and a sample of shipping containers fully prepared for delivery shall be selected from each lot of grease in accordance with MIL-STD-105 at inspection level I and acceptable quality level (AQL) = 2.5 percent defective. Sample containers will be examined in accordance with 4.4.4.

4.4 Inspection methods - Unless otherwise specified, all tests shall be conducted on unworked grease.

4.4.1 Conformance of the grease to the requirements for materials (3.2), odor (3.3) and workmanship (3.17) shall be determined by appropriate examination and testing.

4.4.2 The tests listed in Table I shall be performed in accordance with the specified methods in FED-STD-791 or ASTM Standards on Petroleum Products and Lubricants.

TABLE I
Inspection Method

TESTS	FED-STD-791 METHOD	ASTM METHOD NO.
Dropping Point		D2265
Penetration		D217
Particulate contamination <u>1/</u>	3005	
Bomb oxidation		D942
Bomb copper corrosion <u>2/</u>		D1261
Water resistance <u>3/</u>		D1264
Evaporation		D972
Oil separation	321	
Low temperature torque <u>4/</u>		D1478
Gear wear	335	
Penetration after mechanical working	313	
Rust preventive properties		D1743

1/ To be counted in a Class 100 environment conforming to the requirements of FED-STD-209

2/ Use chemical cleaning only

3/ Except the test temperature shall be 105 \pm 2°F (41 \pm 1°C)

4/ Observations for skidding or ball sliding shall be made during this test

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4.4.3 Storage stability - Two standard grease worker cups (ASTM Method D217) shall be filled with the grease sample; one struck flush with the tip of the cup for unworked penetration; and the second filled with additional quantity of grease to insure sufficient sample to conduct the worked penetration. The cups shall be stored in an oven at a temperature of $100 \pm 5^{\circ}\text{F}$ ($38 \pm 3^{\circ}\text{C}$) for six months subsequent to the original determination of the penetration. Upon termination of storage the samples are allowed to cool to 77°F (25°C) prior to determining the unworked penetration in accordance with ASTM D217.

4.4.4 Examination of filled containers - Each filled container selected in accordance with 4.3.3.3 shall be examined for defects of container and closure for evidence of leakage, and for unsatisfactory markings. Each sample container shall be weighed to determine amount of contents. If the number of defective or underweight containers in any sample exceed the acceptance number for the appropriate sampling plan of MIL-STD-105, failure of the lot shall be indicated.

4.4.5 High temperature performance - The high temperature performance of the grease shall be determined in accordance with ASTM D 3337 except for the following:

- (a) The bearing grease torque tester shall be run at $260 \pm 2^{\circ}\text{F}$ for a minimum of 65 hours.
- (b) A Class 10,000 environment conforming to the requirements of FED-STD-209 shall be used when packing the test bearing. Pack the bearing with a total quantity of $0.070 \pm .005$ ml of grease taken from the "as received" sample. Do not screen the grease through the specified 40 micron retention filter.

5. PREPARATION FOR DELIVERY

5.1 Packaging, packing, and marking - The grease shall be packaged, packed, and marked in accordance with MIL-STD-290 and with the details specified by the procuring activity with respect to the various options, choices, and alternatives indicated in MIL-STD-290 (see 6.2).

5.1.1 Tubes used to package the ultra clean instrument grease must be either pre-cleaned or certified to be clean in order to meet the tight cleanliness requirements of 3.6. Tube material must be compatible with the grease and shall not interact with the grease during a two year storage period.

6. NOTES

6.1 Intended use - The grease covered by this specification is intended to be used for the lubrication of bearings in instruments and

related components such as synchros and gyros. It is ideally suited for bearings having small tolerances with respect to clearance.

6.2 Ordering data - Procurement documents should specify the following:

- (a) Title and number of this specification
- (b) Quantity desired in pounds
- (c) Type and size of container in which grease is to be furnished
- (d) Packaging, packing, and marking data with requirements in detail

6.3 Qualification - With respect to products requiring qualification, awards will be made only for such products as have prior to the time set for opening of bids, been tested and approved for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement and manufacturers are urged to arrange to have the products 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. The activity responsible for the Qualified Products List is the Naval Air Systems Command, Washington, D.C. 20361; however, the information pertaining to qualification of products may be obtained from the Director, Aeronautical Materials Laboratory, Vehicle Technology Department, Warminster, Pa. 18974.

6.3.1 The grease furnished under contract should be identical within commercial limits to the qualification samples which have been inspected and approved. In the event that the grease furnished under contract is found to deviate from the composition of the approved product, or if the product fails to meet all the requirements of this specification, or the product fails to perform satisfactorily, approval of such product will be subject to immediate withdrawal from the Qualified Products List.

Custodians:

Army - MR
Navy - AS
Air Force - 11

Preparing Activity:

Navy - AS

(Proj. No. 9150-0382)

Review activities:

Army - MU, SM, AV
Navy - SH
Air Force - 84
DSA - PS

User activities:

Navy - OS

