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AEROSPACE MATERIAL SPECIFICATION

SAE AMS-G-81937

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Grease, Instrument, Ultra-Clean, Metric

NOTICE

This document has been taken directly from U.S. Military Specification MIL-G-81937A, Notice 1, and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. The initial release of this document is intended to replace MIL-G-81937A, Notice 1. Any part numbers established by the original specification remain unchanged.

The original Military Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, and (b) the use of the existing government specification or standard format.

Under Department of Defense policies and procedures, any qualification requirements and associated qualified products lists are mandatory for DOD contracts. Any requirement relating to qualified products lists (QPL's) has not been adopted by SAE and is not part of this SAE technical document.

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1. SCOPE:

1.1 This specification covers the requirements for one grade of an ultra-clean instrument grease with characteristics which permit its use from –54°C to 121°C.

2. APPLICABLE DOCUMENTS:

The following publications, 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.

2.1 Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

FED-STD-209	Clean Room and Work Station Requirements, Controlled Environment
FED-STD-313	Material Safety Data Sheets, Preparation and Submission of
FED-STD-791	Lubricants, Liquid Fuels and Related Products, Methods of Testing
MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-290	Packaging of Petroleum and Related Products

2.2 Code of Federal Regulations:

Available from Superintendent of Documents, Government Printing Office, Washington, DC 20402.

49 CFR	Transportation – Hazardous Materials

2.3 ANSI Publications:

Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI Z129.1	American National Standards for the Precautionary Labeling of Hazardous Industrial Chemicals

2.4 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 942	Oxidation Stability of Lubricating Greases by the Oxygen Bomb Method
ASTM D 972	Evaporation Loss of Lubricating Greases and Oils
ASTM D1264	Water Washout Characteristics of Lubricating Greases
ASTM D 1403	Cone Penetration of Lubricating Grease Using One-Quarter and One-Half Scale Cone Equipment
ASTM D 1743	Corrosion Preventive Properties of Lubricating Greases
ASTM D 2265	Dropping Point of Lubricating Grease Over Wide Temperature Range
ASTM D 3337	Greases in Small Bearings, Evaluation of
ASTM D 4048	Effect of Grease on Copper

2.5 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 shall take precedence.

3. REQUIREMENTS:

3.1 Qualification:

The grease furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.3 and 6.3).

3.2 Material:

The grease shall consist essentially of a lithium soap, a low temperature diester lubricant. The composition of the lubricant shall not otherwise be limited except to exclude silicone oils and additives that are not completely soluble in the base oil.

3.3 Physical properties:

Physical properties of the grease shall be in accordance with Table I.

3.4 Environment:

The grease shall be formulated, processed, and packaged in a class 100,000 environment conforming to the requirements of FED-STD-209.

3.5 Material safety data sheets:

Material safety data sheets shall be prepared and submitted in accordance with FED-STD-313. Material safety data sheets shall also be forwarded as specified in 4.3.2. The grease shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the contracting activity to the appropriate departmental medical service who will act as an advisor to the contracting agency (see 4.3.2 and 6.2.1e).

3.6 Workmanship:

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

4. QUALITY ASSURANCE PROVISIONS:

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 as specified herein. Except as otherwise specified in the contract or purchaser 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 assure supplies and services conform to prescribed requirements.

4.2 Classification of inspections:

The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.3).
b. Quality conformance inspection (see 4.4).

4.3 Qualification inspection:

Qualification inspection shall consist of a review of the manufacturer's test report (see 4.3.2) to determine that the qualification inspection sample (see 4.3.1) complies with all the requirements for the physical properties specified in Table I when tested in accordance with the inspection methods specified in Table II and 4.6.3 through 4.6.3.2.

4.3.1 Qualification inspection sample: The qualification inspection sample shall consist of 2.5 kg of grease. The sample shall be forwarded to the Aircraft and Crew Systems Technology Directorate, Code 60612, Naval Air Development Center, Warminster, PA 18974. The sample shall be plainly identified by a securely attached durable tag or label marked with the following information:

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

4.3.2 Test reports: Two copies of the manufacturer's test report, containing complete test data showing that material submitted for qualification conforms to the requirements of this specification, shall be submitted with the qualification sample. Location and identity of the plant which produced the sample tested shall also be supplied. Material safety data sheets shall be prepared in accordance with FED-STD-313 (see 3.5) and submitted to the qualifying laboratory (see 4.3.1).

4.3.3 Retention of qualification: In order to retain qualification of a product approved for listing on the Qualified Products List (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 that the product continues to meet any or all of the specification requirements.

4.4 Quality conformance inspection:

The quality conformance inspection of the grease shall consist of tests of samples from 4.4.2.2 in accordance with Table III and an examination of samples from 4.4.2.1 for conformance with 4.6.1. Samples shall be labeled completely with the information identifying the purpose of the sample, name of product, specification number, lot and batch number, date of sampling and contract number.

4.4.1 Lot formation: A lot shall consist of all the grease produced by one manufacturer, at one plant, from the same materials and under essentially the same conditions, provided the operation is continuous and does not exceed a 24 hour period. In the event the process is a batch operation, each batch constitutes a lot (see 6.4).

4.4.2 Sampling:

4.4.2.1 For examination of filled containers: A random sample of filled containers, fully prepared for delivery, shall be selected from each lot of grease in accordance with MIL-STD-105, inspection level II with an acceptable quality level (AQL) of 2.5 percent defective.

4.4.2.2 For tests: The sample for tests shall consist of a 0.25 kg sample of grease taken at random from each lot of grease. The lot shall be unacceptable if the sample fails to comply with any of the tests specified in Table III and 4.6.3 through 4.6.3.2.

4.5 Inspection conditions:

4.5.1 Test conditions: Test conditions shall be in accordance with 4.6 and the physical values specified in Table I apply to the average of determinations made on the sample. Unless otherwise specified, all tests shall be conducted on unworked grease.

4.6 Methods of examinations and tests:

4.6.1 Examinations: Each of the filled containers selected in accordance with 4.4.2.1, shall be examined for defects of the container and closure, for evidence of leakage and for unsatisfactory markings to determine conformance with 5.1 and 5.2. Each sample container shall also be weighed to determine the amount of contents. If the number of defective containers exceeds the acceptance number of the sampling plan specified in 4.4.2.1, the lot shall be rejected.

4.6.2 Tests: Tests shall be performed in accordance with Table II and 4.6.3 through 4.6.3.2 to determine conformance with the requirements specified in 3.3.

4.6.3 Low temperature torque:

4.6.3.1 Apparatus: A suitable torque test apparatus assembly is illustrated in Figure 1. It consists of the components described as follows:

a. Low temperature box. Use a well insulated cold box of at least 0.03 cubic meters interior size, in which the temperature can be controlled and maintained within ±0.5°C of the -54°C test temperature. Baffles shall be used, if necessary, to prevent direct radiation between the test bearing and the cooling medium. The drive mechanism can be mounted externally as shown schematically in Figure 2. When the drive is mounted externally, the temperature, measured at a point on the surface of the test shaft between the test bearing and the wall of the box, shall be not more than 0.5°C above the test temperature.

b. Bearing. Select an R4A4 size open ball bearing containing eight balls separated by a two piece pressed steel cage, and manufactured to ABEC-1 tolerances. After having been cleaned and dried, the bearing shall show no roughness or catching when rotated between the fingers while applying a light pressure axially and then radially. Lubricate the bearing with an oil having a viscosity of five centistokes at 99°C. Determine the running torque at room temperature, and note the maximum running torque peaks. The average shall not exceed 0.0005 Nm, and no peak should be measured over 0.001 Nm. If values fall below these limits, the bearing is suitable for the grease torque test.

c. Drive Assembly. As shown in Figure 2, the test shaft shall receive the test bearing against a shoulder no higher than the inner race shoulder of the bearing. A spacer washer of the same diameter along with a lock nut shall be used to clamp the inner ring of the test bearing to the 1 rpm shaft.

d. Housing. Use a balanced low temperature torque bearing housing and load disc made in accordance with Figure 3.

e. Torque measuring equipment. Consisting of a calibrated dynamometer scale with a 203 mm (eight inch) face and a zero to 0.45 kg range.

f. Grease cup and spindle. As shown in Figure 4.

4.6.3.2 Procedure: The procedure shall be as follows:

a. Wash the selected test bearing thoroughly in a suitable petroleum solvent and rinse with grease analysis naphtha or petroleum ether. Dry the bearing for at least five minutes in a warm oven (not over 99°C). Permit the bearing to cool to room temperature before proceeding.

b. Mount the clean, dry bearing on a hand spindle (Figure 4), fastening the inner race by means of the washer and screw. Fill the grease cup (Figure 4) about three fourths full with the test grease, using a clean, steel spatula.

c. Force the bearing down into the grease while rotating the inner ring and spindle slowly to insure working the grease into all parts of the bearing. When the bearing bottoms in the cup, take it out and remove it from the spindle. Turn the bearing end for end and refasten it to the spindle. Repack the excess grease into the grease cup. Again, force the bearing into the cup until it bottoms. Remove the spindle and bearing as a unit. Scrape the excess grease off flush with the sides, filling any visible voids and then remove the spindle. Care should be taken not to rotate the bearing at any time after striking the grease flush and prior to measurement of the starting torque.

d. Insert the packed bearing into the test housing and fasten the clamp cap over the bearing.

e. With the low temperature box prechilled to the test temperature, open the box and slide the test bearing and housing over the end of the test shaft, fasten it with the washer and nut tightly enough to prevent slippage.

f. Saturate a string with silicone oil to prevent absorbed moisture from stiffening it at the test temperature. Hang the string from the hook of the dynamometer scale and attach the other end of the string under the head of the screw on the periphery of the housing. Rotate the test shaft until the slack in the string from the dynamometer scale is taken up. The screw on the periphery must then be at least 90 degrees down from vertical. More than 90 degrees will be satisfactory, provided the string does not slip off the periphery of the housing.

g. Close the box and resume the test temperature. Maintain this temperature within ± 0.5°C for two hours. During this time the bearing must not be disturbed or the test will be invalid.

h. Check the torque string to be sure it is free of the ice and not stuck to the box. Closing the hole with a split rubber stopper during the chilling will help to keep the string and passage free of ice from moisture laden air. Remove the stopper prior to the run.

4.6.3.2 (Continued):

i. Start the drive motor, watching the dynamometer indicator. Note the maximum reading reached. This will occur within a few seconds after start of rotation. Determine the starting torque using the following equation:

T = 454D x 2.859 cm

Where:

T = Torque in gram-centimeters
D = Dynamometer reading in pounds.

j. Continue the rotation of the test shaft for one hour, at the end of which time note the average dynamometer reading for a period of 15 seconds. Determine the running torque using the above equation.

5. PACKAGING:

5.1 Preservation and packing:

The grease shall be preserved and packed in accordance with MIL-STD-290. The type and size of the containers and the level of preservation and packing shall be specified by the acquiring activity (see 6.2.1). Tubes used to package the grease must be either pre-cleaned or certified to be clean and tube material must be compatible with the grease.

5.2 Marking:

All unit, intermediate and shipping containers shall be marked in accordance with MIL-STD-290 and Title 49 of the Code of Federal Regulations and any other additional special markings specified by the acquiring activity (see 6.2.1f). All unit and intermediate packs of toxic and hazardous chemicals and materials shall also be labeled in accordance with the applicable laws, statues, regulations or ordinances, including Federal, State, and Municipal requirements. In addition unit or intermediate containers, including unit containers that serve as shipping containers, such as pails and drums, shall be marked with the applicable precautionary information detailed in ANSI Z129.1.

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:

6.2.1 Acquisition requirements: Acquisition documents should specify the following:

a. Title, number and date of this specification.

b. Quantity desired.

c. Size and type of container for grease (see 5.1).

d. Applicable levels of preservation and packing and other options (see 5.1).

e. Specify FAR Clauses 7-104.98 and 1-323.2.

f. Any special markings required (see 5.2).

6.3 Qualification:

With respect to products requiring qualification, awards may be made only for products which are, at the time set for opening of bids, qualified for inclusion in Qualified Products List (QPL-81937) 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. The activity responsible for the Qualified Products List is Commander, Naval Air Systems Command, Attn: AIR-5304C1 Washington, DC 20361; however, information pertaining to qualification of products and letter of authorization for submittal of sample may be obtained from the Aircraft and Crew Systems Technology Directorate, Code 60612, Naval Air Development Center, Warminster, PA 18974.

6.3.1 Qualification information: It is understood that the grease furnished under this specification subsequent to final approval should be of the same composition and shall be equal to products upon which approval was originally granted. In the event that the grease furnished under contract is found to deviate from the composition of the approved product, or that the product fails to perform satisfactorily, approval of such products will be subject to immediate withdrawal from the Qualified Products List.

6.4 Batch:

A batch is defined as that quantity of material which has been manufactured by some unit chemical process and subjected to some physical mixing operation intended to make the final product substantially uniform.

6.5 Changes from previous issue:

Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

PREPARED UNDER THE JURISDICTION OF AMS COMMITTEE “M”

TABLE I. Physical properties

Characteristics	Limits
Odor	No unusual or objectionable odor of rancidity, perfume or free alcohol
Dropping point, °C, minimum	177
Penetration (1/4 scale):	
Unworked, minimum	45
Worked	60-75
Particulate contamiration per cubic centimeter of grease, maximum: 1/	
10 micrometers or larger	1,000
35 micrometers or larger	None
Oxidation, stability:	
Bomb oxidation, pressure drop, MPa, maximum:	
in 100 hours	0.0207
in 500 hours	0.0689
Corrosiveness (copper strip), maximum 2/	1b
Water resistance, at 40° ± 1°C, percent maximum 3/	20
Evaporation, percent, weight loss in 22 hours at 121° ± 0.6°C, maximum	2.5
Oil separation, percent, weight loss in 30 hours, maximum	5
Low temperature torque:	
Starting, Newton meters (Nm) (gram-cm), maximum	0.010 (102)
Running (after 60 minutes), at -55°C, NM (gram-cm), maximum	0.003 (30.6)
High temperature performance, hours, at 127° ± 1°C, minimum	65
Gear wear, mg/1,000 cycles, maximum:	
under 2.3 kg load	2.5
under 4.5 kg load	3.5
Rust preventative properties 4/	pass
Storage stability, penetration:	
Unworked, minimum	45
Worked (change from original), maximum	± 10

TABLE I. Physical properties. - Continued

1/ The grease shall not contain dirt, crystals, lumps, or particles of gelling agent exceeding the limits. The particle size shall be measured along the largest dimension of the particle.

2/ 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.

3/ After the water washout period, the grease on the bearing shall remain homogeneous without visual evidence of degradation.

4/ The grease coated bearings shall show no pitting, etching, discoloration or corrosion in excess of three small spots per bearing.

TABLE II. Inspection methods

Test	Method	
	FED-STD-791	ASTM
Dropping point	-	D 2265
Penetration	-	D 1403
Particulate contamination 1/	3005	-
Bomb oxidation	-	D 942
Corrosiveness (Copper strip)	-	D 4048
Water resistance	-	D 1264
Evaporation	-	D 972
Oil separation	321	-
High temperature performance 2/	-	D 3337
Gear wear	335	-
Rust preventive properties	-	D 1743
Storage stability 3/	3467	-