

METRIC

MIL-PRF-81322F

21 July 1998

SUPERSEDING

MIL-G-81322E

22 January 1992

## PERFORMANCE SPECIFICATION

## GREASE, AIRCRAFT, GENERAL PURPOSE, WIDE TEMPERATURE RANGE

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 two National Lubricating Grease Institute (NLGI) grades of grease. Both grades of grease are formulated to withstand operations at high speeds and a temperature range of  $-54^{\circ}$  to  $177^{\circ}\text{C}$  ( $-65^{\circ}$  to  $350^{\circ}\text{F}$ ).

1.2 Classification. The grease covered by this specification is classified by its consistency as measured by the worked penetration (see tables I and II). The NLGI grading system is used as the classification (see table I, 6.2, and 6.8), as follows:

NLGI Grade 1-	Worked penetration range of 310 to 340 at $25^{\circ}\text{C}$ ( $77^{\circ}\text{F}$ ).
NLGI Grade 2-	Worked penetration range of 265 to 295 at $25^{\circ}\text{C}$ ( $77^{\circ}\text{F}$ ). This grade is identified by NATO Code G-395 and Military Symbol WTR (see 6.7).

## 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 requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Air Warfare Center Aircraft Division, Code 414100B120-3, Highway 547, Lakehurst, NJ 08733-5100, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 9150

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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### 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

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document 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 (see 6.2).

##### NAVAL AIR SYSTEMS COMMAND

NAVAIR 51-5BCA-1.1 - Technical Manual, Operation, Maintenance, and Overhaul Instructions, Aircraft Recovery Equipment, Mark 7, Mod 3

(Copies of this document are available from the Commanding Officer, Naval Air Technical Services Facility (NATSF), 700 Robbins Avenue, Philadelphia, PA 19111.)

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-B150M - Aluminum Bronze, Rod, Bar, and Shapes [Metric], Standard Specification for (DoD adopted)

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- ASTM-D130 - Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test, Standard Test Method for (DoD adopted)
- ASTM-D217 - Cone Penetration of Lubricating Grease, Standard Test Methods for (DoD adopted)
- ASTM-D942 - Oxidation Stability of Lubricating Greases by the Oxygen Bomb Method, Standard Test Method for (DoD adopted)
- ASTM-D1264 - Determining the Water Washout Characteristics of Lubricating Greases, Standard Test Method for (DoD adopted)
- ASTM-D1478 - Low-Temperature Torque of Ball Bearing Grease, Standard Test Method for (DoD adopted)
- ASTM-D1743 - Determining Corrosion Preventive Properties of Lubricating Greases, Standard Test Method for (DoD adopted)
- ASTM-D2265 - Dropping Point of Lubricating Grease Over Wide Temperature Range, Standard Test Method for (DoD adopted)
- ASTM-D2266 - Wear Preventive Characteristics of Lubricating Grease (Four-Ball Method), Standard Test Method for (DoD adopted)
- ASTM-D2595 - Evaporation Loss of Lubricating Greases Over Wide Temperature Range, Standard Test Method for (DoD adopted)
- ASTM-D2596 - Measurement of Extreme Pressure Properties of Lubricating Grease (Four-Ball Method), Standard Test Method for (DoD adopted)
- ASTM-D3336 - Life of Lubricating Greases in Ball Bearings at Elevated Temperatures, Standard Test Method for (DoD adopted)
- ASTM-D3704 - Wear Preventive Properties of Lubricating Greases Using the (Falex) Block and Ring Test Machine in Oscillating Motion, Standard Test Method for (DoD adopted)
- ASTM-D4048 - Detection of Copper Corrosion from Lubricating Grease, Standard Test Method for (DoD adopted)
- ASTM-D4057 - Manual Sampling of Petroleum and Petroleum Products, Standard Practice for (DoD adopted)
- ASTM-D4289 - Compatibility of Lubricating Grease with Elastomers, Standard Test Method for (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.)

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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 this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

## 3. REQUIREMENTS

3.1 Qualification. The greases 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 4.3 and 6.3). Any change in the formulation of a qualified product shall necessitate its requalification.

3.1.1 Materials. The grease shall consist of a liquid lubricant and a jelling agent that when formulated will result in a compound meeting the wide temperature range of this specification.

3.2 Toxicity. The grease furnished under this specification shall have no adverse effect on the health of personnel when used for its intended purpose (see 6.2).

3.3 Physical properties. Physical properties of the grease shall conform to table I when tested in accordance with table II.

TABLE I. Physical properties.

Property	Requirement
Corrosiveness (copper strip)	1-b, max. The grease shall show no green color in that portion contacting the copper strip. Any corrosion produced on the surface of the copper shall be less than 1-b when compared with the ASTM Copper Strip Corrosion Standard (ASTM-D130 Adjunct, available from ASTM as number 12-401300-00).
Dirt	
NLGI Grade 1 - 25 to 125 microns ( $\mu\text{m}$ )	1000 particles per milliliter of grease, max.
NLGI Grade 1 - 125 $\mu\text{m}$ or larger	None
NLGI Grade 2 - 25 to 74 $\mu\text{m}$	1000 particles per milliliter of grease, max.
NLGI Grade 2 - 75 $\mu\text{m}$ or larger	None
Dropping point	232°C, min.
Evaporation, after 22 hours at 177° $\pm$ 3°C	
NLGI Grade 1	12.0 percent weight loss, max.
NLGI Grade 2	10.0 percent weight loss, max.
High temperature performance, at 177° $\pm$ 3°C	
NLGI Grade 2	400 hours, min. (average of four test runs)

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TABLE I. Physical properties - Continued.

Property	Requirement
Load carrying capacity (Load wear index) NLGI Grade 1 NLGI Grade 2	36.0, min. 30.0, min.
Low temperature torque, at -54°C Starting Running (after 60 minutes)	0.98 Newton-meter (Nm), max. 0.098 Nm, max.
Odor	No odor of rancidity, perfume or free alcohol
Oil separation, after 30 hours at 177° ±3°C NLGI Grade 1 NLGI Grade 2	10.0 percent weight loss, max. 2.0-8.0 percent weight loss
Oscillation Friction and wear after 35,000 cycles	6.35 mm width of wear scar, max.
Oxidation stability, at 99°C In 100 hours In 500 hours	83 kilopascals (kP) pressure drop, max. 172 kP pressure drop, max.
Rust preventive properties, ASTM rating	Pass (based on the pass or fail rating of at least two of three bearings)
Steel on steel wear	0.8 millimeter (mm), max. (based on the average wear scar diameter on the three balls)
Storage stability, penetration: Unworked Separation of crystalline material Worked	200, min. None ±30, max.
Swelling of synthetic rubber, NBR-L, after 168 ±0.5 hours at 70° ±1°C	10.0 percent, max.
Water washout, at 41° ±1°C	20 percent loss, max.
Worked penetration NLGI Grade 1 NLGI Grade 2	310-340 265-295
Worked stability, penetration, after 100,000 double strokes NLGI Grade 1 NLGI Grade 2	370, max. 350, max.
Service evaluation, NLGI Grade 1 only	Compatible with, pumpable in, provide lubrication to shipboard based aircraft arresting engines and automatic lubricating systems

3.4 Workmanship. The grease, when examined visually, shall be a smooth and homogeneous mixture, free from lumps and extraneous materials.

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3.5 Compatibility. The grease shall be compatible with all previously qualified greases of the same grade when tested in accordance with 4.5.3. Immediately after mixing, and after undisturbed storage for seven days, the mixture shall not form resinous gums, sludge or insoluble solid materials and shall comply with the worked penetration and worked stability requirements (see table I). In the event of failure, the previously qualified grease (unmixed with other greases) shall be tested to verify that it meets the worked penetration and worked stability requirements under the conditions specified in 4.5.3. If the previously qualified sample fails to meet the worked penetration or worked stability requirement, a fresh sample shall be obtained and the compatibility test repeated. For Grade 2, additional mix ratios of 90 percent previously qualified and 10 percent new and vice versa may be used during qualification testing (see 4.3.1).

## 4. VERIFICATION

4.1 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 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the conditions specified in tables I and II on unworked grease. The physical values specified in table I apply to the average of determinations made on the sample.

4.3 Qualification inspection. Qualification inspection shall consist of all the tests specified in table II.

4.3.1 Sampling. Qualification test samples shall consist of a minimum of 6.81 kg (15.0 lb.) of grease of the grade for which qualification is desired.

4.4 Conformance inspection. The conformance inspection shall consist of tests to verify conformance to the following requirements (see table II): worked penetration, worked stability, steel on steel wear, oil separation, odor, low temperature torque, load carrying capacity, evaporation, dropping point, dirt, corrosiveness (copper strip), and workmanship. The inspection shall be conducted on samples taken in accordance with 4.4.1.

4.4.1 Sampling for tests. Select two 2.95-kg (6.5-lb.) containers of grease, taken at random from each filled lot (see 6.4). For users who obtain grease in large containers, samples shall be selected in accordance with ASTM-D4057. One sample shall be used for tests and the other shall be retained. If any test result does not comply with the stated requirement, the test in question shall be repeated on the retained sample; if the sample fails again, the lot shall be rejected.

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4.5 Tests.

4.5.1 Oscillation – Friction and wear. Oscillation – friction and wear shall be determined in accordance with ASTM-D3704 and the following test conditions:

Time: 35,000 cycles  
 Angle of oscillation: 90°  
 Test ring: Type S-10

The test block shall be an ASTM-B150M, alloy C64200 having a Rockwell B hardness of HRB 88 ±3 with dimensions and surface finish the same as those specified for H-30 or H-60 blocks.

TABLE II. Qualification inspection and methods.

Property	Test method or paragraph
Corrosiveness (copper strip)	ASTM-D4048
Dirt	FED-STD-791, method 3005
Dropping point	ASTM-D2265
Evaporation	ASTM-D2595
High temperature performance	ASTM-D3336
Load carrying capacity	ASTM-D2596
Low temperature torque <u>1/</u>	ASTM-D1478
Oil separation	FED-STD-791, method 321
Oscillation	
Friction and wear	4.5.1
Oxidation stability	ASTM-D942
Rust preventive properties	ASTM-D1743
Steel on steel wear	ASTM-D2266
Storage stability	4.5.2
Swelling of synthetic rubber, NBR-L	ASTM-D4289
Water washout	ASTM-D1264
Worked penetration	ASTM-D217
Worked stability	FED-STD-791, method 313
Workmanship	Visual
Compatibility	4.5.3
Service evaluation	4.5.4
Odor	4.5.5

1/ Observation for skidding or ball sliding shall be made during test run.

4.5.2 Storage stability. The storage stability shall be in accordance with FED-STD-791, Method 3467 and the following:

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Temperature of  $38^{\circ} \pm 3^{\circ}\text{C}$  ( $100^{\circ} \pm 5^{\circ}\text{F}$ ) to be maintained for 6 months. After determination of unworked penetration, the unworked penetration sample shall be stored at  $38^{\circ} \pm 3^{\circ}\text{C}$  ( $100^{\circ} \pm 5^{\circ}\text{F}$ ) for an additional 6 months. The sample shall be covered in such fashion to provide an air space above the grease and to prevent the surface of the grease from being disturbed. The sample shall then be examined for presence of crystalline material.

4.5.3 Compatibility. Fill standard grease cups with equal volumes of the grease being tested and previously qualified greases of the same class. The cup shall be filled by alternately adding approximately 60 grams of each of the two greases being tested, until the cup is full (about 454 grams). Mix the two greases by working the sample for 60 double strokes in accordance with the worked penetration procedure of ASTM-D217 and then let the mixture stand undisturbed for seven days at  $18.0^{\circ}$  to  $29.5^{\circ}\text{C}$  ( $65^{\circ}$  to  $85^{\circ}\text{F}$ ) and  $50 \pm 10$  percent relative humidity. Examine the worked penetration and then the worked stability in accordance with table II, using the same sample of grease mixture for both tests. Small amounts of fresh grease may be added to the worked cup just prior to the worked stability test, as needed to maintain a full cup for testing.

4.5.4 Service evaluation. The NLGI Grade 1 grease shall undergo a performance evaluation by a designated activity (see 6.9). The evaluation shall be made in accordance with the Periodic Inspection and Lubrication procedures of section 25 in NAVAIR 51-5BCA-1.1.

4.5.5 Odor. The odor of the grease shall be observed for conformance to table I immediately upon opening the test container.

## 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 of materiel 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 within 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 greases covered by this specification are intended to lubricate equipment subject to extreme marine conditions and operating temperatures between  $-54^{\circ}$  to  $177^{\circ}\text{C}$  ( $-65^{\circ}$  to  $350^{\circ}\text{F}$ ). Commercial equipment is not exposed to these extreme conditions.

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NLGI Grade 1 is intended for use in lubricating military aircraft arresting gear sheave spacers and other equipment that operate under high contact loads and high sliding speeds. NLGI Grade 2 is intended for use in military aircraft wheel bearings and internal brake wheel assemblies, antifriction bearings, gearboxes, and plain bearings.

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 2.1).
- c. Quantity desired.
- d. Grade (see 1.2).
- e. Toxicity (see 6.5).
- f. Packaging and marking (see 5.1 and 6.2.1).

6.2.1 Marking. Containers should be marked in accordance with MIL-STD-290, "Packaging of Petroleum and Related Products." All unit and intermediate packs of toxic and hazardous chemicals and materials should also be labeled in accordance with the applicable laws, statutes, regulations, and ordinances, including federal, state, and municipal requirements. Unit and intermediate containers should be marked in accordance with ANSI-Z129.1, "Precautionary Labeling of Hazardous Industrial Chemicals."

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-81322 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 the Commander, Attn.: Code 4.3.4.1, Building 2188, Naval Air Warfare Center Aircraft Division, 22347 Cedar Point Road, Unit 6, Patuxent River, MD 20670-1161.

6.3.1 Submission of qualification samples and additional information. Prior to submitting samples for qualification testing, vendors will request authorization from the qualifying activity. Upon receipt of authorization, samples will be forwarded as directed. The qualifying activity will require the manufacturer to submit for review and approval, two copies of the manufacturer's test report, including the sample's material safety data sheet (MSDS) (see 6.5),

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the location and identity of the plant which produced the sample, and the item composition report. The samples should be plainly and durably marked with the following information:

## Sample for Qualification Test

- GREASE, AIRCRAFT, GENERAL PURPOSE, WIDE TEMPERATURE RANGE
- Specification MIL-PRF-81322F
- NLGI Grade 1 or 2, as applicable.
- Manufacturer's name.
- Manufacturer's product number.
- Batch number.
- Date of manufacture.
- Submitted by (name and date), for qualification inspection in accordance with MIL-PRF-81322F, NLGI Grade (1 or 2), under authorization of (reference authorization letter).

6.3.2 Retention of qualification. In order to retain qualification of a product approved for listing on the Qualified Products List (QPL), the Government will require the manufacturer to 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 will be in two-year intervals from the date of original qualification and will be initiated by the Government. The Government reserves the right to re-examine the qualified product whenever deemed necessary to ensure that the product continues to meet any or all of the specification requirements.

6.4 Lot and batch. Unless otherwise specified a lot consists of 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 will constitute a lot. 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 Material Safety Data Sheets (MSDSs). Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313; and 29 CFR 1910.1200 requires that the Material Safety Data Sheet for each

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hazardous chemical used in an operation must be readily available to personnel using the material. Contracting officers will identify the activities requiring copies of the Material Safety Data Sheet.

6.6 Standard rubber samples. Samples of the standard synthetic rubber NBR-L (see table I) may be obtained from the Akron Rubber Co., Akron, OH.

6.7 International standardization agreements. Certain provisions of this specification are the subject of international standardization agreements AIR-STD-15/1, "Interchangeability Chart of Standardized Aviation Fuels, Lubricants and Allied Products" and STANAG 1135, "Interchangeability of Fuels, Lubricants and Associated Products Used by the Armed Forces of the North Atlantic Treaty Nations." When amendment, revision or cancellation of this specification is proposed, which will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels, including departmental standardization offices, to change the agreement to make other appropriate accommodations.

6.8 Part numbers. Part numbers for cataloging purposes should be coded as follows:

M81322F	-	X
Specification identifier		1 = NLGI Grade 1 2 = NLGI Grade 2

6.9 Service evaluation. Service evaluation (see 4.5.4) will be performed at a facility designated by the Naval Air Warfare Center Aircraft Division, Code 4.8.1.4 B562-2, Highway 547, Lakehurst, NJ 08733.

6.10 Subject term (key word) listing.

High melt point  
Lubricant

6.11 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.

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CONCLUDING MATERIAL

Custodians:

Army - AT  
Navy - AS  
Air Force - 11

Preparing activity:

Navy - AS  
(Project 9150-1173)

Review activities:

Army - AR, AV, EA, MI  
Navy - OS, SH  
Air Force - 68  
DLA - GS

International interest:

NATO (see 6.7)

# 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-81322F

2. DOCUMENT DATE (YYMMDD)  
21 July 1998

3. DOCUMENT TITLE

GREASE, AIRCRAFT, GENERAL PURPOSE, WIDE TEMPERATURE RANGE

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:

7. DATE SUBMITTED  
(YYMMDD)

(2) DSN:  
(*If Applicable*)

8. PREPARING ACTIVITY

a. NAME  
COMMANDER  
NAVAL AIR WARFARE CENTER  
AIRCRAFT DIVISION

b. TELEPHONE NUMBER (*Include Area Code*)  
(1) Commercial (732) 323-2947 (2) DSN

c. ADDRESS (*Include Zip Code*)  
CODE 414100B120-3  
HIGHWAY 547  
LAKEHURST, NJ 08733-5100

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:  
Defense Logistics Agency (DLSC-LM),  
Attn: Carla Jenkins/John Tascher  
8725 John J. Kingman Road, Ste 2533  
Fort Belvoir, VA 22060-6221  
Telephone (703) 767-6874