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PERFORMANCE SPECIFICATION

GREASE, AUTOMOTIVE AND ARTILLERY

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

1. SCOPE

1.1 Scope. This specification covers one grade of a multi-purpose grease for lubrication of ground vehicles and equipment (see 6.1) and is identified by Military Symbol GAA and NATO Code Number G-403.

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 requirement 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: U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/BLUE, Warren, MI 48397-5000, 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

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2.2 Government documents.

2.2.1 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.

U.S. DEPARTMENT OF LABOR (DOL)

OSHA 29 CFR 1910.1200 - Hazard Communication; Interpretation Regarding Lubricating Oils.

(Copies of the Code of Federal Regulations (CFR) are available from the Superintendent of Documents, U.S. Government Printing Office, Washington DC 20402.)

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)

D217 - Cone Penetration of Lubricating Grease. (DoD Adopted).
D942 - Oxidation Stability of Lubricating Greases by the Oxygen Bomb Method. (DoD Adopted).
D972 - Evaporation Loss of Lubricating Greases and Oils (DoD Adopted).
D1092 - Apparent Viscosity of Lubricating Greases (DoD Adopted).
D1742 - Oil Separation from Lubricating Grease During Storage (DoD Adopted).
D1831 - Roll Stability of Lubricating Grease (DoD Adopted).
D2265 - Dropping Point of Lubricating Grease Over Wide Temperature Range (DoD Adopted).
D2266 - Wear Preventive Characteristics of Lubricating Grease (Four-Ball Method) (DoD Adopted).
D2596 - Measurement of Extreme Pressure Properties of Lubricating Grease (Four-Ball Method) (DoD Adopted).
D3527 - Life Performance of Automotive Wheel Bearing Grease (DoD Adopted).
D4048 - Detection of Copper Corrosion from Lubricating Grease by the Copper Strip Tarnish Test (DoD Adopted).

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D4057	- Manual Sampling of Petroleum and Petroleum Products (DoD Adopted).
D4289	- Testing Compatibility of Lubricating Greases with Elastomers (DoD Adopted).
D4693	- Low-Temperature Torque of Grease-Lubricated Wheel Bearings (DoD Adopted).
D5969	- Corrosion-Preventive Properties of Lubricating Greases in Presence of Dilute Synthetic Sea Water Environments (DoD Adopted).
E145	- Gravity-Convection and Forced-Ventilation Ovens.

(Application for copies may be obtained from 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 this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. Greases furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.1.1 and 6.4).

3.2 Materials. Unless otherwise specified herein, the materials selection is the prerogative of the contractor as long as all articles submitted to the Government fully meet the requirements specified.

3.2.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.3 Operating requirements. The grease shall meet all the operating requirements as specified in 3.3.1.

3.3.1 Finished grease properties. The values, after the application of tolerances (see 4.1.1.1), shall not exceed the maximum (max.) or fall below the minimum (min.) limits as specified in table I.

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TABLE I. Finished grease properties.

Characteristics	Limits
Dropping point, °C, minimum 1/	220
Oxidation stability at 99°C	
Pressure drop, kPa, maximum	
In 100 hours	34.5
In 400 hours	138.0
Worked penetration (1/10 mm)	265-295
Corrosiveness (copper strip), maximum 2/	1 b
Water stability, after 10 0000 Double strokes, +10.0% water, Penetration (1/10 mm), minimum/maximum	-25 to +60
Life performance (four test runs) at 160°C, hours, minimum	100
Evaporation loss at 99°C	3.0
Percent, maximum	
Oil separation	
Percent, maximum	5.0
Wear preventive characteristics	
Avg. scar dia. mm, maximum	0.60
Load carrying capacity	
Load wear index, kgf, minimum	30.0
Low temperature torque, N·m, maximum at -54°C	
Breakaway	7.00
Running (at 5 min)	5.00
Worked stability, after 10 0000	
Double strokes, penetration (1/10 mm),	
Minimum/maximum	-25 to +60
Elastomer compatibility	
CR:	
Volume change, %	0 to +30
Hardness change, Durometer-A points	0 to –10
NBR-L:	
Volume change, %	-5 to +30
Hardness change, Durometer-A points	+2 to -15
Salt water corrosion resistance	Pass
Roll stability, penetration (1/10 mm), Minimum/maximum	-25 to +60

1/ °C = degrees Celsius

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 l b when compared with the ASTM copper strip corrosion standards (ASTM D4048).

3.4 Support and ownership requirements. The grease shall meet all support and ownership requirements as specified in 3.4.1 through 3.4.5.

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3.4.1 Hazardous materials. The grease shall not contain carcinogenic or potentially carcinogenic constituents as defined under the Hazard Communication Standard 29 CFR 1910.1200.

3.4.2 Storage stability. The grease shall be capable of prolonged storage without degradation in performance.

3.4.3 Color. The grease color shall be the discretion of the manufacturer as long as the grease contains no dye which could cause discoloration to adjacent surfaces, personnel or clothing.

3.4.4 Odor. The grease shall have no odor, which by its rancid, alcohol, or perfume nature, will impede its application or use by personnel.

3.4.5 Homogeneity. The grease shall be homogeneous, smooth in texture, and free of entrapped air which could cause variation in its performance.

4. VERIFICATION

4.1 Classification of inspection. Inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.1.1).
b. Conformance inspection (see 4.1.2).

4.1.1 Qualification inspection. Qualification inspection shall consist of all the verifications listed in table II and shall be in accordance with acceptable tolerances (see 4.1.1.1).

4.1.1.1 Tolerances. Acceptable tolerances for values or limits in 3.3.1 shall be as specified by the qualifying activity (see 6.2).

TABLE II. Verification methods.

Title	Requirements	Verification
Operating requirements	3.3	4.3.3
Finished grease properties	3.3.1	4.3.3.1
Support and ownership	3.4	4.3.8
Hazardous materials	3.4.1	4.3.8.1
Storage stability	3.4.2	4.3.8.2
Color	3.4.3	4.3.8.3
Odor	3.4.4	4.3.8.4
Homogeneity	3.4.5	4.3.8.5

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4.1.2 Conformance inspection. Unless otherwise specified (see 6.2 and 6.4), the results obtained shall fall within the tolerances/specific values determined at the time of qualification (see 4.1.1.1). The grease shall be tested for all the requirements specified in table II, except for oxidation stability at 99°C, life performance, low temperature torque, roll stability from table I and storage stability.

4.2 Sampling for tests. The sample for tests shall consist of two 2.27 kilogram (kg) samples of grease taken at random from filled containers from each lot of grease (see 6.3). For users who obtain grease in large containers, two 2.27 kg samples shall be taken in accordance with ASTM D4057. The lot shall be unacceptable if either sample fails to comply with any of the tests specified.

4.3 Verification methods. The types of verification methods included in this section are visual inspection, measurement, sample tests, full-scale demonstration tests, simulation, modeling, engineering evaluation, component properties analysis, and similarity to previously approved or previous qualified designs.

4.3.1 Verification alternatives. The manufacturer may propose alternative test methods, techniques, or equipment, including the application of statistical process control, tool control, or cost effective sampling procedures, to verify performance. See the contract for alternatives that replace verification required by this specification.

4.3.2 Inspection conditions. Unless otherwise specified herein, tests shall be conducted on unworked grease, in any sequence.

4.3.3 Operating requirements verification. Complete each test under 4.3.3.

4.3.3.1 Finished grease property verifications. Use the test methods as specified in table III to determine that finished grease properties are as specified within tolerances (see 4.1.1.1).

Table III. Finished grease property test methods.

Test	ASTM Method
Dropping point	D2265
Oxidation stability at 99°C	D942
Worked penetration	D217
Corrosiveness (copper strip)	D4048
Water stability	D217 1/
Life performance	D3527
Evaporation	D972

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Table III. Finished grease property test methods- Continued.

Test	ASTM Method
Oil separation	D1742
Wear preventative characteristic	D2266
Load carrying capacity	D2596
Low temperature torque 2/	Appendix A and D4693, D1092
Worked stability	D217 3/
Salt water corrosion resistance	D5969 4/
Elastomer compatibility	D4289
Roll stability	D1831

1/ Water stability shall be performed in accordance with 4.3.4.
2/ Low temperature torque shall be performed in accordance with 4.3.5 and Appendix A.
3/ Worked stability shall be performed in accordance with 4.3.6.
4/ Salt water corrosion resistance test shall be performed in accordance with 4.3.7.

4.3.4 Water stability test. This test shall be performed using the standard procedure of ASTM D217 with the modifications specified herein. A change in worked penetration of the grease of more than 60 units higher or 25 units lower than the original worked penetration shall constitute failure of the water stability test.

a. Prepare a homogeneous mixture of grease and water by placing nine parts by weight of grease and one part by weight of distilled water in a suitable mixing bowl using an electric kitchen-type mixer (low speed 500 ±10 rpm).
b. Fill a glass syringe with the calculated amount of distilled water and gradually add the water to the grease in the bowl.
c. Mix the contents for 4 ±1 minutes. A spatula may be used to channel the constituents to the mixer.
d. Fill a standard ASTM D217 grease worker with the mixture and work the sample on a motorized grease worker for 10 0000 double strokes (approximately 28 hours). After the test grease containing 10 percent (by weight) distilled water has been subjected to 10 0000 double strokes, bring the grease worker and the sample to 25 ±0.5°C in accordance with the procedure described in ASTM D217 for prolonged worked penetration.
e. Immediately after the test grease sample reaches 25 ±0.5°C, rework the sample an additional 60 double strokes. Determine the worked penetration. Compare the worked penetration of the grease-water mixture with the worked penetration (60 double strokes) obtained by the sample under test.

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4.3.5 Low temperature torque. The test shall be conducted at -54 ±0.5°C according to the low temperature torque test method described in the Appendix A. The breakaway (maximum) torque shall be determined at the beginning of the operation and the running torque shall be determined after five minutes of operation. Both determinations should be calculated by the averaging of four test runs. If the test apparatus is not available, the test shall be conducted using the ASTM D1092 test method at -54°C. The apparent viscosity shall be determined at shear rate, 25 reciprocal seconds. This value is then converted to the breakaway torque Newton-meters (N·m) using the following correlation equation (1). If this alternate method is used, only breakaway torque values can be reported. However, in case of referee disputes, only the results from the low temperature torque test method measured as described in Appendix A shall be accepted. Failure of the grease to meet the requirements of table I shall constitute failure of this test.

Breakaway torque (N·m) = 2.36 x (apparent viscosity at 25 sec^{-1} x 10^{-4}) +1.48 (1)
[Standard error: 0.373]

4.3.6 Worked stability test. The test shall be performed using the standard procedure of ASTM D217 with the following modifications. A change in worked penetration of the grease of more than 60 units higher or 25 units lower than the original worked penetration shall constitute failure of this test.

a. Work a sample of the test grease on a motorized grease worker for 10 0000 double strokes (approximately 28 hours) in accordance with the procedure described in ASTM D217 for prolonged worked penetration.
b. Immediately after the grease has been subjected to 10 0000 double strokes, bring the grease worker and the sample to 25 ±0.5°C in accordance with the procedure described in ASTM D217 for prolonged worked penetration.
c. Immediately after the test grease sample reaches 25 ±0.5°C, determine the prolonged worked penetration of the grease.

4.3.7 Salt water corrosion test. This test shall be performed using the standard procedure of ASTM D5969 with NaCl solution (1 percent NaCl by weight in distilled water). Failure of the grease to meet the requirements as defined in ASTM D5969 under rating shall constitute failure of this test.

4.3.8 Support and ownership requirements. Complete each test under 4.3.8.

4.3.8.1 Hazardous materials and compatibility tests. Use one or more of the methods outlined in 4.3 and 4.3.1 to verify the absence of hazardous materials or hazards to personnel.

4.3.8.2 Storage stability test. The test shall be performed on a 6.8 kg unopened can of grease that has been dated and labeled "Storage Stability Test. The undisturbed can or pail of the test grease shall be placed in a thermostatically controlled, dark, convection oven, meeting the

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requirements of ASTM E145, located in an area essentially free from vibration, at 38 ±3°C for 180 ±5 days. The can shall be positioned in center of the oven and raised at least 75 mm from the bottom, to ensure temperature uniformity. At the end of the storage interval, the can of test grease shall be subjected to the test of table III except for oxidation stability at 99°C, water stability, and low temperature torque. Failure of the grease to meet the requirements of table I, within tolerances, shall constitute failure of this test (see 4.1.1.1).

4.3.8.3 Color tests. Use one or more of the methods outlined in 4.3 and 4.3.1 to verify the absence of any dye which could cause discoloration to adjacent surfaces, personnel or clothing.

4.3.8.4 Odor tests. Use one or more of the methods outlined in 4.3 and 4.3.1 to verify the absence of rancid, alcohol, or perfume odor, which could impede application or use of the grease.

4.3.8.5 Homogeneity tests. Use one or more of the methods outlined in 4.3 and 4.3.1 to verify the absence of entrapped air and the homogeneous and smooth texture of the grease.

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 that may be helpful, but is not mandatory.)

6.1 Intended use. The grease covered by this specification is intended for the lubrication and surface corrosion protection of all ground vehicles and equipment operated over the temperature range from -54 to +180°C. This grease may also be used in other applications within this temperature range where a National Lubricating Grease Institute (NLGI) No. 2 consistency grease with oxidation resistant and corrosion prevention properties is desirable. This grease is not intended for use on machinery which comes in contact with food. This specification requires a grease that is capable of lubrication and corrosion protection over an extremely wide range of temperatures; there is no currently available non-government standard which fulfills the requirements of this specification.

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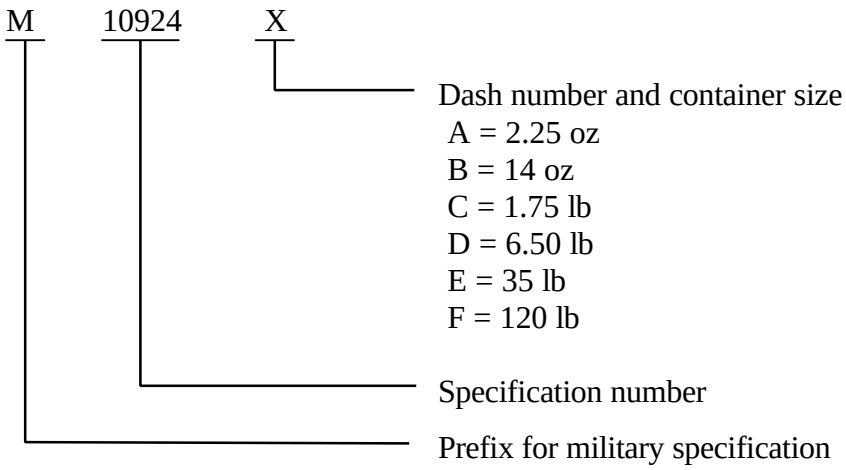
6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number and date of this specification.
b. The specific issue of individual documents referenced (see 2.3).
c. Quantity of grease requested, in kilograms.
d. Size and type of container for grease.
e. Tolerances for finished oil requirements (see table I and 4.1.1.1).
f. If conformance testing is other than as specified (see 4.1.2).
g. Packaging requirements, quantity and PIN (see 5.1 and 6.3).

6.3 Part or identifying number (PIN) configuration. The PIN to be used for oils acquired to this specification are created as follows:



6.4 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. 10924 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 US Army Tank-automotive and Armaments Command, Warren, Michigan 48397-5000.

6.5 Conformance testing. Affordable conformance inspection with confidence varies depending upon a number of procurement risk factors. Some of these factors include: Contractor past performance, government schedules and budget, product material and design maturity, manufacturing capital equipment and processes applied, the controlled uniformity of those processes, labor skill and training, and the uniformity of measuring processes and techniques.

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During the solicitation, contracting documents should indicate those tests desired from table II and their designated frequency based on a risk assessment for the procurement.

6.6 Material Safety Data Sheets. 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 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.

6.7 National stock numbers. The following National Stock numbers have been assigned to the grease covered by this specification:

Grease	National Stock No.
Tube, 2-1/4 oz. (64 g)	9150-01-197-7688
Cartridge, 14 oz. (400 g)	9150-01-197-7693
Can, 1.75 lb (800 g)	9150-01-197-7690
Can, 6.50 lb (3 kg)	9150-01-197-7689
Pail, 35 lb (16 kg)	9150-01-197-7692
Drum, 120 lb (54 kg)	9150-01-197-7691

6.8 Subject term (key word) listing.

Corrosion, surface protection
Lubricating, ground vehicles
(NLGI), No. 2 consistency

6.9 International Standardization Agreement. Certain provisions of this specification are subject to international standardization agreement STANAGs 1135 and 2845. 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 or make other appropriate accommodations.

6.10 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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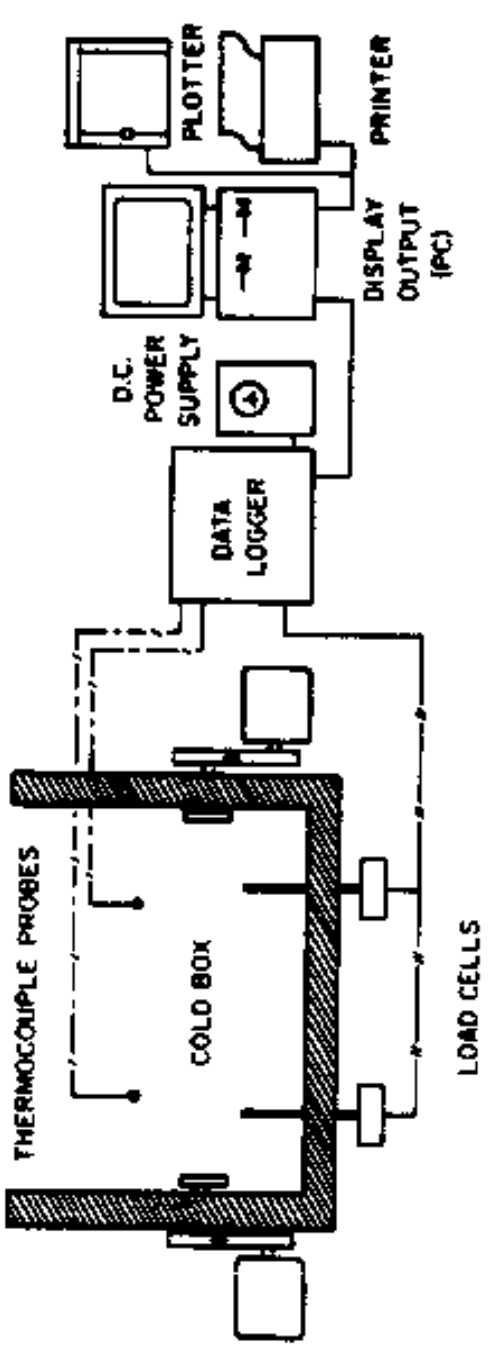

FIGURE 1. Schematic diagram of US Army low temperature torque test unit.

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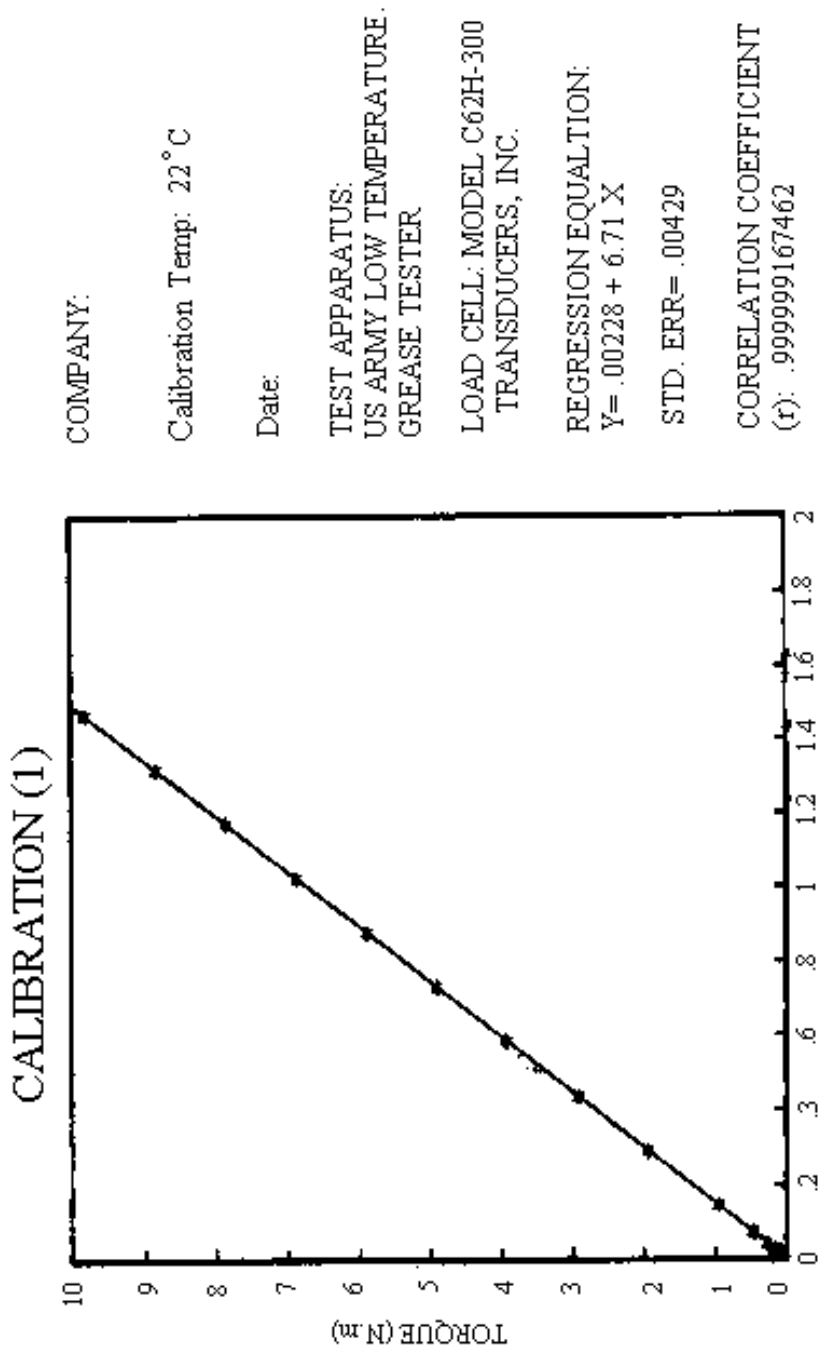

FIGURE 2. Calibration.

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APPENDIX A

US ARMY LOW TEMPERATURE TORQUE TEST METHOD FOR LUBRICATING GREASES

A.1. SCOPE

A.1.1 This appendix details the test method to be used for determining the torque values of lubricating greases using tapered roller bearings when subjected to low temperatures. The method was developed using greases giving torque of less than 80 N·m at -54°C. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.2. APPLICABLE DOCUMENTS

A.2.1 Government documents. - Does not apply.

A.3. SUMMARY

A.3.1 A worked sample of the test grease is packed into four test specimen assemblies which simulate the automotive front wheel bearing system. These assemblies are mildly heated and then rotated one revolution. The test assemblies are soaked for 16 hours at -54°C. At the end of this time, the two test assemblies are rotated consecutively at 1 revolutions per minute (rpm) and both breakaway (starting torque) and torque after 5 minutes of rotation (running torque) are then determined. The two remaining test assemblies are tested after the additional four hours cooling to restore the test temperature.

A.4. SIGNIFICANCE

A.4.1 This method was developed to assess the low temperature performance of greases at -54°C and clearly distinguish between differing grease formulations. The torque data obtained from this test method agree with the low temperature performance of military greases in the field. A correlation was found between the breakaway torque and the apparent viscosity range of 5000-30 000 poises at a shear rate of 25 reciprocal seconds.

A.5. DEFINITIONS

A.5.1 Breakaway torque. The maximum torque measured at start of rotation.

A.5.2 Running torque. The torque value after rotation for a specified period of time (5 minutes).

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APPENDIX A

A.6. APPARATUS

A.6.1 Low temperature torque test unit. This test unit consists of an ASTM D4693 test apparatus which is designed with a cold chamber and two spindle drive systems, torque measuring system, test specimen assembly, and data acquisition and control system. The schematic diagram of US Army low temperature torque test unit is shown in figure 1.

A.6.1.1 The low temperature test chamber consists of a cascade mechanical refrigeration system, a blower, and a solid state electronic temperature controller. This chamber is designed to maintain the test temperature down to -58°C. The chamber temperature is monitored with a T type thermocouple.

A.6.1.2 The spindle drive system consists of a 1/3 hp electric motor, a timing belt and pulley, a gear reducer and a solid stainless steel extension shaft (diameter: 2.2 centimeters (cm), length: 25.6 cm). The gear reducer provides 84 N·m of maximum output torque and approximately 1 rpm of fixed speed. Two spindle drive systems are mounted externally and connected to the inside of the cold chamber using a solid coupling and extension shaft, respectively. These shafts are supported by two sealed roller bearings which are lubricated with grease. Only the outside supporting bearings are rotated with the extension drive shafts during the test time.

A.6.1.3 The torque measuring system consists of a strain-gage load cell (capacity: 136 kg), a cylindrical rod (diameter: 1.9 cm, length: 22.5 cm), a load button and a direct current (dc) power supply (capacity 20 volts (V)). Two torque measuring systems are mounted on a plate which is situated below and external to the cold chamber. To measure the grease torque, rods are connected to the inside of the cold chamber with the load cell. A spherical load button is attached to the top of the rod to allow for the adjustment of the level of the torque arm. A dc power supply is connected to both load cells and applies 10 V for the input bridge excitation.

A.6.1.4 The test specimen assembly is as specified in the ASTM D4693 test method.

A.6.1.5 The data acquisition and control system consists of a HP data acquisition and control unit, a HP computer as system controller and the user operation program (LOWTEMP). The HP data acquisition and control unit also contains three plug-in assemblies: relay multiplexer assembly for measuring the torque value, relay multiplexer assembly with thermocouple compensation, and high voltage actuator to control the drive system.

A.6.2 Laboratory oven, gravity convection, 70 ±3°C.

A.6.3 Grease packer, as described in the ASTM D3527 test method.

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A.6.4 Spindle holder or test preparation stand.

A.6.5 Ultrasonic cleaner.

A.7. CALIBRATION

A.7.1 Torque calibration. Attach a support disk (diameter: 4 cm), for holding the dead weight, on the top of the rod. Measure output (millivolt) of load cell as a known force (dead weight: 0.5 kg, 1-10 kg) is applied to load cell at the room temperature. Then, the calibration equation shall be determined using the statistic method. The Method of Regression analysis is very suitable to develop the torque calibration equation. The typical calibration curve is shown in figure 2. This calibration needs be done only at the time of initial setup and when occasional checks indicate that it is required.

A.7.2 Temperature calibration, as described in ASTM D4693, or equivalent.

A.7.3 Spring calibration, as described in ASTM D4693, or equivalent.

A.8. TEST BEARINGS. Use LM67010-LM67048 and LM11910-LM11949 inboard and outboard bearings, respectively. Timken bearings are suitable. Prior to use in this test, new bearings shall be conditioned by installing any suitable wheel bearing grease in the bearings and running them at room temperature for 48 hours at 1,000 rpm under a normal thrust load of 111 N. ASTM D3527 test apparatus is suitable for conditioning the bearings.

NOTE 1. The bearings must be keyed to prevent race rotation on spindle.

A.9. PROCEDURE

A.9.1 Clean the test bearings with heptane or equivalent reagent using a ultrasonic cleaner and dry with compressed air.

A.9.2 Work a grease sample for 60 double strokes using the full scale grease or one-half scale grease worker at room temperature.

A.9.3 Weigh an inboard and outboard bearing cone to the nearest 0.1 gram (g).

A.9.4 Pack a worked grease sample into the test bearings (inboard: 3.0 ±0.1 g outboard: 2.0 ±0.1 g) using the following bearing packing procedure: Fill the bearings with the worked test grease using a grease packer utilized in ASTM D3527 test method. Use care to prevent relative rotation of rollers and bearing components while removing the cones from cups and in all

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subsequent wiping and handling steps. Strike off excess grease flush using a small spatula. Wipe all grease from cone bore, cone back face, exterior cage surfaces and exposed roller surfaces with a clean lint free cloth or towel and reweigh. Adjust the grease weight in the inboard and outboard cones to 3.0 and 2.0 ±0.1g, by wiping or adding grease to the groove between the cage and cone back face.

A.9.5 Clean the bearing cups installed in the hub using heptane and apply a thin film of the test grease to the races.

A.9.6 Set-up a test specimen assembly according to the following procedure: Without any rotation of the test bearing, the inboard bearing is installed on the spindle. Then, this spindle is mounted on the test preparation stand which was designed for holding it in a vertical position. The hub is gently set on the inboard bearing with the torque arm aligned with the spindle set screw. (i.e., pointing in the same direction). Then, the outboard bearing is placed on the hub. The thrust force (400 N) is applied to the test bearings with a calibrated spring-loading device.

A.9.7 Prepare four test specimen assemblies using the above test assembly preparation procedure.

A.9.8 Without disturbing the test assemblies, place them in an oven preheated to 70 ±3°C for 1 hour.

A.9.9 Rotate the test specimen assemblies for 1 revolution using the test apparatus at room temperature.

A.9.10 Install two test specimen assemblies on each drive shaft for the first two tests. Without any handling of the test assemblies, the torque arms should be placed vertically with the drive motors.

A.9.11 Place the other two test assemblies inside the cold chamber in preparation (cold soak) for the next tests.

A.9.12 Insert two thermocouples (T type) in the test spindles to monitor the test temperature.

A.9.13 Start 16 hour cold-soak at -54 ±0.5°C.

A.9.14 Following a 16 hour cold-soak, the two torque tests shall be consecutively performed using the LOWTEMP computer application program. The following additional test conditions are applied to the torque test runs:

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APPENDIX A

Test temperature: -54 ±0.5°C
Test time: 5 minutes
Spindle speed: 1 rpm
Data scanning interval: 20 centiseconds
The torque reading starts when torque value is >0.1 N·m

A.9.15 Store the test results on a floppy disk and plot them on the formatted papers.

A.9.16 Cut off the cooling system, and remove the tested specimen assemblies from the drive shafts and place them in the preheated oven until completely dried in order to preclude rust formation.

A.9.17 For the second series of tests, the two remaining test specimen assemblies shall be set up on the drive shafts identically to the previous tests.

A.9.18 Resume the cooling for the next four hours to restore the test temperature.

A.9.19 After four hours, two additional torque data shall be generated using the above torque measurement procedure.

A.10 VERIFICATION

A.10.1 Breakaway torque. Breakaway torque shall be 7.00.

A.10.2 Running torque. Running torque at 5 minutes shall be 5.00.

NOTE 2. Both determinations shall be calculated by the average of four test runs.

A.11. PRECISION

A.11.1 Repeatability

Breakaway torque: 10%
Running torque at 5 minutes: 7%

NOTE 3. Duplicate results by the same operator should be considered suspect if they differ from the mean by more than the above amounts at the 95 percent confidence level.

A.11.2 Reproducibility has not been established.

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Custodians:
Army - AT
Navy - YD1
Air Force - 68

Preparing Activity:
Army - AT

(Project 9150-1233)

Review Activities:
Army - AR, EA, MI, SM
Navy - AS, SA
Air Force - 11
DLA - GS, PS

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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, and 7.
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I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-PRF-10924G	**2. DOCUMENT DATE *(YYMMDD)*** 980924

3. DOCUMENT TITLE
GREASE, AUTOMOTIVE AND ARTILLERY

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** **(2) AUTOVON** ***(If applicable)***	**7. DATE SUBMITTED *(YYMMDD)***

8. PREPARING ACTIVITY

a. NAME	**b. TELEPHONE *(Include Area Code)*** **(1) Commercial** **(2) AUTOVON** **(810) 574-8745** **786-8745**
c. ADDRESS *(Include Zip Code)* **Commander** **U.S. Army Tank-automotive and Armaments Command** **ATTN: AMSTA-TR-E/BLUE** **Warren, MI 48397-5000**	**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**