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Standard Test Method for Low-Temperature Torque of Grease-Lubricated Wheel Bearings[1]

This standard is issued under the fixed designation D4693; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the extent to which a test grease retards the rotation of a specially-manufactured, spring-loaded, automotive-type wheel bearing assembly when subjected to low temperatures. Torque values, calculated from restraining-force determinations, are a measure of the viscous resistance of the grease. This test method was developed with greases giving torques of less than ~~35 N·m at −40°C.~~35 N·m at −40 °C.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 **WARNING**—Mercury has been designated by many regulatory agencies as a hazardous material that can cause central nervous system, kidney and liver damage. Mercury, or its vapor, may be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury containing products. See the applicable product Material Safety Data Sheet (MSDS) for details and EPA's website—http://www.epa.gov/mercury/faq.htm—for additional information. Users should be aware that selling mercury and/or mercury containing products into your state or country may be prohibited by law.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]
D217 Test Methods for Cone Penetration of Lubricating Grease
D1403 Test Methods for Cone Penetration of Lubricating Grease Using One-Quarter and One-Half Scale Cone Equipment
D3527 Test Method for Life Performance of Automotive Wheel Bearing Grease
D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants
E1 Specification for ASTM Liquid-in-Glass Thermometers
E77 Test Method for Inspection and Verification of Thermometers
E220 Test Method for Calibration of Thermocouples By Comparison Techniques
E230 Specification and Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples
E563 Practice for Preparation and Use of an Ice-Point Bath as a Reference Temperature
E585/E585M Specification for Compacted Mineral-Insulated, Metal-Sheathed, Base Metal Thermocouple Cable
E608/E608M Specification for Mineral-Insulated, Metal-Sheathed Base Metal Thermocouples
2.2 *Military Standard:*[3]
MIL-G-10924F Specification for Automotive and Artillery
2.3 *ABMA Standard:*[4]
Anti-Friction Bearing Manufacturer Assoc. (AFBMA) Standard 19, 1974 (ANSI B.3.19-1975)

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[1] This test method is under the jurisdiction of Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.G0 on Lubricating Grease.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

[4] Available from American Bearing Manufacturers Association (ABMA), 2025 M St., NW, Suite 800, Washington, DC 20036. www.americanbearings.org

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3. Terminology

3.1 *Definitions:*

3.1.1 *automotive wheel bearing grease, n*—a lubricating grease specifically formulated to lubricate automotive wheel bearings at relatively high grease temperatures and bearing speeds. **D3527**

3.1.2 *lubricant, n*—any material interposed between two surfaces that reduces the friction or wear between them. **D4175**

3.1.3 *lubricating grease, n*—a semi-fluid to solid product of a dispersion of a thickener in a liquid lubricant.

3.1.3.1 *Discussion*—

The dispersion of the thickener forms a two-phase system and immobilizes the liquid lubricant by surface tension and other physical forces. Other ingredients are commonly included to impact special properties. **D217**

3.1.4 *thickener, n—in lubricating grease*, a substance composed of finely-divided particles dispersed in a liquid lubricant to form the product's structure.

3.1.4.1 *Discussion*—

The solid thickener can be fibers (such as various metallic soaps) or plates or spheres (such as certain non-soap thickeners) which are insoluble or, at the most, only very slightly soluble in the liquid lubricant. The general requirements are that the solid particles be extremely small, uniformly dispered, and capable of forming a relatively stable, gel-like structure with the liquid lubricant. **D217**

4. Summary of Test Method

4.1 A freshly stirred and worked sample of test grease is packed into the bearings of a specially-manufactured, automotive-type spindle-bearings-hub assembly. The assembly is heated and then cold soaked at −40°C, unless another test temperature is specified by the grease specification. The spindle is rotated at 1 rpm and the torque required to prevent rotation of the hub is measured at ~~60 s.~~60 s.

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5. Significance and Use

5.1 This test method differentiates among greases having distinctly different low-temperature characteristics. This test is used for specification purposes and correlates with its precursor which has been used to predict the performance of greases in automotive wheel bearings in low-temperature service.[5] It is the responsibility of the user to determine the correlation with other types of service.

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6. Apparatus

6.1 *Low-Temperature Wheel Bearing Torque Apparatus,*[6,7] illustrated in Fig. 1.

NOTE 1—Several apparatus configurations are available, differing mainly in the drive system. For example, with large cold chambers, a unitized apparatus (see Fig. 1) can be used totally within the cold chamber. With small cold chambers, the drive system can be mounted externally and only the test unit subjected to low temperature. Regardless of the exact configuration, the essential apparatus consists of a 1/3 hp electric motor connected to a gear reducer by means of a timing belt and pulleys, which drive a specially-manufactured spindle-bearings-hub assembly equipped with a spring-loading mechanism. For apparatus contained totally within the cold chamber, the drive system should be prepared by replacing the grease in the motor bearings with a suitable low-temperature grease (<1 N·m torque ~~at −40°C),~~at −40 °C), such as one meeting the requirements of Specification MIL-G-10924F or similar, and the lubricant in the gear reducer should be replaced with a suitable low-temperature ~~(< −50°C~~(< −50 °C pour point) worm-gear lubricant.[7,8] In addition, if not already so-equipped, large-diameter ~~(152 mm), narrow-width (13 mm)~~ (152 mm), narrow-width (13 mm) timing pulleys and a suitable timing belt should be used.

6.2 *Torque Measuring System,* consisting of a strain-gage load cell with a matching bridge-balance unit,[7,9] a suitable strip-chart recorder to record the load-cell output, and a series of weights (up to ~~20 kg,~~ 20 kg, at least) suitable for load-cell calibration.

NOTE 2—In order to calculate torque from force measurements, the load cell should be located a known distance from the test-unit centerline; ~~100 mm~~ 100 mm is convenient. A convenient way to do this is to centrally drill a ~~1.78-mm~~1.78 mm diameter hole (No. 50 drill) in the torque arm, ~~100 mm~~ 100 mm

[5] Verdura, T. M., "Performance of Service Station Wheel Bearing Greases in a New Low-Temperature Test," *NLGI Spokesman 35* 10-21, 1971.

[6] The sole source of supply of the apparatus known to the committee at this time is available from Koehler Instrument Company, Inc., 1595 Sycamore Avenue, Bohemia, NY 11716.

[7] If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

[8] The sole source of supply of the apparatus known to the committee at this time is Mobil SHC 624 (or similar), available from Mobil Oil Corporation, 3225 Gallows Rd., Fairfax, VA 22037.

[9] The sole source of supply of the apparatus known to the committee at this time is a Model 3167-50 load cell and matching electronic circuitry, available from Lebow Associates, Inc., 1728 Maplelawn, Troy, MI 48062.