



Designation: D3527 – 23

Standard Test Method for Life Performance of Automotive Wheel Bearing Grease¹

This standard is issued under the fixed designation D3527; 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.

INTRODUCTION

This standard is based on a test rig that was originally designed in the 1960s. Since the standard was first published, there have been several attempts to revise the equipment and test procedure to improve the precision of the test. Since the first publication, there have been many advances in the quality of the hardware and automated control systems have superseded manual and analogue controls.

Several generations of test rig are still in commercial use, each potentially having their own issues relating to certification and contributing to the overall poor precision of this test. The Subcommittee responsible for this standard is aware of these issues, but has been unable to obtain sufficient interest to conduct an ILS program required to evaluate possible revisions and establish updated precision and bias data for comparison to the current test.

A 2017 ballot to withdraw this standard was unsuccessful and the standard will be re-approved to meet the needs of users and its inclusion in other industry and military standards, even though the hub design is obsolete. Work is underway to develop a replacement test that will better represent contemporary bearing designs and offer a selection of test conditions.

1. Scope*

1.1 This test method covers a laboratory procedure for evaluating the high-temperature life performance of wheel bearing greases when tested under prescribed conditions.

NOTE 1—Changes to this test method in the 1985 revision increased test severity. Results will not be comparable with data from earlier procedures.

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

1.2.1 *Exception*—Apparatus dimensions in inches are to be regarded as the standard.

1.3 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* For specific warning statements, see 8.1 – 8.4.

1.4 *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.*

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.G0.05 on Functional Tests - Temperature.

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mentations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 *AFBMA Standard:*
AFBMA Standard 19, 1974 (ANSI B. 3.19-1975)²

3. Terminology

3.1 *Definitions:*

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

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

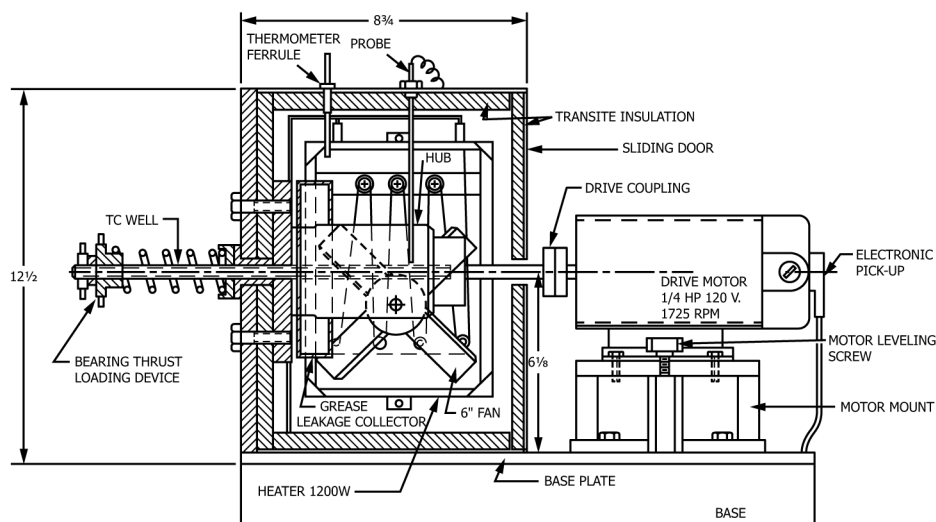
3.1.2.1 *Discussion*—The dispersion of the thickener forms a two-phase system and immobilizes the liquid lubricant by surface tension and other physical forces. Other ingredients are commonly included to impart special properties.

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

3.1.3.1 *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

² Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

*A Summary of Changes section appears at the end of this standard



NOTE 1—Caution should be taken when modifying older units since some may still contain asbestos insulation leading to a possible inhalation hazard.

FIG. 1 Wheel Bearing Lubricant Tester (Elevation View)

requirements are that the solid particles be extremely small, uniformly dispersed, and capable of forming a relatively stable, gel-like structure with the liquid lubricant.

3.2 Definitions of Terms Specific to This Standard:

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

3.2.2 *grease life, n*—of wheel bearing grease, amount of time operated under prescribed conditions of load, speed, and temperature until preset torque limit is exceeded.

3.2.2.1 *Discussion*—The *off-time*, which is part of the 20 h and 4 h off-cycle, is not recorded and is not included as part of grease life.

4. Summary of Test Method

4.1 The test grease is distributed in the bearings of a modified, automobile front wheel hub-spindle-bearings assembly. While the bearings are thrust-loaded to approximately 111 N, the hub is rotated at 1000 r/min and the spindle temperature maintained at 160 °C for 20 h, 4 h off operating cycle. The test is terminated when grease deterioration causes the drive motor torque to exceed a calculated motor cut off value. Grease life is expressed as the accumulated on-cycle hours.

5. Significance and Use

5.1 This test method differentiates among wheel bearing greases having distinctly different high-temperature characteristics. It is not the equivalent of longtime service tests, nor is it intended to distinguish between the products having similar high-temperature performance properties.

5.2 This test method has proven to be helpful in screening greases with respect to life performance for automotive wheel bearing applications.

6. Apparatus

6.1 *Test Assembly* (see Fig. 1 and Fig. 2).

6.1.1 *Custom-made Wheel Hub-Spindle-Bearing Assembly* (Fig. 3).

6.1.2 *Oven*, electrically heated by a 1200 watt heater, thermostatically controlled to maintain spindle temperature at 160 °C ± 1.5 °C.

6.1.3 *Spindle Drive Motor*, ¼ hp, 120 volts dc with 1725 r/min speed control the hub; motor torque is indicated by a meter equipped with an adjustable, automatic cut-off.

6.1.4 *Fan Drive Motor*, ⅓₀ hp, 120 v dc, 1550 r/min.

6.2 Motor speed, oven temperature, spindle temperature, time cycles and torque are controlled or monitored, or both, by accessory equipment. (Must have the capability to measure amps out to three decimal places or report as milliamps.)

6.3 *Balance* having a minimum capacity of 100 g and minimum sensitivity of 0.1 g.

7. Test Bearings

7.1 Use LM67048-LM67010 and LM11949-LM11910 (AF-BMA Standard 19) inboard and outboard bearings, respectively.

8. Reagents and Materials

8.1 *n-Heptane*—reagent grade minimum purity (Warning—Flammable. Harmful if inhaled.)

8.2 *Isopropyl Alcohol*—reagent grade minimum purity (Warning—Flammable.)

8.3 *Penmul L460 (previously called Penetone ECS)*³—(Warning—Combustible. Vapors can be harmful.)

³ The sole source of supply of Penmul L460 (previously called Penetone ECS) known to the committee at this time is Penetone Corp., 74 Hudson Ave., Tenafly, NJ 07670. 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.

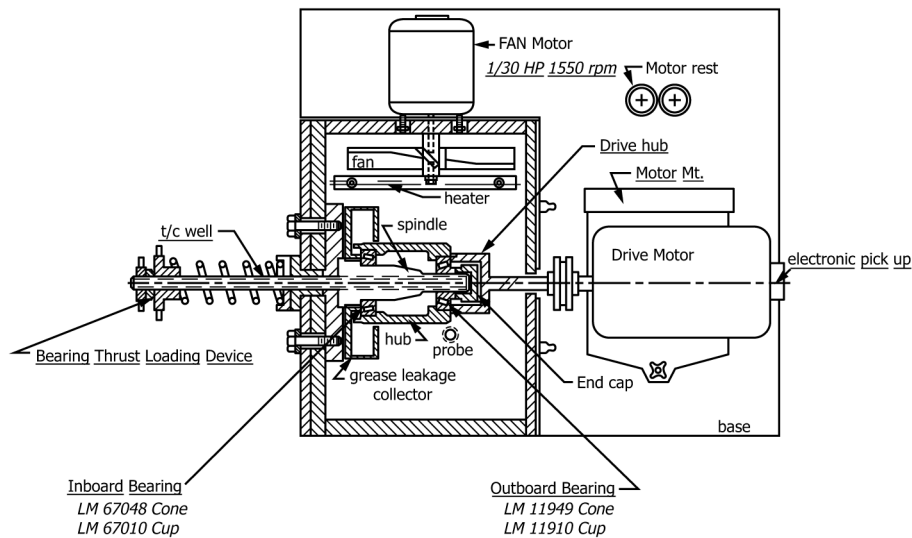


FIG. 2 Wheel Bearing Lubricant Tester (Top View)

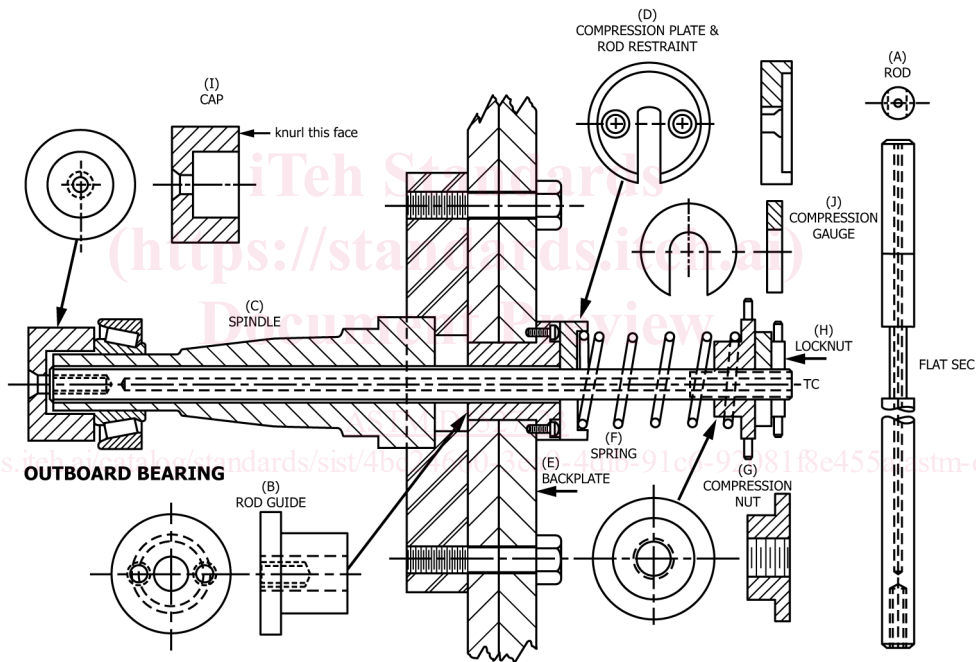


FIG. 3 Spindle and Thrust Rod Components

8.4 Mineral Spirits, Reagent Grade—(Warning—Combustible. Vapors may be harmful.)

8.5 SAE 10W Engine Oil.

8.6 00 Grade Steel Wool.

9. Preparation of Bearings

9.1 Carefully remove new bearings (cups and cones) from their packages and place in a suitable clean container. Wash with *n*-Heptane to remove all rust preventative.

9.2 Repeat washing with *n*-Heptane two additional times to be certain all rust preventative has been removed. Use a clean beaker each time.

9.3 Drain *n*-Heptane from the bearings and set them on a clean, lint-free cloth or towel to air dry.

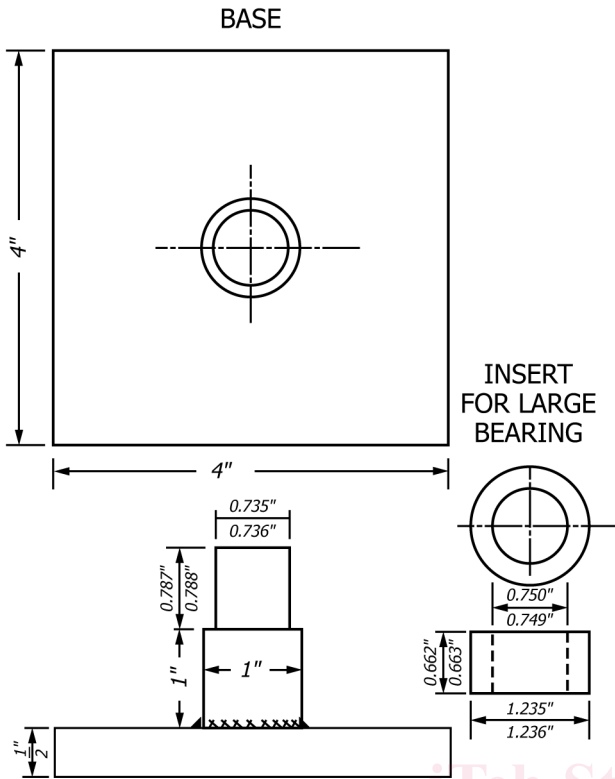
NOTE 2—Cleaning may be facilitated by the use of a sonic cleaner.

10. Procedure

10.1 Prior to each test, check the freedom of movement of the thrust loading shaft (Fig. 3) in the spindle. If binding is noted, remove and clean both shaft and spindle bore.

10.2 Install the new cups in the cleaned hub in the location shown in Figs. 1 and 2.

10.3 Weigh an inboard and outboard bearing cone to the nearest 0.1 g. Fill the cones with test grease using an extra set



MATL: STAINLESS STEEL
FIG. 4 Bearing Packer

of cups and the grease packer shown in Figs. 4 and 5. Use care to avoid moving the rollers or bearing components while removing the cones from the cups and in all subsequent wiping and handling steps. Strike off excess grease flush with the front face of the cone (near small end of rollers) 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 cone to $3.0\text{ g} \pm 0.1\text{ g}$ and in the outboard cone to $2.0\text{ g} \pm 0.1\text{ g}$ by wiping or adding grease to the groove between the cage and the cone back face. Apply a thin film of grease on the cups.

10.4 Install the leakage collector, inboard cone, hub, and outboard cone on the spindle (Fig. 2). Lock the components in place with the end cap and screw. Install the spindle connector.

10.5 Referring to Fig. 3, adjust the thrust load as follows: tighten the compression nut *G* until the spring *F* is seated against the back plate *E*, but not compressed. Bring the lock nut *H* up to the compression nut *G*. Without moving *H*, compress *F* by tightening *G* until the compression gage *J* will fit between *H* and *G*. Hold *J* in position and back off *G* until *J* is held firmly between *H* and *G*.

NOTE 3—Compression gage *J* has been machined such that insertion and adjustment of *G* causes spring *F* to compress and apply approximately 111 N (25 lbf) of axial loading on the wheel bearings. It is the understanding of Subcommittee G that the intent of the axial load is to ensure that the bearing is properly aligned on the spindle and remains so through the duration of the test.

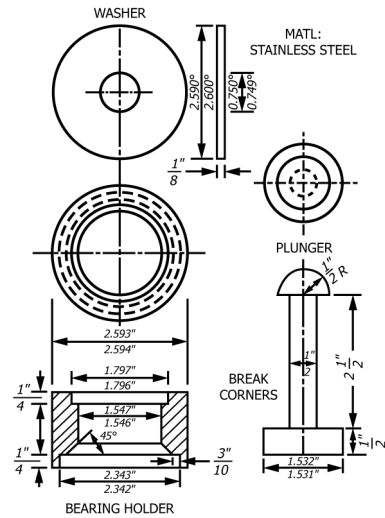


FIG. 5 Bearing Packer

Evaluation of a limited selection of these parts indicates the potential for significant variations in axial load when the instructions in 10.5 are followed. Since it was first published, this test method has not required calibration of the compression nut, spring, and gauge. So it seems that it is not critical to achieve an axial load of 111 N within an unspecified tolerance. Therefore there is no requirement to calibrate the test parts or to confirm the loading achieved.

10.6 Insert the thermocouple in the spindle thrust rod and position the junction at the center of the outboard bearing position. Close the cabinet and position the motor to operating location. (Warning—Do not engage the drive at this point. Start the motor and adjust the speed to $1000\text{ r/min} \pm 50\text{ r/min}$. Allow an unloaded motor current stabilization time of 120 min before recording as the unloaded motor current *N*.)

10.7 Turn off the motor, engage the drive coupling and lock in position. Set the timer to begin a 20 h cycle. Restart the motor and again adjust the speed to $1000\text{ r/min} \pm 50\text{ r/min}$. Turn on the heaters and adjust the oven temperature to maintain the spindle temperature at $160\text{ }^\circ\text{C} \pm 1.5\text{ }^\circ\text{C}$ ($320\text{ }^\circ\text{F} \pm 2.7\text{ }^\circ\text{F}$). When the spindle temperature has stabilized at the test temperature, make no further adjustment of the oven temperature for the duration of the test.

10.8 A steady-state running torque will develop in the first 2 h of operation as indicated by a stabilized value on the meter. Record this value as steady-state current *T*. Determine the motor cutoff value as follows:

$$C = 8(T - N) + N \quad (1)$$

where:

- C* = motor cut-off value, amps,
- T* = steady-state current, amps, and
- N* = unloaded motor current, amps (recorded at 120 min).

NOTE 4—Must have the capability to measure amps current out to three decimal places or report as milliamps.

Set the automatic torque cutoff of motor to value of *C*.

10.9 Permit the apparatus to operate under the prescribed conditions of load, speed, and temperature until the preset torque limit is exceeded either during restart of off-cycle or