



Designation: **D3336—17 D3336 – 18**

Standard Test Method for Life of Lubricating Greases in Ball Bearings at Elevated Temperatures¹

This standard is issued under the fixed designation D3336; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This test method covers the evaluation of the performance of lubricating greases in ball bearings operating under light loads at high speeds and elevated temperatures.

1.2 The values stated in SI units are to be regarded as standard.

1.2.1 *Exception*—The values given in parentheses are mathematical conversions to inch-pound units that are provided for information only and are not considered 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.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*²

A600 [Specification for Tool Steel High Speed](#)

2.2 *ABMA Standard:*³

[Standard 4, Tolerance Definitions and Gaging Practices for Ball and Roller Bearings](#)

3. Summary of Test Method

3.1 A grease lubricated SAE No. 204 size ball bearing is rotated at 10 000 r/min under light load at a specified elevated temperature. Tests are continued until failure or completion of a specified number of hours of running time.

4. Significance and Use

4.1 This test method can be used to evaluate the ability of grease to provide adequate lubrication for extended periods of ball bearings operating under light loads at high speeds and elevated temperatures.

5. Apparatus^{4,5}

5.1 *Test Spindle*⁶(see [Figs. 1-4](#)), capable of operating at speeds of 10 000 r/min and temperatures as high as 371 °C (700 °F). The test bearing seat dimension shall be 19.99 mm to 20.00 mm (0.7870 in. to 0.7874 in.). For spindles having the test bearing and

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.

Current edition approved June 1, 2017/June 1, 2018. Published June 2017/July 2018. Originally approved in 1975. Last previous edition approved in 2015/2017 as [D3336 – 05 \(2015\):D3336 – 17](#). DOI: [10.1520/D3336-17.10.1520/D3336-18](#).

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 American Bearing Manufacturers Assoc., 2025 M St., NW, Ste 800, Washington, DC 20036.

⁴ Complete apparatus is available from Falex Corp., 1020 Airpark Dr., Sugar Grove, IL 60554.

⁵ 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.

⁶ Pope Machinery Corporation Grease Test Spindles No. P-1911 or P-6301A-HT (Fig. 1) and No. P-7605-B (Fig. 2); and Falex Corp. spindles of the type shown in [Fig. 1](#) and [Fig. 2](#) have been found satisfactory for this purpose.

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

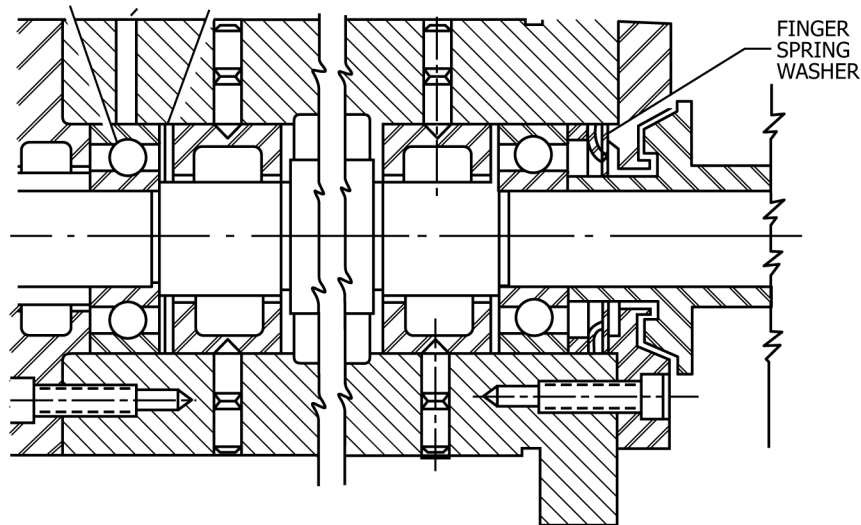


FIG. 1 Test Spindle (Both Bearings Floating)

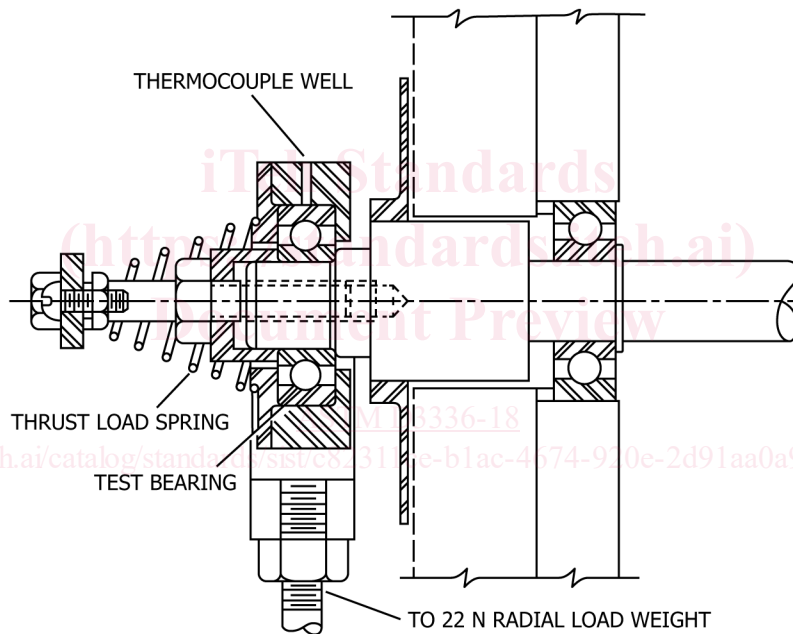


FIG. 2 Test Spindle (with Radial Load)

the support bearing in the same housing (CRC Type, Figs. 1-3) (Note 2) the internal construction of the spindle shall be such that the outboard support bearing, or both bearings are free to float axially in the housing. In designs where both bearings are free to float, the spindle shaft shall have a 0.508 mm to 0.762 mm (0.020 in. to 0.030 in.) free axial movement or end play. The outboard bearing seat dimension should be 19.99 mm to 20.00 mm (0.7870 in. to 0.7874 in.).

5.1.1 The test unit design (Fig. 1 and Fig. 2) should be such that a finger spring washer produces a 22 N to 67 N (5 lbf to 15 lbf) thrust load on the floating outboard support bearing.^{7,5}

5.2 Bearing Housing:

5.2.1 For CRC Type Spindles—The bearing housing diameter shall be 47.005 mm to 47.021 mm (1.8506 in. to 1.8512 in.) to give proper bearing mounting. Construction shall be such that the test bearing is equipped with flush spacers or shields to confine the grease to the bearing. The spacers or shields shall have a clearance between the inside diameter and the shaft of 0.127 mm to 0.178 mm (0.005 in. to 0.007 in.) per side.

NOTE 1—This type of spindle is described in CRC Research Technique for the Determination of Performance Characteristics of Lubricating Grease

⁷ The sole source of supply of the apparatus known to the committee at this time is Falex Part No. 643-187-070, Falex Corp. 1020 Airpark Dr., Sugar Grove, IL 60554.

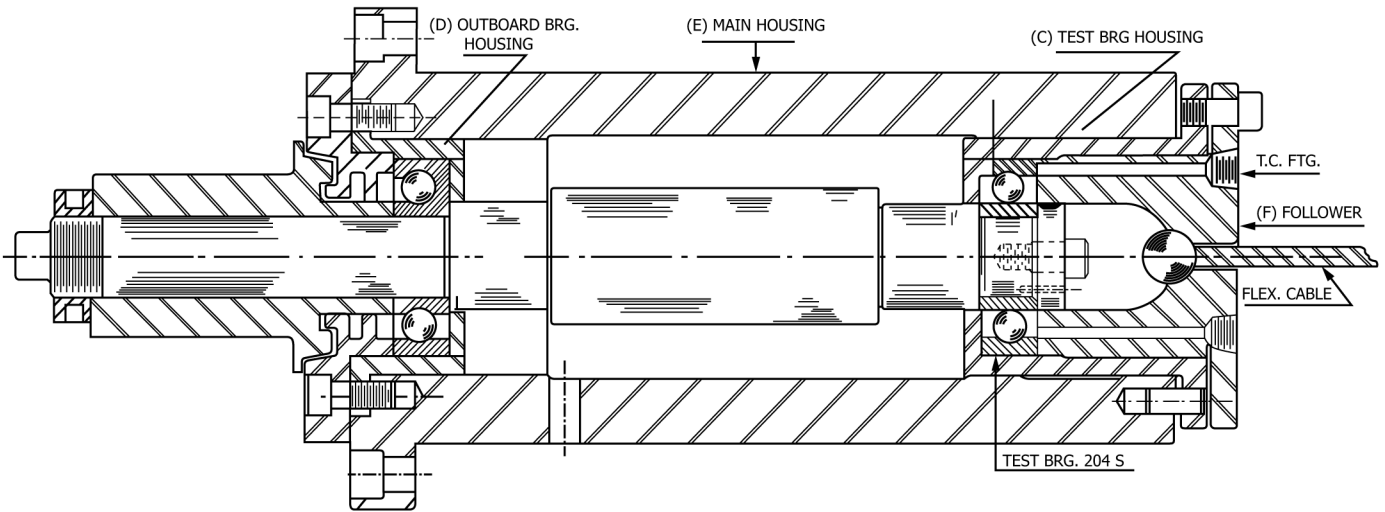


FIG. 3 Test Spindle Thrust Load Design

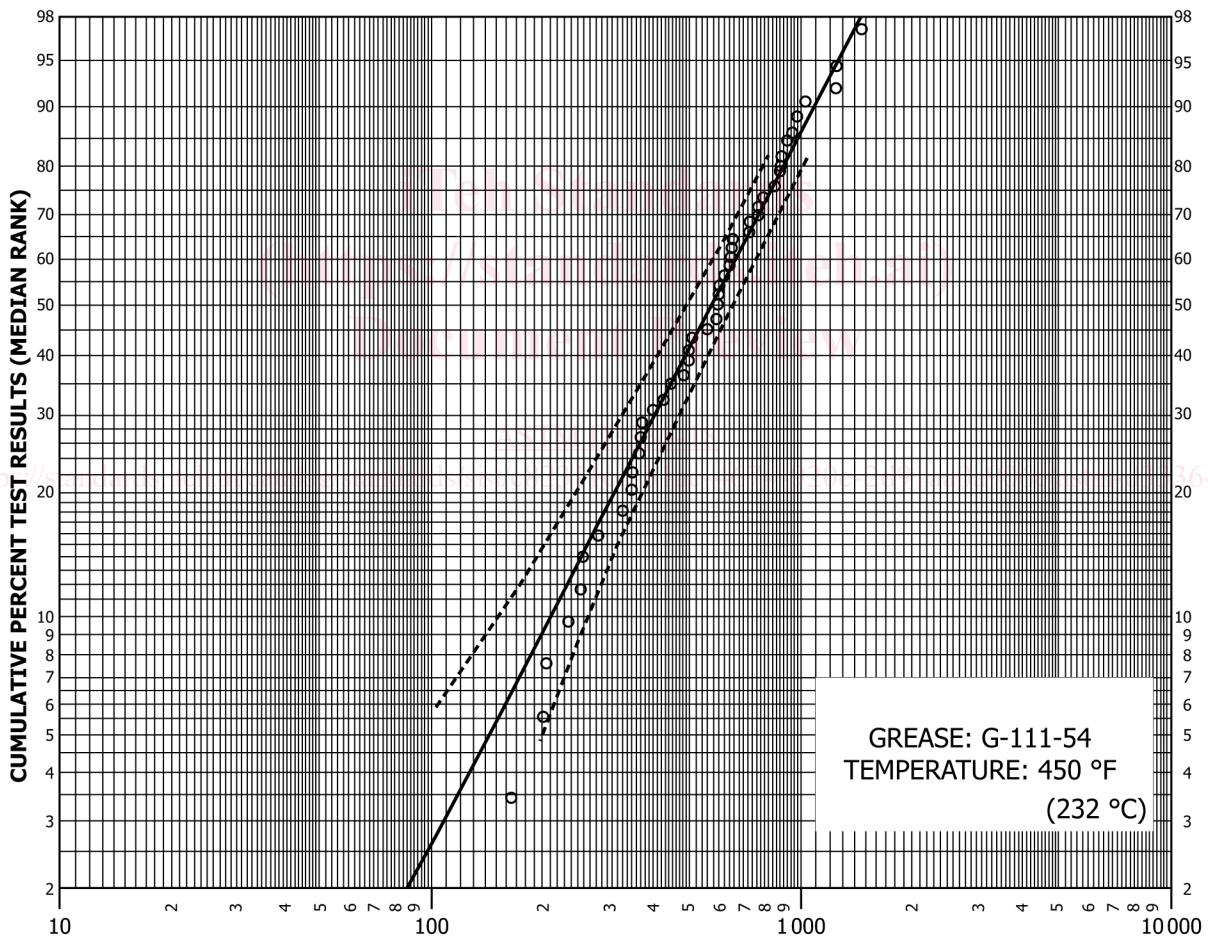


FIG. 4 G-III-54 Grease Life, Hours to Failure

in Antifriction Bearings at Elevated Temperature (CRC Designations L-35-54 and CRC L-35-62).

5.2.2 For Navy Type Spindles (Test Bearing Mounted Outside Spindle Housing)—The bearing housing shall be constructed of material similar to that of the test bearing and shall be tempered to retain dimensional stability at temperatures up to 371 °C (700 °F). Internal diameter shall be 47.005 mm to 47.021 mm (1.8506 in. to 1.8512 in.). The housing cover shall be flush fitting to confine the grease to the bearing. Provision shall be made for insertion in the housing of one or two small thermocouples which shall lightly press on and be in continual contact with the outer race of the test bearing. The housing shall be fitted with lugs to

accommodate a yoke and added weight so that a radial load may be applied to the test bearing. A thrust load of $22\text{ N} \pm 2\text{ N}$ ($5\text{ lbf} \pm 0.55\text{ lbf}$) shall be applied to the outer race of the bearing by means of a helical spring calibrated at room temperature.

5.3 *Motor Drive Assembly*—Spindle bracket and constant belt tension motor drive assembly capable of providing spindle speeds up to $10\,000\text{ r/min} \pm 200\text{ r/min}$ by means of an endless belt. The motor shall be mounted so that a belt tension of approximately 67 N (15 lbf) can be maintained on the test spindle pulley.

5.4 *Oven*, removable, capable of producing a test temperature of $371\text{ }^{\circ}\text{C}$ ($700\text{ }^{\circ}\text{F}$) within $1\frac{1}{2}\text{ h}$.

5.5 *Control Equipment*:

5.5.1 The temperature at the outside diameter of the test bearing shall be maintained within $3\text{ }^{\circ}\text{C}$ ($5\text{ }^{\circ}\text{F}$) of the specified test temperature. The temperature control equipment shall be adequate to maintain the temperature at the outer race of the test bearing within the limits specified by control of the oven temperature. The oven temperature shall be controlled by means of a thermocouple placed in the oven cavity.

5.5.2 Suitable equipment such as adjustable reset relay and overload device for shutting off oven heaters and drive motor and other accessory equipment (timer, recorder, etc.) shall be provided. Oven temperature as well as bearing temperature should be recorded.

6. Materials

6.1 *Test Bearing, General Requirements*—SAE No. 204 size, fabricated from heat-resistant steel, suitable for temperatures as high as $371\text{ }^{\circ}\text{C}$ ($700\text{ }^{\circ}\text{F}$). The bearing shall be ISO 6204 (SAE No. 204) size, manufactured to ABEC-3 quality, having a radial clearance of from 0.025 mm to 0.031 mm (0.0010 in. to 0.0012 in.), quality. See [Annex A1](#), which describes ABMA's standard method of measuring radial internal clearances of ball bearings. The bearing shall be equipped with a ball retainer fabricated from suitable material capable of withstanding temperatures as high as $371\text{ }^{\circ}\text{C}$ ($700\text{ }^{\circ}\text{F}$). Support bearings of CRC Type spindles shall be identical to the test bearings.

NOTE 2—Bearings fabricated from 18-4-1 high speed or M-50 (Specification A600) tool steel with retainers fabricated from heat-treated silver-plated beryllium copper⁸ have been found satisfactory for this purpose. Alternatively, for testing at temperatures of $149\text{ }^{\circ}\text{C}$ ($300\text{ }^{\circ}\text{F}$) and below, ASTM Test Bearings Size 6204 (PCN 12-433360-12) ABEC-3 has been found satisfactory. This bearing is fabricated from AISI 52100 steel, with a retainer fabricated from AISI C1010 steel and with an internal clearance range of 0.021 mm to 0.028 mm (0.0008 in. to 0.0011 in.).⁹

6.1.1 *Lower Temperature Bearing*—For testing at temperatures of $149\text{ }^{\circ}\text{C}$ ($300\text{ }^{\circ}\text{F}$) and below, a size 6204 bearing (PCN 12-433360-12) has been found satisfactory. This bearing is fabricated from AISI 52100 steel, with a retainer fabricated from AISI C1010 steel and with an internal clearance range of 0.021 mm to 0.028 mm (0.0008 in. to 0.0011 in.).⁸

6.1.2 *Higher Temperature Bearing*—For testing at temperatures above $149\text{ }^{\circ}\text{C}$ ($300\text{ }^{\circ}\text{F}$), the bearing shall be fabricated from heat-resistant steel and equipped with a ball retainer fabricated from suitable material, both capable of withstanding temperatures as high as $371\text{ }^{\circ}\text{C}$ ($700\text{ }^{\circ}\text{F}$). Bearings fabricated from 18-4-1 high speed or M-50 (Specification A600) tool steel with retainers fabricated from heat-treated silver-plated beryllium copper⁹ have been found satisfactory for this purpose. The bearing shall have a radial clearance of from 0.025 mm to 0.031 mm (0.0010 in. to 0.0012 in.).

6.2 ASTM *n*-Heptane.¹⁰

6.3 *Mineral Spirits*, reagent grade.

7. Test Conditions

7.1 *Temperature*—As specified up to $371\text{ }^{\circ}\text{C}$ ($700\text{ }^{\circ}\text{F}$).

7.2 *Speed*— $10\,000\text{ r/min} \pm 200\text{ r/min}$.

7.3 *Test Cycle*:

7.3.1 Twenty-one and one-half hours running at temperatures of $149\text{ }^{\circ}\text{C}$ ($300\text{ }^{\circ}\text{F}$) and below— $2\frac{1}{2}\text{ h}$ shutdown without applied heat.

7.3.2 Twenty hours running at temperatures of above $149\text{ }^{\circ}\text{C}$ ($300\text{ }^{\circ}\text{F}$)— 4 h shutdown without applied heat.

8. Preparation of Apparatus

8.1 Just prior to lubrication for test, clean the test bearing by rotating it in warm (approximately $50\text{ }^{\circ}\text{C}$ ($120\text{ }^{\circ}\text{F}$)) mineral spirits, reagent grade (**Warning**—Flammable. Harmful if inhaled) followed by two successive washes of ASTM *n*-heptane (**Warning**—Combustible. Vapor harmful) and flash dry in an oven at $71\text{ }^{\circ}\text{C}$ ($160\text{ }^{\circ}\text{F}$). Cool the bearing to room temperature.

⁸ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1272. Contact ASTM Customer Service at service@astm.org.

⁹ The sole source of supply of the apparatus known to the committee at this time is Bearing MRC204S17, SKF Bearings, www.skf.com. 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.

² Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1272.

¹⁰ Described in 1996 *Annual Book of ASTM Standards*, Vol 05.04, Annex 2, Section A2.7 on Reference Materials.