



Standard Test Method for Wear Preventive Characteristics of Lubricating Grease (Four-Ball Method)¹

This standard is issued under the fixed designation D 2266; 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 test method has been adopted for use by government agencies to replace Method 6514 of Federal Test Method Standard No. 791b.

1. Scope

1.1 This test method covers the determination of the wear preventive characteristics of greases in sliding steel-on-steel applications. It is not intended to predict wear characteristics with metal combinations other than steel-on-steel or to evaluate the extreme pressure characteristics of the grease.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety problems, 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.* For specific hazard statement see 7.2, 7.3, and 9.1.

2. Referenced Documents

2.1 ASTM Standards:

D 235 Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)²

2.2 Other Document:

ANSI Specifications B 3.12 for Metal Balls³

3. Terminology

3.1 There are no terms in this standard that require new or other than dictionary definitions.

4. Summary of Test Method

4.1 A steel ball is rotated under load against three stationary steel balls having grease-lubricated surfaces. The diameters of the wear scars on the stationary balls are measured after completion of the test.

5. Significance and Use

5.1 The four-ball wear-test method can be used to determine

the relative wear-preventing properties of greases under the test conditions and if the test conditions are changed the relative ratings may be different. No correlation has been established between the four-ball wear test and field service. The test method cannot be used to differentiate between Extreme Pressure (EP) and Non-Extreme Pressure (Non-EP) Greases.⁴

6. Apparatus

6.1 *Four-Ball Wear-Tester and Accessories*—See Fig. 1 and Fig. 2.⁵

NOTE 1—It is important to distinguish between the Four-Ball EP Tester and the Four-Ball Wear Tester. The Four-Ball Wear Tester can be used under a variety of test conditions at loads up to 50 kgf. The Four-Ball EP Tester is designed for testing under more severe conditions and lacks the sensitivity necessary for the four-ball wear test.

7. Reagents and Materials

7.1 *Test Balls*—Test balls shall be chrome alloy steel, made from AISI standard steel No. E-52100, with diameter of 12.7 mm (0.5 in.), Grade 25 EP (Extra Polish). Such balls are described in ANSI Specifications B 3.12, for Metal Balls. The Extra-Polish finish is not described in that specification. The Rockwell C hardness shall be 64 to 66, a closer limit than is found in the ANSI requirement.

NOTE 2—Steel balls meeting this description were used in developing the precision of the test. They are available from ball, bearing, or laboratory equipment manufacturers and distributors. All balls used in one test should be taken from one carton (of 500 balls) as received from the supplier.

7.2 ASTM n-Heptane.⁶

NOTE 3—**Warning:** Flammable. Harmful if swallowed.

7.3 *Stoddard Solvent*, conforming to requirements of Specification D 235.

NOTE 4—**Warning:** Combustible. Vapor harmful.

¹ This test method is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.G on Lubricating Grease.

Current edition approved Sept. 15, 1991. Published November 1991. Originally published as D 2266 – 64 T. Last previous edition D 2266 – 86.

² *Annual Book of ASTM Standards*, Vol 06.04.

³ Available from American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036.

⁴ Further details on this test method may be found in: Stallings, L., et al., *NLGI Spokesman*, Vol 31, No. 11, February 1968, pp. 396–401.

⁵ The Four-Ball Wear Tester, available from Falex Corp., 2055 Comprehensive Drive, Aurora, IL 60505, has been found suitable for this purpose.

⁶ Described in the *Annual Book of ASTM Standards*, Vol 05.04, Test Methods for Rating Motor Diesel and Aviation Fuels, Annex 2, Section A2.7 Reference Materials.

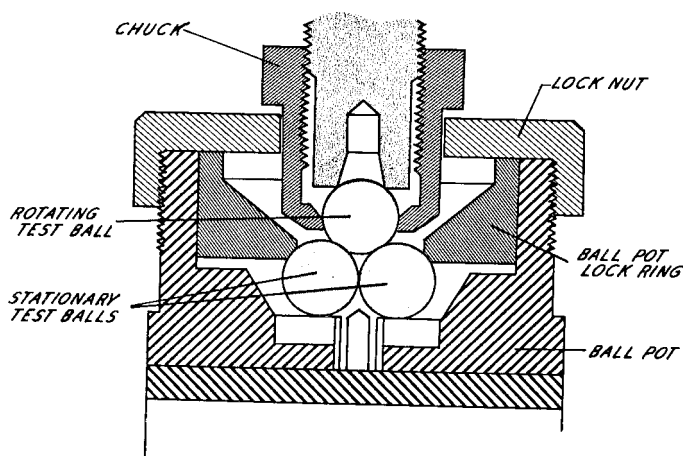


FIG. 1 Precision Scientific Company Four-Ball Test Arrangement

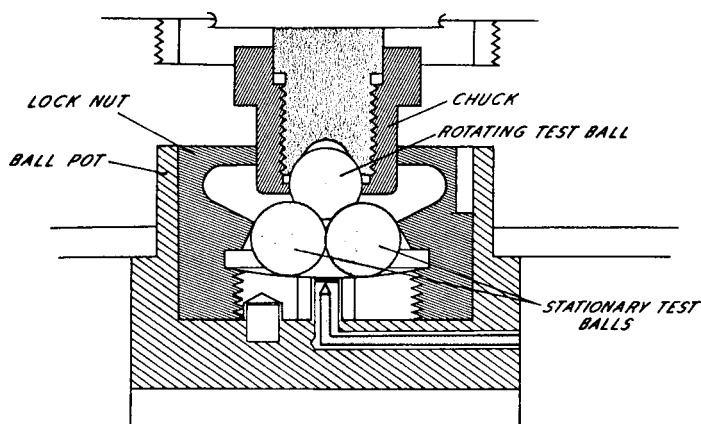


FIG. 2 Falex Corporation (Roxanna) Four-Ball Test Arrangement

8. Test Conditions

8.1 The test shall be conducted under the following conditions:

Temperature	$75 \pm 1.7^{\circ}\text{C}$ ($167 \pm 3^{\circ}\text{F}$)
Speed	1200 ± 50 rpm
Load	40 ± 0.2 kgf (392 ± 2 N)
Duration of test	60 ± 1 min

NOTE 5—Although the test can be run under other conditions, the precision limits described in Section 11 apply only to tests conducted under the conditions described in Section 8.

9. Preparation of Apparatus

9.1 Thoroughly clean the test balls, chuck, and ball pot assembly by rinsing with Stoddard solvent (**Warning**—See Note 4) and wiping with a soft lint-free cloth. Follow with a second wash in clean Stoddard solvent and a final wash in ASTM *n*-heptane (**Warning**—See Note 3). Dry the test balls, chuck, and ball pot assembly by allowing the solvent to evaporate in air.

9.2 Place one of the clean steel test balls into the chuck. Tighten the chuck holding the test ball firmly onto the shaft of the machine.

9.3 Place a small amount of the grease (approximately 5 g) in the ball pot. Insert the three test balls in the ball pot and lock the balls in position by tightening the locknut on the ball pot.

9.4 Coat the test balls located in the chuck and pot completely and thoroughly with the test grease; fill the ball pot with

grease and level off with the top surface of the locknut.

10. Procedure

10.1 *For Falex (Roxanna) Deadweight Loaded Four-Ball Wear Tester*—Place the ball pot into the ball-pot holder and position this assembly in the test unit. Raise the assembly and insert the pivot pin so that the tapered ends (pivot points) rest in hardened seats. Lower the assembly, thereby applying the load at a specific point on the balance beam. Check to see that no binding occurs. Turn the adjusting screw on the balance beam until the arm is balanced. Check sensitivity by moving the poise on the balance beam. A change in loading of 0.2 kgf (2 N) should produce a noticeable deflection from the balance point.

10.2 *For Precision Four-Ball Wear Tester*—Lock the load arm by means of the sliding lock. Place the poise and weight support on the load arm. Position the ball-pot assembly on the torque arm and heater assembly. Remove the ring assembly, place the ball-pot assembly in position and replace the ring assembly. Disengage the sliding lock to release the load arm and balance by adjusting the load arm counterweight and locknut.

10.3 Ensure that the drive is arranged for the specified speed (1200 rpm). Apply the specified load 40 kgf (392 N) by appropriate means such as pneumatic or dead weight loading. Set the mercury cup assembly and rotating-ball pot assembly so that the proper electrical contacts are made, and connect the dynamometer to the torque arm. Set the temperature controller to the specified temperature of 75°C (167°F), turn on the heater and adjust the variable transformer so that equilibrium will be reached at the test temperature. Turn on the motor when the test temperature has been reached. The temperature can rise rapidly after the motor is operating and may level off above the preset temperature. In such cases the temperature must be preset at a lower temperature level to allow for the higher thermal input on starting.

10.4 After a period of 60 min turn off the drive motor and heater. Lower the assembly and remove the ball pot.

10.5 Measure the scar diameter as follows:

10.5.1 *Option A*—Remove the locknut and release the test balls. Clean the balls with Stoddard solvent and *n*-heptane and wipe dry with a soft cloth. Place the individual balls on a suitable holder and by means of a microscope, measure the scar diameters at two positions on each of the three test balls. Measure to the nearest 0.01 mm the minimum scar diameter. Again to the nearest 0.01 mm, measure the minimum scar diameter 90° from the first position of measurement. Report the arithmetic average of the six readings as scar diameter, in millimetres.

10.5.2 *Option B*—Retain the balls in the ball pot. Wipe excess grease from the balls and ball pot. Wash the ball surfaces with Stoddard solvent and *n*-heptane. Using a microscope assembly,⁷ measure and report the scar diameters as specified under Option A.

⁷ Falex Corp. Microscope F-1519-2 has been found suitable for this purpose. F-1519-2 measures to 0.1 mm directly to 0.01 mm by interpolation. A higher resolution version, F-1519-2A, measures to 0.01 mm.