



Designation: D6138 – 23a

Standard Test Method for Determination of Corrosion-Preventive Properties of Lubricating Greases Under Dynamic Wet Conditions (Emcor Test)¹

This standard is issued under the fixed designation D6138; 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 corrosion-preventive properties of greases using grease-lubricated ball bearings under dynamic wet conditions.

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 *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.*

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

D665 Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water

D1193 Specification for Reagent Water

D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants

2.2 ISO Standards:³

ISO 15 Rolling bearings—Radial bearings—Boundary dimensions—General plan

ISO 3696 Water for analytical laboratory use—Specifications and test methods

ISO 7120 Petroleum products and lubricants—Petroleum oils and other fluids—Determination of rust-preventing characteristics in the presence of water

2.3 EI Standards:⁴

IP 530 Determination of the density of grease—Density cup method

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this test method, refer to Terminology **D4175**.

3.1.2 *corrosion, n*—the chemical or electrochemical reaction between a material, usually a metal, and its environment that produces a deterioration of the material and its properties.

3.1.2.1 *Discussion*—In this test method, corrosion is manifested by red rust or black stains on the bearing race. Stains, through which the underlying metal surface is still visible, are not considered corrosion in Test Method D6138 and shall be ignored.

3.1.3 *lubricating grease, n*—a semifluid to solid product 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 impart special properties.

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 thickeners can be fibers (such as various metallic soaps) or plates or spheres (such as certain non-soap thickener), which are insoluble or, at most, only very slightly soluble in the liquid lubricant. The general 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.

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.G0.06** on Functional Tests - Contamination.

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

⁴ Available from Energy Institute, 61 New Cavendish St., London, W1G 7AR, U.K., <http://www.energyinst.org>.

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

4. Summary of Test Method

4.1 New, cleaned, and lubricated bearings are tested partially immersed in water (distilled, synthetic sea water, or sodium chloride solution) under no applied load at a speed of 83 r/min $\pm$ 5 r/min in a predetermined sequence of running and stopping for a period of approximately one week. After cleaning, the bearing rings are examined and rated according to the degree of corrosion.

5. Significance and Use

5.1 This test method is used to assess the ability of grease to prevent corrosion in rolling bearings operated in the presence of distilled water, sodium chloride solution, or synthetic sea water. It is used for development and specification purposes.

6. Apparatus

6.1 *Test Bearings*—Use a double row self-aligning ball bearing (30 mm by 72 mm by 19 mm), conforming to 1306 K of ISO 15, with a steel cage.⁵ In cases of dispute, the SKF bearing specified in Footnote 5 shall be used as the referee bearing.

6.2 *SKF TMG/Emcor Test Machine*, see **Annex A1** for description.

6.3 *Dentist's Mirror*, non-magnifying.

6.4 *Graduated Pipette or Syringe*, capable of measuring 20 mL $\pm$ 1 mL water.

6.5 *Oven*, capable of maintaining 90 °C $\pm$ 2 °C.

7. Reagents

7.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.⁶ Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean freshly boiled double distilled water, water conforming to Specification **D1193** Type II, or reagent water as defined by Grade 2 of ISO 3696.

7.3 *Synthetic Sea Water*—If required, as specified in Test Method **D665**, and ISO 7120.

7.4 *Sodium Chloride Solution*—a 0.5 mol/L solution of sodium chloride prepared using freshly boiled double distilled water, water conforming to Specification **D1193** Type II, or water conforming to Grade 2 of ISO 3696, at a pH of 8.0 to 8.2 adjusted by titration with sodium hydroxide solution.

⁵ 1306 K steel caged bearing manufactured by NTN and DKF may be used; however, precision had only been evaluated using SKF 1306 K/236 725 bearings.

⁶ *ACS Reagent Chemicals, Specifications and Procedures for Reagents and Standard-Grade Reference Materials*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

NOTE 1—Other water types, such as that specified in Specification **D1193**, Type III, or other salt solutions and salt concentrations can be used in this test method, although the precision when using other water types and salt solutions has not been determined. It is recommended that the pH of the other water types is determined before use.

7.5 *Isopropyl Alcohol*—(**Warning**—Flammable. Poison. Causes burns. Vapor extremely irritating. May be fatal if swallowed. Harmful if inhaled.)

7.6 *Ammonium Hydroxide*—(**Warning**—Flammable. Poison. Causes burns. Vapor extremely irritating. May be fatal if swallowed. Harmful if inhaled.)

7.7 *Solvent Rinse Solution*, of the following composition by volume:

7.7.1 90 % Isopropyl alcohol.

7.7.2 9 % Distilled water.

7.7.3 1 % Ammonium hydroxide, 3.2 mol/L concentration. (**Warning**—Flammable. Poison. Causes burns. Vapor extremely irritating. May be fatal if swallowed. Harmful if inhaled.)

7.8 *Mineral Spirit*, also known as Stoddard Solvent, reagent grade. (**Warning**—Combustible. Vapor Harmful.)

8. Preparation of Bearings

8.1 Examine the test bearings carefully and select only bearings that have outer rings and balls entirely free of corrosion. During the bearing preparation, handle the bearings with tongs or protective gloves. Do not touch the bearings with bare fingers at any time. Use two new bearings for each grease being tested.

8.2 Number bearings on the outside diameter of the outer ring, but do not use chemical etching. One method to number the bearings is with an electric pen, which should be grounded on the outer ring surface being marked.

8.3 Wash the selected bearings thoroughly in hot (50 °C to 65 °C) mineral spirits (**Warning**—see 7.8) to remove the rust preventive. To ensure complete removal, subject the bearing to a second wash in fresh hot mineral spirits. (**Warning**—The washing temperatures specified are considerably above the flash point of the solvent. Accordingly, the washing operation should be carried out in a well-ventilated hood where no ignition source is present.)

NOTE 2—The purpose of the two washes with hot mineral spirits in 8.3 is to completely remove the rust preventative applied to the bearings for storage. The duration of the washes required to remove this preventative will be dependent on the equipment used by the lab and the type and amount of rust preventative applied by the bearing manufacturer. It is recommended to visually inspect each bearing to assure the rust preventative is removed before proceeding to 8.4. If rust preventative is still present after two washes, the bearings should be washed again in the hot mineral spirits until the bearings are clean and free of residue.

8.4 Transfer bearings to the solvent rinse solution (**Warning**—see 7.7.3) to remove any mineral spirits which may be present. Rinse each bearing and slowly rotate one ring relative to the other ring in fresh hot (65 °C $\pm$ 5 °C) solvent rinse solution. Fresh rinse solution is used to avoid the selective evaporation of the components at the rinse temperature.

NOTE 3—Care must be taken when handling bearings in the hot rinse