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Standard Test Method for Detection of Copper Corrosion from Lubricating Grease[1]

This standard is issued under the fixed designation D4048; 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 Department of Defense.

1. Scope

1.1 This test method covers the detection of the corrosiveness to copper of lubricating 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 concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and heal practices and determine the applicability of regulatory limitations prior to use.*For specific warning statements, see Sections 7, 8, and 10.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D97 Test Method for Pour Point of Petroleum Products

D130 Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test

D2500 ~~Test Method for Cloud Point of Petroleum Products~~ Test Method for Cloud Point of Petroleum Products

D4175 Terminology Relating to Petroleum, Petroleum Products, and Lubricants

2.2 *ASTM Adjuncts:*

Copper Strip Corrosion Standard[3]

3. Terminology

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

3.1 *Definitions*—See Terminology D4175.

3.2 *copper corrosion*, *n*—effect of a chemical attack on copper metal by a lubricant causing various levels of tarnishing and change in appearance.

3.2.1 *Discussion*—Acidic and other aggressive species, often sulfur-based, in a lubricant can attack copper or copper alloys present in bearings or other lubricated surfaces. The presence of this antagonistic interaction is often apparent in a well-defined series of color changes.

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

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

3.4.1 *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.

4. Summary of Test Method

4.1 A prepared copper strip is totally immersed in a sample of grease and heated in an oven or liquid bath at a specified temperature for a definite period of time. Commonly used conditions are 100 ± 1°C (212 ± 2°F) for 24 h ± 5 min. At the end of this heating period, the strip is removed, washed, and compared with the Copper Strip Corrosion Standard.

5. Significance and Use

5.1 This test method measures the tendency of lubricating grease to corrode copper under specific static conditions. It may be of some value in predicting possible chemical attack on lubricated parts, such as bearings that contain copper or copper alloys. Such corrosion, for example, can cause premature bearing failures. However, no correlations with actual field service, most of

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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 ASTM International Headquarters. Order Adjunct No. ADJD0130. Originally produced in 1973.

which are under dynamic conditions, have been established. It does not measure either the ability of the lubricant to inhibit copper corrosion caused by factors other than the lubricant itself nor does it measure the stability of the grease in the presence of copper.

NOTE 1—Because this test method requires the ability to determine subtle differences in color of copper strips, persons with certain types of color blindness may find it difficult to accurately comparre a test strip to the Copper Strip Corrosion Standard.

6. Apparatus

6.1 *Test Jars*—Cloud and pour jars, cylindrical jars of clear glass with flat bottoms, 30 mm to 33.5-mm (1³⁄₁₆ in. to 1⁵⁄₁₆ in.) inside diameter, and 115 mm to 125 mm (4½ in. to 5 in.) in height as described in Test Methods D97 and D2500.

6.2 *Test Jar Covers—Beakers* , 50-mL; borosilicate glass, approximately 40 mm (1.6 in.) by 50 mm (2.0 in.) suitable for covering individual test jars. Small porcelain or glazed silica crucibles or crucible covers or watch glasses or vented corks that lightly cover the test jars, allowing pressure equalization between the inside and outside of the jars, yet minimizing exposure of the inside of the jars to foreign vapors present in the oven will also be satisfactory.

6.3 *Oven*—A circulating air oven or liquid bath capable of maintaining a temperature of 100 ± 1°C (212 ± 2°F) or other desired temperatures with the same precision.

6.4 *Polishing Vise*—For holding the copper strip firmly without marring the edges while polishing. Any convenient type of holder (see Appendix X1 on Optional Useful Equipment in Test Method D130) may be used, provided that the strip is held tightly and that the surface of the strip being polished is supported above the surface of the holder.

6.5 *Viewing Test Tubes*—Flat glass test tubes may be used to protect corroded strips for close inspection or storage. (See Appendix X1 on Optional Useful Equipment in Test Method D130.)

6.6 *Copper Strip Corrosion Standard*—consists of reproductions in color of typical strips representing degrees of tarnish and corrosion, the reproductions being encased in plastic in the form of a plaque.

6.6.1 Keep the plastic-encased printed Copper Strip Corrosion Standardprotected from light to avoid the possibility of fading. Inspect for fading by comparing two different plaques, one of which has been carefully protected from light (new). Observe both sets in diffused daylight (or equivalent), first from a point directly above and then from an angle of approximately 45°. If any evidence of fading is observed, particularly at the left end of the plaque, it is suggested that the one that is the more faded with respect to the other be discarded.

6.6.1.1 Alternatively, place a 20-mm (¾ in.) opaque strip (masking tape) across the top of the colored portion of the plaque when initially purchased. At intervals, remove the opaque strip and observe. If there is any evidence of fading of the exposed portion, it is suggested that the standard be replaced.

6.6.1.2 These plaques are full-color productions of typical strips. They have been printed on aluminum sheets by a four-color process and are encased in plastic for protection. Directions for their use are given on the reverse side of each plaque.

6.6.2 If the surface of the plastic cover shows excessive scratching, it is suggested that the plaque be replaced.

7. Reagents and Materials

7.1 *Acetone*—American Chemical Society Reagent Grade acetone is suitable. (**Warning**—Extremely flammable. Harmful if inhaled. Vapors may cause flash fires.)

7.2 *Copper Strips*—Use strips 12.5 ± 2 mm (½ ± ¹⁄₁₆ in.) wide, 1.5 to 3.0 mm (¹⁄₁₆ to ⅛ in.) thick, cut 75 ± 5 mm (3 ± ¼ in.) long from smooth-surfaced, hard-temper, cold-finished copper of 99.9 + % purity; electrical bus bar stock is generally suitable. (See Appendix X1 on Optional Useful Equipment in Test Method D130.) The strips may be used repeatedly but should be discarded when the surfaces become deformed on handling.

7.3 *Polishing Materials*—Silicon carbide grit paper of varying degrees of fineness, including 65-µm (240-grit) paper or cloth, also a supply of 105-µm (150-mesh) silicon carbide grain and absorbent cotton (cotton wool).

7.4 *Wash Solvent*—Volatile, sulfur-free hydrocarbon solvent may be used provided that it shows no tarnish at all when tested at 50 ± 1°C (or 122 ± 2°F). Knock test-grade *iso*octane (**Warning**—see 8.1.2) or American Chemical Society Reagent Grade *n*-heptane (**Warning**—see 7.1) are suitable solvents. Because of possible toxic effects, the use of benzene should be avoided.

8. Preparation of Strip

8.1 *Mechanical Cleaning of Strips*:

8.1.1 *Surface Preparation*—Remove all surface blemishes from all six sides of the strip with silicon carbide paper of such degrees of fineness as are needed to accomplish the desired results efficiently. Finish with 65-µm (240-grit) silicon carbide paper or cloth, removing all marks that may have been made by other grades of paper used previously. Immerse the strip in wash solvent (**Warning**—see 7.1.) from which it can be withdrawn immediately for final polishing or in which it can be stored for future use.

8.1.1.1 As a practical manual procedure for surface preparation, place a sheet of the paper on a flat surface, moisten it with wash solvent, and rub the strip against the paper with a rotary motion, protecting the strip from contact with the fingers or by wearing impervious gloves (see ~~Note 1~~Note 2). Alternatively, the surface of the strip may be prepared by use of motor-driven machines using appropriate grades of dry paper or cloth.

NOTE ~~1~~2—Disposable polyethylene is one type of glove that has been found to be satisfactory. However, any type of glove that is impervious to the reagents and materials used in this test method, while preventing fingers from contacting the strip directly, may also be used.