Designation: D2511 – 93 (Reapproved 2009)

Standard Test Method for Thermal Shock Sensitivity of Solid Film Lubricants[1]

This standard is issued under the fixed designation D2511; 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 measurement of the resistance of dry solid film lubricants to deterioration when subjected to temperature extremes.

1.2 The values stated in SI units are to be regarded as the standard. The inch-pound units 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 health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

D2510 Test Method for Adhesion of Solid Film Lubricants

D4175 Terminology Relating to Petroleum, Petroleum Products, and Lubricants

2.2 *U.S. Federal Specification:*

P-D-680 Dry Cleaning Solvent[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *lubricant*, *n*—any material interposed between two surfaces that reduces the friction or wear between them (see Terminology D4175).

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *dry solid film lubricant*, *n*—on a steel surface, one consisting of friction-reducing powders bonded in tight matrix to the surface of the metal.

4. Summary of Test Method

4.1 A steel panel having the solid film lubricant deposited on one surface is subjected to 260°C (500°F) heat followed by immediate exposure to −54°C (−65°F). The solid film is then examined for cracking, flaking, blistering, or other evidence of thermal instability.

5. Significance and Use

5.1 Solid lubricant coatings are applied to surfaces that are exposed to heat and cold to such a degree that in many cases liquid lubricants are not practical. Adherence under these conditions is mandatory to preserve the bearing surfaces during sliding motion.

6. Apparatus

6.1 *Oven*, capable of maintaining a temperature at 260 ± 5.5°C (500 ± 10°F) and 149 ± 5.5°C (300 ± 10°F) (forced circulation).

6.2 *Sub-Zero Cabinet*, capable of maintaining a constant temperature of −54 ± 0.5°C (−65 ± 1°F).

6.3 *Micrometer*, reading 0 to 25 ± 0.0025 mm, (0 to 1 ± 0.0001 in.) with a 1-ball anvil.

7. Reagents and Materials

7.1 *Test Panels*, of corrosion-resistant steel, 76 by 152 by 0.914 mm (3 by 6 by 0.036 in.), conforming to Specification A167, No. 2D finish, condition annealed. Type 321 has proved satisfactory and is generally available.

7.2 *Dry Cleaning Solvent*, conforming to U. S. Federal Specification P-D-680.

8. Sampling, Test Specimens, and Test Units

8.1 Have a sufficient quantity of solid film mixture to perform test. Prepare the test panels as follows:

8.1.1 Liquid-degrease the test panels in P-D-680 dry cleaning solvent and dry them.

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[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.L0.05 on Solid Lubricants.

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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 Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098.

8.1.2 Apply solid film lubricant to one surface of the test panel by spraying, or an equivalent technique, to produce a dry film thickness of 0.005 to 0.013 mm (0.0002 to 0.0005 in.).

8.1.3 In most cases, curing shall be carried out according to the particular manufacturer's specifications. If such instructions are not provided, cure the film by air drying for 6 h at 26.7 ± 3°C (80 ± 5°F) or by air drying for 30 min at 26.7°C (80°F) followed by 1 h in an air-circulating oven at 148.9°C (300°F).

8.1.4 Measure the dry film thickness using a micrometer.

9. Procedure

9.1 Preheat the oven to 260 ± 5.5°C (500 ± 10°F) and place the panels in the oven for a period of 3 h.

9.2 After 3 h at 260 ± 5.5°C (500 ± 10°F), place the panels directly into the sub-zero cabinet at a temperature of −54 ± 0.5°C (−65 ± 5°F). Allow the panels to remain at −54°C (−65°F) for 3 h.

9.3 Remove the test panels and allow them to reach room temperature.

9.4 Examine the coating visually. It may be necessary to test some coatings under nonstandard conditions for special applications (that is, plunging into liquid oxygen after removal from the oven). All such deviations should be noted in the report.

NOTE 1—If no damage is evident, the coating shall be further tested by the adhesion test given in Procedure B for Silicate or Phosphoric Acid-Bonded Coatings in Test Method D2510.

10. Report

10.1 The report shall include the following:

10.1.1 Conditions of application and curing of the coating,

10.1.2 The degree of blistering, flaking, cracking or softening of the film, or both (percent of surface area), and

10.1.3 Any deviations from standard procedure such as special temperature or times of thermal exposure.

11. Precision and Bias

11.1 It is not practicable to specify the precision and bias of this test method on thermal shock sensitivity because the results of the test are only intended to give a pass/fail rating.

12. Keywords

12.1 solid film lubricant; thermal shock