Designation: D5282 – 05 (Reapproved 2020)

Standard Test Methods for Compatibility of Construction Material with Silicone Fluid Used for Electrical Insulation[1]

This standard is issued under the fixed designation D5282; 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 These test methods cover screening for the compatibility of construction materials with silicone fluid for use in electrical equipment.

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]

D92 Test Method for Flash and Fire Points by Cleveland Open Cup Tester

D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

D664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration

D828 Test Method for Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus

D877 Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

D924 Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids

D974 Test Method for Acid and Base Number by Color-Indicator Titration

D1169 Test Method for Specific Resistance (Resistivity) of Electrical Insulating Liquids

D1933 Specification for Nitrogen Gas as an Electrical Insulating Material

D2129 Test Method for Color of Clear Electrical Insulating Liquids (Platinum-Cobalt Scale)

D2225 Test Methods for Silicone Liquids Used for Electrical Insulation

D2413 Practice for Preparation of Insulating Paper and Board Impregnated with a Liquid Dielectric

D3612 Test Method for Analysis of Gases Dissolved in Electrical Insulating Oil by Gas Chromatography

D4243 Test Method for Measurement of Average Viscometric Degree of Polymerization of New and Aged Electrical Papers and Boards

D4559 Test Method for Volatile Matter in Silicone Fluid

D4652 Specification for Silicone Liquid Used for Electrical Insulation

D5837 Test Method for Furanic Compounds in Electrical Insulating Liquids by High-Performance Liquid Chromatography (HPLC)

3. Significance and Use

3.1 The magnitude of the changes in the electrical properties of the silicone fluid is of importance in determining the contamination of the fluid by the test specimen.

3.2 Physical and chemical changes in the fluid, such as color and acidity, also indicate solubility or other adverse effects of the test specimen on the fluid.

3.3 Physical changes of the test specimen, such as hardness, swelling, and discoloration, show the effect of the fluid on the test specimen and are used to determine the suitability of the material for use in silicone fluid.

3.4 A material meeting the criteria recommended does not necessarily indicate suitability for use in electrical equipment. Other properties must also be considered. Additionally, certain materials containing additives may meet the requirements of

[1] These test methods are under the jurisdiction of ASTM Committee D27 on Electrical Insulating Liquids and Gasesand are the direct responsibility of Subcommittee D27.06 on Chemical Test.

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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.

these test methods yet be unsatisfactory when subjected to longer-term evaluations.

3.5 These test methods may be used as a guide for testing the compatibility of materials for silicone fluids other than 50 cSt poly-dimethyl siloxane fluid, but different criteria for judgment may be necessary.

4. Apparatus

4.1 *Sample-Handling Apparatus:*

4.1.1 *Oven,* forced draft, adjustable to 120 ± 1°C, and a drying oven, adjustable to 105 ± 5°C.

4.1.2 *Glass Containers,* 1-L, fitted with glass or aluminum foil covers (Note 1).

NOTE 1—Other materials have been found to be suitable as covers.

4.1.3 *Fritted Glass Dispersion Tube* (coarse).

4.2 *Sample-Testing Apparatus:*

4.2.1 *Tensile Strength*—As specified in appropriate test method.

4.2.2 *Hardness*—As specified in appropriate test method.

4.2.3 *Dimensional Change*—Micrometer and caliper.

4.2.4 *Weight Change*—Analytical balance.

5. Reagents

5.1 *Dry Nitrogen Gas,* Meeting the requirements of Specification D1933, Type III with the following exception: the total hydrocarbon content must by <0.5 ppm. Sometimes referred to as Ultra-High Purity (UHP).

5.2 *Dimethyl Silicone Fluid* (50 CSt), conforming to Specification D4652.

6. Preparation of Test Specimen

6.1 Test specimen size shall be such that the ratio of surface area to liquid volume is four times as large as the ratio encountered in normal use in electrical equipment unless there is some special reason for using a different ratio (Note 2). Some suggested ratios are as follows:

6.1.1 If the test specimen can be measured, no less than 52 cm^2 is used with each 800 mL of silicone.

6.1.2 If the test specimen is insoluble in silicone fluid and the surface area cannot be measured, use a test specimen in the amount of 1 % by weight of the silicone.

6.1.3 If the material is soluble in the silicone fluid, use a test specimen in the amount of 0.5 % by weight of the silicone fluid.

6.1.4 When surface areas are employed for solid material testing, all sides of the solid material are to be used in the calculation of surface area as long as that surface is in contact with the silicone fluid.

6.1.5 Varnishes and materials used as dip coatings, and paints shall be cured on aluminum foil or paper known to be compatible with the silicone fluid. They should be tested at a ratio of 14 g or approximately 1300 cm^2 of surface area per 800 mL of silicone fluid.

6.1.6 Core steel and core-steel coatings shall be tested at a ratio of 3100 cm^2 for each 400 mL of silicone fluid for transformer applications. A realistic core steel ratio for regulators is 5000 cm^2 of surface area per each 400 mL of silicone fluid.

6.1.7 Gasket materials shall be tested at a ratio of 13 cm^2 of surface area per 800 mL of silicone fluid.

6.1.8 Wire enamels shall be tested at a ratio of 1300 cm^2 of surface area per 800 mL of silicone fluid.

6.1.9 Cellulosic insulation shall be tested at a ratio 2000 cm^2 of surface area per 800 mL of silicone fluid. These test specimens shall be prepared according to the instructions provided in Practice D2413.

6.2 Caution must be taken in obtaining and preparing the sample to ensure that it is a representative sample of the material as supplied by the manufacturer. Use forceps to handle the test specimens or adequately protect them from contamination such as skin oils during handling.

6.3 Pre-dry all solid materials for 16 h in an oven at 105 ± 5°C. Gasket materials shall not be pre-dried and cellulosic insulation does not require any further drying as long as it is prepared according to 6.1.9.

6.4 Remove the test specimen from the oven and place in a 1-L jar with 800 mL of silicone fluid. Bubble the silicone fluid with dry nitrogen for approximately 10 min through a fritted glass tube. To minimize contamination, slide the cover on quickly while removing the aluminum foil and the bubble tube. Fasten the cover tightly.

NOTE 2—There are certain materials in electrical apparatus for which the suggested ratios of material to liquid are impractical; when this condition exists, report the ratio.

6.5 Prepare a reference silicone fluid specimen (control) for each group of specimens tested, as directed in 6.4. A reference specimen consists of the silicone fluid only.

7. Conditioning

7.1 Place the covered glass jars in an oven at 120± 1°C for 168 h.

7.2 Remove the jars from the oven and cool to room temperature.

8. Procedure

8.1 With a pair of clean tongs or forceps, remove the test specimen from the fluid, observe the condition, and conduct any desired test on the material.

8.1.1 Typical tests on materials can include swelling or dimensional changes, weight changes, hardness, discoloration, brittleness, tensile strength (Test Method D828), degree of polymerization (Test Method D4243), etc.

8.1.2 For comparative tests, use the appropriate method.

8.2 The following tests, as modified in Test Method D2225, are suggested for the properties listed below:

8.2.1 *Fire Point*—Test Method D92.

8.2.2 *Viscosity*—Test Method D445.

8.2.3 *Neutralization Number*—Test Methods D664 or D974.

8.2.4 *Dielectric Strength*—Test Method D877.

8.2.5 *Dissipation Factor (Power Factor at 25 and 100°C)*—Test Method D924.