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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Test Methods for Compatibility of Construction Material with Silicone Fluid Used for Electrical Insulation[1]

This standard is issued under the fixed designation D 5282; 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 the standard.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 92 Test Method for Flash and Fire Points by Cleveland Open Cup[2]

D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids[2]

D 664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration[2]

D 877 Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes[3]

D 924 Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids[3]

D 974 Test Method for Acid and Base Number by Color-Indicator Titration[2]

D 1169 Test Method for Specific Resistance (Resistivity) of Electrical Insulating Liquids[3]

D 2129 Test Method for Color of Clear Electrical Insulating Liquids (Platinum-Cobalt Scale)[3]

D 2225 Test Methods for Silicone Fluids Used for Electrical Insulation[3]

D 4559 Test Method for Volatile Matter in Silicone Fluid[3]

D 4652 Specification for Silicone Fluid Used for Electrical Insulation[3]

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

4.1.3 *Fritted Glass Dispersion Tube* (coarse).[4]

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.

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[1] These test methods are under the jurisdiction of ASTM Committee D-27 on Electrical Insulating Liquids and Gases and are the direct responsibility of Subcommittee D27.07 on Physical Test.

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[2] *Annual Book of ASTM Standards*, Vol 05.01.

[3] *Annual Book of ASTM Standards*, Vol 10.03.

[4] Fisher Catalog No. 11-138, available from Fisher Scientific, 711 Forbes Ave., Pittsburgh, PA 15219-4785.

5. Reagents

5.1 *Dry Nitrogen Gas*

5.2 *Dimethyl Silicone Fluid* (50 CSt), conforming to Specification D 4652.

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. 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 Varnishes and materials used as dip coatings 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.

6.1.5 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.

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

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

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. Do not handle with fingers.

6.3 Pre-dry all solid materials for 16 h in an oven at 105 ± 5°C.

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 for each group of specimens tested, as directed in 6.4.

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, remove the test specimen from the liquid, observe the condition, and conduct any desired test on the material.

8.1.1 Typical tests on materials can include swelling or dimensional changes, hardness, discoloration, brittleness, etc.

8.1.2 For comparative tests, use the appropriate method.

8.2 The following tests, as modified in Test Method D 2225, are suggested for the properties listed below:

8.2.1 *Fire Point*—Test Method D 92.

8.2.2 *Viscosity*—Test Method D 445.

8.2.3 *Neutralization Number*—Test Methods D 664 and D 974.

8.2.4 *Dielectric Strength*—Test Method D 877.

8.2.5 *Dissipation Factor (Power Factor)*— Test Method D 924.

8.2.6 *Color*—Test Method D 2129.

8.2.7 *Resistivity*— Test Method D 1169.

8.2.8 *Percent Volatiles*—Test Method D 4559.

9. Evaluation of Results

9.1 *Evaluation of Physical Changes of the Material at Room Temperature*—The changes in physical properties of the material being tested must be considered on the basis of the specific needs of the application.

9.2 *Evaluation of Test Results on Silicone Fluid*:

9.2.1 The test results obtained on the liquids containing the test specimens of construction material must be compared with those of the reference liquid sample to determine any variation.

9.2.2 The absence of any differences between the test specimen liquid and the reference liquid indicates that the test specimen liquid was not affected by the material and that the material is worthy of further consideration or testing, or both.

9.2.3 A significant difference in any of the results, as defined in 9.2.5, may indicate some compatibility problem, and the material should be either further reviewed or rejected.

9.2.3.1 The amount of change between the reference liquid and the test specimen liquid that is considered to be significant should be established prior to testing by agreement between the purchaser and the seller.

9.2.4 If the aged control liquid reference fails to meet the criteria in 9.2.5, the liquid itself is suspect for one or more of the following reasons:

9.2.4.1 The liquid does not meet the requirements for approved silicone.

9.2.4.2 The liquid has become contaminated.

9.2.4.3 The test aging temperature exceeded the prescribed limit (see 7.1).

9.2.5 The aged properties for the control 50 cSt dimethyl silicone fluid sample should be as follows:

Fire point	340°C, min
Viscosity	47.5 to 52.5 cSt
Neutralization number	0.04, max
Dielectric strength	38 kV, min
Dissipation factor (Power factor), 100°C	0.35 %, max
Color	100, max
Resistivity, 100°C	10×10^{12}, min
Percent volatiles	0.5 %, max
Condition of silicone	clear
Condition of material	unchanged

10. Report

10.1 Report the following information:

10.1.1 The results of the tests specified in 9.2.5, on both the reference oil specimen and the test specimen fluid,

10.1.2 Any changes in appearance, dimensions, hardness or other relevant properties of the construction material test specimens, and

10.1.3 Whether the construction material evaluated by this test method appears to be compatible (or incompatible) with silicone fluid.

11. Precision and Bias

11.1 No practical means exists to specify precision and bias, as this method is used to test materials which may age differently in the presence of silicone fluid.

11.2 Refer to the precision and bias statements for each of the individual test methods used for comparative tests in 8.1.2 and the suggested tests in 8.2.

12. Keywords

12.1 compatibility; construction material; electrical equipment; electrical insulating liquid; silicone fluid