



Standard Test Methods for Silicone Fluids Used for Electrical Insulation¹

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1. Scope

1.1 These test methods cover the testing of silicone fluids for use in transformers, capacitors, and electronic assemblies as an insulating or cooling medium, or both. These methods are generally suitable for specification acceptance, factory control, referee testing, and research.

1.2 Although some of the test methods listed here apply primarily to petroleum-based fluids, they are, with minor revisions, equally applicable to silicone fluids.

1.3 Silicone fluids are used for electrical insulating purposes because of their stable properties at high and low temperatures and their relative environmental inertness.

1.4 A list of the properties and standards are as follows:

Property Measured	Section	ASTM Test Method
<i>Physical:</i>		
Color	6	D2129
Flash point	7	D92
Fire point	7	D92
Polychlorinated biphenyl content	8	D4059
Pour point	9	D97
Refractive index	10	D1807
Specific gravity	11	D1298, D1481, D4052
Volatility	12	D4559
Viscosity	13	D445, D2161
<i>Chemical:</i>		
Neutralization number	14	D974
Water content	15	D1533
<i>Electrical:</i>		
Relative permittivity	16	D924 ²
Dielectric breakdown voltage	17	D877 ³
Dissipation factor	18	D924 ²
Specific resistance	19	D1169 ²
Compatibility	20	D5282

1.5 *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.*

¹ These test methods are under the jurisdiction of ASTM Committee D27 on Electrical Insulating Liquids and Gases and are the direct responsibility of Subcommittee D27.02 on Gases and Non-Mineral Oil Liquids.

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² A modified cell cleaning procedure is given for Test Methods D924 and D1169.

³ A modified cell cleaning procedure is recommended for Test Method D877.

2. Referenced Documents

2.1 ASTM Standards:⁴

- D92 Test Method for Flash and Fire Points by Cleveland Open Cup Tester
- D97 Test Method for Pour Point of Petroleum Products
- D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
- D877 Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
- D923 Practices for Sampling Electrical Insulating Liquids
- 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
- D1298 Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
- D1481 Test Method for Density and Relative Density (Specific Gravity) of Viscous Materials by Lipkin Bicapillary Pycnometer
- D1533 Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration
- D1807 Test Methods for Refractive Index and Specific Optical Dispersion of Electrical Insulating Liquids
- D1816 Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using VDE Electrodes
- D2129 Test Method for Color of Clear Electrical Insulating Liquids (Platinum-Cobalt Scale)
- D2161 Practice for Conversion of Kinematic Viscosity to Saybolt Universal Viscosity or to Saybolt Furol Viscosity
- D2864 Terminology Relating to Electrical Insulating Liquids and Gases
- D4052 Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter

⁴ 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.

D4059 Test Method for Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography

D4559 Test Method for Volatile Matter in Silicone Fluid

D4652 Specification for Silicone Fluid Used for Electrical Insulation

D5282 Test Methods for Compatibility of Construction Material with Silicone Fluid Used for Electrical Insulation

3. Terminology

3.1 Definitions:

3.1.1 *fire point*—the temperature at which oil first ignites and burns for at least 5 s when a small test flame is passed across the surface under specified conditions.

3.1.2 *flash point*—the temperature at which vapors above the oil surface first ignite when a small test flame is passed across the surface under specified conditions.

3.1.3 *refractive index*—the ratio of the velocity of light (of a specified wavelength) in air at 25°C to its velocity in the substance under test.

3.1.4 *specific gravity*—the ratio of weight of a given volume of material to the weight of an equal volume of water. In this method, both weights are corrected to weight in vacuum, and the material is at 25°C using hydrometers calibrated at 60/60°F.

3.1.5 *volatility*—the weight of liquid lost when a specified weight of liquid is held at a specified elevated temperature for a specific period of time.

3.1.6 *water content*—the amount of water (mg/kg) dissolved in the liquid.

3.1.7 For additional terms refer to Terminology D2864.

4. Significance and Use

4.1 Tests covered in this standard may be used for quality control and design considerations.

4.2 Included in each test method is a brief statement describing its significance.

5. Sampling

5.1 Accurate sampling, whether of the complete contents or only parts thereof, is extremely important from the standpoint of elevation of the quality of the product sampled. Obviously, examination of a sample that because of careless sampling procedure or contamination in the sampling equipment is not directly representative, leads to erroneous conclusions concerning quality.

5.2 Sample the silicone fluid in accordance with Test Methods D923.

PHYSICAL METHODS

6. Color

6.1 *Significance*—The chief significance of color as applied to silicone fluid lies in the fact that if the fluid is colored, some degree of contamination exists that may affect the physical, chemical, and electrical properties of the fluid.

6.2 *Procedure*—Determine the color in accordance with Test Method D2129.

7. Flash and Fire Points

7.1 *Significance*—The flash and fire points of a silicone insulating fluid indicates the limit to which the material may be heated, under the specified test conditions, before the emitted vapors form a flammable mixture in air. Unusually low flash or fire points for a given product may indicate contamination.

7.2 *Procedure*—Determine the flash and fire points in accordance with Test Method D92.

8. Polychlorinated Biphenyl Content

8.1 Scope:

8.1.1 *Test Method D4059*—describes a quantitative technique for determining the concentration of polychlorinated biphenyls (PCB's) in electrical insulating liquids.

8.2 Definition:

8.2.1 *PCB concentration*—is normally expressed in units of parts per million (PPM) on a weight by weight basis. Standard chromatograms of Aroclors 1242, 1254, and 1260 are used to determine the concentration of PCB in the sample.

8.3 *Summary of Test Method*—Following dilution of the sample in a suitable solvent, the solution is treated to remove interfering substances. A small portion is then injected into a packed gas chromatographic column where the components are separated and their presence measured by an electron capture or halogen-specific electrolytic conductivity detection. The method is made quantitative by comparing the response of a sample to that of a known quantity of one or more standard Aroclors obtained under the same conditions.

8.4 *Significance and Use*—United States regulations require that electrical apparatus and electrical insulating fluids containing PCB be handled and disposed of through the use of specific procedures as determined by the PCB content of the fluid. The results of this test method can be useful in selecting appropriate handling and disposal procedures.

9. Pour Point

9.1 *Significance*—The pour point is important as an index of the lowest temperature to which the material may be cooled without seriously limiting the degree of circulation of the fluid.

9.2 *Procedure*—Determine the pour point in accordance with Test Method D97.

10. Refractive Index

10.1 *Significance*—The refractive index is often useful for the detection of some types of contamination and for the identification of the molecular makeup of the various types of silicone insulating fluids.

10.2 *Procedure*—Determine the refractive index in accordance with Test Methods D1807.

11. Specific Gravity

11.1 *Significance*—Silicone insulating fluids are usually sold on a weight basis. The values for the specific gravities must frequently be known to calculate the volume of fluid present at any given temperature.