



Designation: **D4652–05 (Reapproved 2012) D4652 – 20**

## Standard Specification for Silicone Fluid~~Liquid~~ Used for Electrical Insulation<sup>1</sup>

This standard is issued under the fixed designation D4652; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This specification covers silicone ~~fluid~~liquid for use in transformers, capacitors, and electronic assemblies as an insulating or cooling medium, or both.

1.2 Silicone ~~fluid~~liquid covered by this specification is polydimethylsiloxane having a nominal viscosity of 50 ~~eStmm~~<sup>2</sup>/s at 25°C and a fire point of 340°C or greater. This specification applies only to new silicone ~~fluid~~liquid. Information on in-service maintenance testing is available in appropriate guides.<sup>2</sup>

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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:<sup>3</sup>

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

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D27 on Electrical Insulating Liquids and Gases and is the direct responsibility of Subcommittee D27.02 on Gases and Non-Mineral Oil Liquids.

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<sup>2</sup> IEEE C57.111, IEEE Guide for Acceptance of Silicone Insulating Fluid and its Maintenance in Transformers is published by the Insulating Fluids Subcommittee of the IEEE Power Engineering Society Transformers Committee.

<sup>3</sup> 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.

- D1807 Test Methods for Refractive Index and Specific Optical Dispersion of Electrical Insulating Liquids (Withdrawn 2014)<sup>4</sup>
- 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~~
- D2225 Test Methods for Silicone Fluids Used for Electrical Insulation
- 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
- D4059 Test Method for Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography
- D4559 Test Method for Volatile Matter in Silicone Fluid

### 3. Terminology

3.1 Definitions and descriptions of terms specific to this specification are given in Test Methods D2225 and Terminology D2864.

### 4. Sampling and Testing

4.1 Take all samples in accordance with Methods/practices listed in D923.

4.2 Test in accordance with the methods specified in Table 1.

NOTE 1—Because of the different needs of the various users, items relating to packaging, labeling, and quality assurance are subject to buyer-seller agreement.

NOTE 2—In addition to all other tests listed herein, it is sound engineering practice for the apparatus manufacturer to perform a functional evaluation of silicone ~~fluid~~liquid in insulation systems, prototype structures, or full-scale apparatus, or any combination thereof, to assure suitable ~~service~~service life.

TABLE 1 Detail Requirements for Silicone ~~Fluid~~Liquid

| Property   | Limit                           | ASTM Test Method             |
|--|---------------------------------|------------------------------|
| <i>Physical:</i>                                       |                                 |                              |
| Color, max   | 15                              | D2129                        |
| Flash point, °C, min                                   | 300                             | D92                          |
| Fire point, °C, min                                    | 340                             | D92                          |
| Pour point, °C, max                                    | -50                             | D97                          |
| Refractive index, 25°C                                 | 1.4010 to 1.4040                | D1807                        |
| <del>Viscosity, cSt, at:</del>                         |                                 | <del>D445, D2161</del>       |
| <del>Viscosity, mm<sup>2</sup>/s, at:</del>            |                                 | <del>D445</del>              |
| 0°C  | 81 to 92                        |                              |
| 25°C   | 47.5 to 52.5                    |                              |
| 40°C   | 35 to 39                        |                              |
| 100°C  | 15 to 17                        |                              |
| Specific gravity, 25/25°C                              | 0.957 to 0.964                  | D1298, D1481, D4052          |
| Volatile matter, weight, max%                          | 0.5                             | D4559                        |
| <i>Electrical Properties:</i>                          |                                 |                              |
| Dielectric breakdown voltage at 60 Hz                  |                                 |                              |
| Disk electrodes, kV, min                               | 30                              | D877 <sup>A</sup>            |
| VDE electrodes, kV, min at:                            |                                 |                              |
| 1 mm (0.04 in.) gap                                    | 20                              | D1816 <sup>B</sup>           |
| 1 mm gap   | 20                              | D1816 <sup>B</sup>           |
| 2 mm (0.08 in.) gap                                    | 35                              |                              |
| 2 mm gap   | 35                              |                              |
| Dissipation factor <sup>C</sup> at 60 Hz, 25°C, %, max | 0.01                            | D924                         |
| <del>Volume resistivity at 25°C, Ω·cm, min</del>       | <del>1 × 10<sup>-14</sup></del> | <del>D1169</del>             |
| Resistivity at 25°C, Ω·cm, min                         | 100 × 10 <sup>12</sup>          | D1169                        |
| <i>Chemical:</i>                                       |                                 |                              |
| Neutralization number, mg KOH/g, max                   | 0.01                            | D664, D974                   |
| <del>Water content, ppm, max</del>                     | <del>50</del>                   | <del>D1533<sup>D</sup></del> |
| Water content, mg/kg, max                              | 50                              | D1533 <sup>D</sup>           |
| <del>PCB content, ppm</del>                            | <del>not detectable</del>       | <del>D4059</del>             |
| PCB content, mg/kg                                     | not detectable                  | D4059                        |

<sup>A</sup> This test method must be modified as described in Test Methods D2225.

<sup>B</sup> Use of this test method requires the discharge energy meet the limits of Section 1.4 of the test method.

<sup>C</sup> Dissipation factor and power factor are numerically equal up to 0.5 %.

<sup>D</sup> With modifications as indicated for silicone ~~fluid~~liquid.

<sup>4</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).