INTERNATIONAL

Designation: D1169 – 19a

Standard Test Method for Specific Resistance (Resistivity) of Electrical Insulating Liquids[1]

This standard is issued under the fixed designation D1169; 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 U.S. Department of Defense.

1. Scope

1.1 This test method covers the determination of specific resistance (resistivity) applied to new electrical insulating liquids, as well as to liquids in service, or subsequent to service, in cables, transformers, circuit breakers, and other electrical apparatus.

1.2 This test method covers a procedure for making referee tests with dc potential.

1.3 When it is desired to make routine determinations requiring less accuracy, certain modifications to this test method are permitted as described in Sections 19 – 26.

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

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* See 17.4.3 for a specific warning statement.

1.6 *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]

D150 Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation

D257 Test Methods for DC Resistance or Conductance of Insulating Materials

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

D2864 Terminology Relating to Electrical Insulating Liquids and Gases

3. Terminology

3.1 Definitions – Definitions of terms used in this test method are given in Terminology D2864.

4. Significance and Use

4.1 The resistivity of a liquid is a measure of its electrical insulating properties under conditions comparable to those of the test. High resistivity reflects low content of free ions and ion-forming particles, and normally indicates a low concentration of conductive contaminants.

5. General Considerations

5.1 Theory and measuring equipment pertaining to this method shall be in accordance with Test Methods D257.

5.2 Where both ac loss characteristic (dissipation factor or power factor) and resistivity measurements are to be made consecutively on the same specimen, make the ac measurement before applying the dc potential to the specimen, and short circuit the cell electrodes for 1 min immediately prior to making the resistivity measurements.

5.3 Make referee tests for resistivity in an atmosphere of less than 50 % relative humidity. For repeatable results make these tests under carefully controlled atmospheric conditions.

5.4 Aside from the adverse influence of contamination on results of the resistivity test, there are other factors that can contribute to variations in the test results as follows:

5.4.1 The use of an instrument not having an adequate range for accurately measuring the current flowing in the circuit. (See Section 6 for two types of recommended instruments.)

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[1] This test method is under the jurisdiction of ASTM Committee D27 on Electrical Insulating Liquids and Gases and is the direct responsibility of Subcommittee D27.05 on Electrical 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.

5.4.2 When the time of electrification is not exactly the same for every test. Upon the application of voltage, the current flow through the specimen decreases asymptotically toward a limiting value. Variation in the time of electrification can result in appreciable variation in the test results.

5.4.3 Undue length of time required for the test specimen in the cell to attain the desired test temperature. This is one of the main sources of erroneous results. For optimum results, attain the test temperature within 20 min.

5.4.4 Fluctuations in the test voltage (see 6.1.4).

6. Instrumentation

6.1 Instrumentation listed in Test Methods D257 is suitable, with the exception of the Voltage Rate-of-Change Method. However, in order to obtain the greatest precision when making this test, use the voltage-current method with the following instruments:

6.1.1 *Voltmeter,* having an accuracy of 2 % or better, operated in the upper one third of its scale range for measuring the voltage supply.

6.1.2 *Current-Measuring Device*—Any type of instrument having adequate sensitivity and precision and with a suitable range for measurement of the wide spread of currents encountered when making this test on new or used liquids will be satisfactory. For currents greater than 10^{-9} A an Ayrton shunt and galvanometer, an appropriate electrometer or picoammeter having a sensitivity of 50 pA (50×10^{-12} A) per division has been found convenient and satisfactory. The galvanometer deflection shall be not less than 20 divisions for the applicable Ayrton shunt ratio. For currents less than 10^{-9} A an electronic picoammeter has been found suitable. In using this instrument the multiplier selected shall be such as to give at least one-half full-scale deflection on the indicating instrument.

6.1.3 *Time-Measuring Device,* accurate to 0.5 s, for measuring the time of electrification.

6.1.4 Batteries or other stable direct-voltage supplies are recommended for the steady voltage source.

NOTE 1—Rectified high-frequency power supplies cannot be used because the high frequency ripple in these supplies can cause the ac component of current to equal or exceed the dc current being measured. The ac component of current is equal to 2 π times the product of the ripple voltage, the ripple frequency, and the capacitance of the test cell in farads (where π = 3.14). If the capacitance of the test cell is 100 pF (10^{-10}F), the ripple frequency is 100 kHz, and the ripple voltage is 5 mV (0.001 % of a 500 V test voltage), the alternating component of current is 3.14×10^{-7} amperes. The meter would be unreadable under these conditions.

7. Test Circuit

7.1 A schematic diagram of the test circuit is shown in Fig. 1.

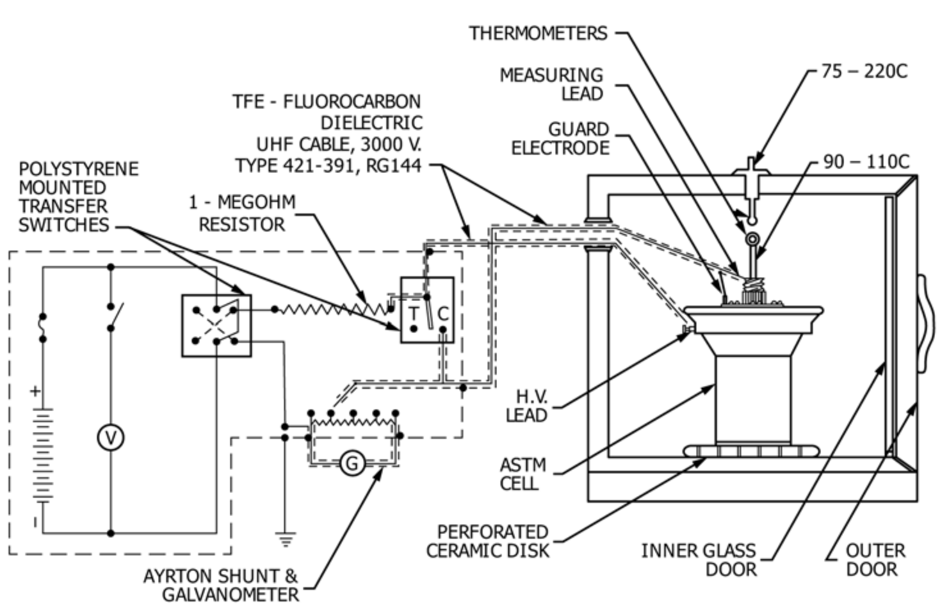
7.2 Construct the circuitry so that leakage is minimal. To this end, mount the transfer switches on polystyrene or TFE-fluorocarbon insulation of sufficient thickness to minimize possible leakage. Make all soldered connections with low-thermal-emf solder using a soldering flux of resin and alcohol.

NOTE 2—The use of ordinary solder and flux can result in spurious thermal emf's that will cause erroneous indications.

7.3 Completely shield the test circuit. Make connections to the current-measuring instrument with shielded leads. TFE-fluorocarbon-insulated shielded leads are recommended for connecting the high-voltage electrode and measuring electrode of the test cell to the test circuit.

8. Sampling

8.1 Sample liquids for use in this test in accordance with Practices D923. When possible, obtain samples for testing



NOTE 1—For measurements of current less than 10^{-9} A replace galvanometer and shunt with picoammeter.

NOTE 2—With the S.P.D.T. switch on C terminal the galvanometer may be calibrated while the electrodes of the test cell are short-circuited.

FIG. 1 Circuit Diagram and Connections with Complete Shielding for Measuring Specific Resistance (Resistivity) of Electrical Insulating Liquids