Designation: D6180 – 05

StandardTest Method for Stability of Insulating Oils of Petroleum Origin Under Electrical Discharge[1]

This standard is issued under the fixed designation D6180; 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 This test method covers a laboratory technique that measures the stability of new, used, or reclaimed insulating oils, similar to those described in Specification D3487 in the presence of a controlled electric discharge. When subjected to this type of discharge, insulating oils absorb energy and produce gases as well as ionized molecules (charge carriers). The quantity of these decay products can be measured and can provide an indication of the stability of oils under the conditions of this test.

1.2 The gases are retained in the discharge cell and their pressure measured. The charge carriers remain in the test specimen. The change in the dissipation factor before and after the discharge is determined.

1.3 The values stated in SI units are to be regarded as the standard. The values stated in parentheses are for information only.

1.4 *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.* Specific cautionary statements are given in 5.3 and 7.1.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

D3487 Specification for Mineral Insulating Oil Used in Electrical Apparatus

2.2 *IEEE Standard:*

4–1995 IEEE Standard Techniques for High-Voltage Testing[3]

3. Summary of Test Method

3.1 A test specimen is introduced into a discharge cell and degassed under vacuum at room temperature. An ac potential of 10 kV is applied between a high voltage electrode and a grounded salt water electrode for 300 min. The gradual rise of the pressure inside the discharge cell is measured on an electronic vacuum meter as a function of time. The dissipation factor of the oil at 100°C is determined before and after the stability test.

4. Significance and Use

4.1 During this test, insulating oil in an evacuated cell is subjected to a high voltage discharge between two electrodes. The discharge generates free electrons. These electrons collide with the oil molecules causing many of them to become electronically excited. Some of these molecules lose this energy as a quanta of light emitting fluorescent radiation. Some of the other excited molecules decompose into gases, ionized molecules and free radicals. These changes can provide an indication of the stability of oils under the conditions of this test method. The measures of these changes are the increase of the pressure in the test cell and the increase in the dissipation factor of the test specimen.

4.2 During the test, the gas content increases in the cell and the concentration of charge carriers increases in the oil.

5. Apparatus

5.1 *Discharge Cell*,[4] shown in Fig. 1, includes an electronic vacuum meter. The cell must be made of quartz, be of spherical shape, and have a 500 mL capacity. The electrode is sealed in the cell as shown in Fig. 1. The free electrons are generated by

[1] This test method is under the jurisdiction of ASTM Committee D27 on Electrical Insulating Liquids and Gasesand 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.

[3] Available from the Institute of Electrical and Electronic Engineers, Inc., P.O. Box 1331, Piscataway, NJ 08855.

[4] The sole source of supply of the discharge cell known to the committee at this time is Insoil Canada Ltd., 231 Hampshire Place, N.W., Calgary, AB Canada T3A 4Y7. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee [1], which you may attend.

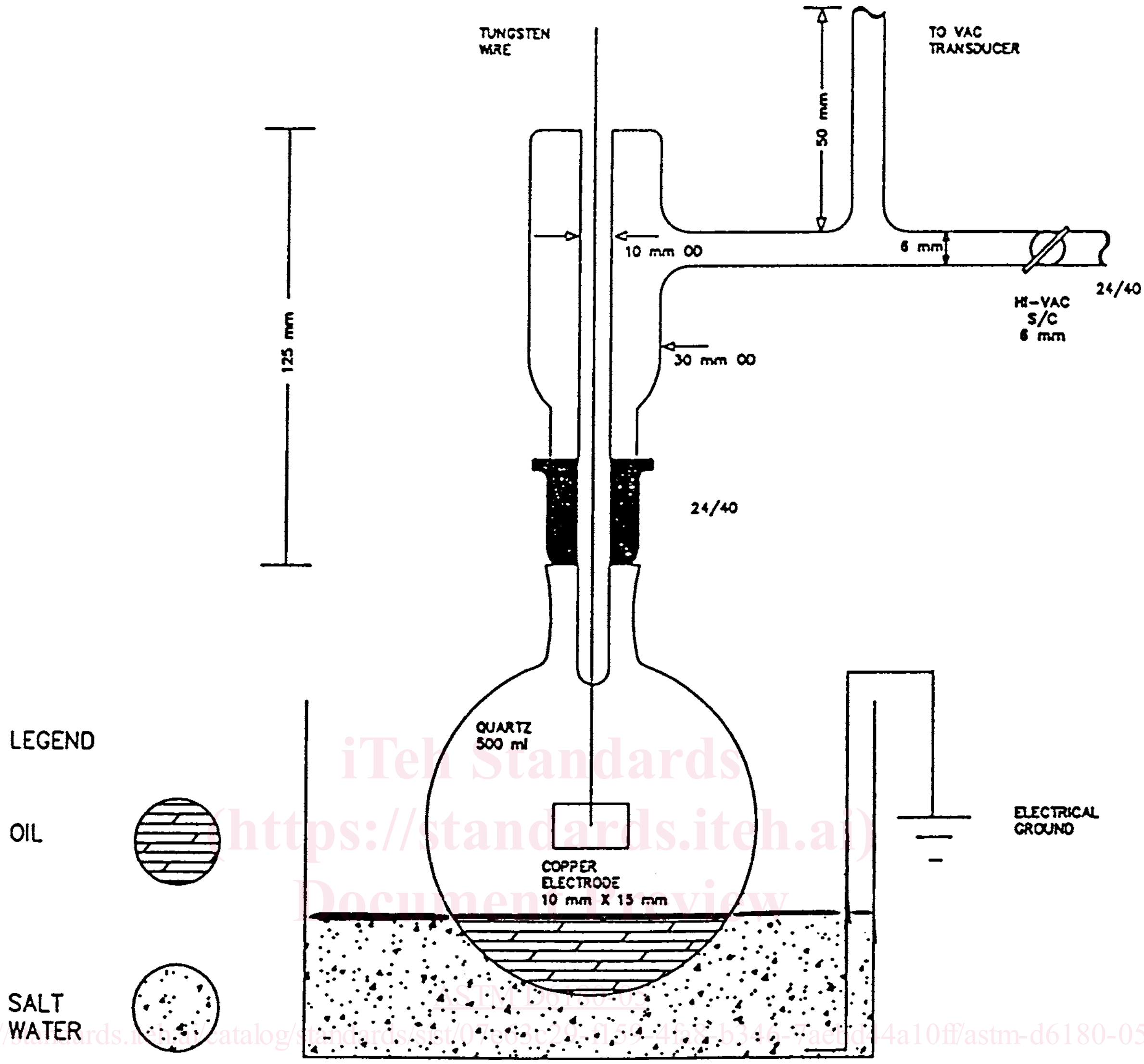

FIG. 1 Discharge Cell

a cylindrical copper electrode 15 mm (0.6 in.) in diameter and 10 mm (50.4–in.) long, which is placed in the center of the discharge cell.

5.2 *Glass Dish,* approximately 150 mm (6 in.) in diameter and 100 mm (4 in.) deep for holding a salt-water ground electrode.

5.3 *Test Chamber,* with safety interlocked door, which deenergizes the test transformer when opened and large enough to contain the desired number of cells with at least 100 mm (4 in.) clearance between cells, sides, and top.

5.4 *Power Source Step-Up Transformer,* 60 Hz, 200 VA, 115 or 230 V to at least 10 kV. Design the transformer of such a size that, with the test specimen in the circuit, the voltage waveshape is approximately a sinusoid with both half cycles alike, and it should have a ratio of peak-to-rms value equal to the $\sqrt{2} \pm 5$ %.

5.5 *Variable-Tap Autotransformer or Equivalent,* 200 VA min, 115 or 230 V for applying voltage to transformer.

5.6 *Relay,* 115 or 230 V, double-pole, for energizing transformer.

5.7 *Switch,* double-pole, 115 or 230 V, on-off switch for applying voltage to circuit.

5.8 *Voltmeter*—Measure the voltage by a method that fulfills the requirements of IEEE Standard No. 4[3], giving rms values, preferably by means of:

5.8.1 A voltmeter connected to the secondary of a separate potential transformer, or

5.8.2 A voltmeter connected to a well-designed tertiary coil in the test transformer, or

5.8.3 A voltmeter connected to the low voltage side of the testing transformer if the measurement error can be maintained within the limit specified in 5.9.

5.9 *Accuracy*—The combined accuracy of the voltmeter and voltage measuring circuit should be such that the measurement error does not exceed 5 %, calibrated by means of a recommended method in IEEE Standard No. 4.[3]