Designation: D 3300 – 00

Standard Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Under Impulse Conditions[1]

This standard is issued under the fixed designation D 3300; 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 the determination of the dielectric breakdown voltage of insulating oils in a highly divergent field under impulse conditions.

1.2 The values stated in inch-pound units are to be regarded as the standard.

1.3 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 923 Practices for Sampling Electrical Insulating Liquids[2]

D 2864 Terminology Relating to Electrical Insulating Liquids and Gases[2]

2.2 *IEEE Documents:*

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

3. Significance and Use

3.1 This test method is most commonly performed using a negative polarity point opposing a grounded sphere (NPS). The NPS breakdown voltage of fresh unused oils measured in the highly divergent field in this configuration depends on oil composition, decreasing with increasing concentration of aromatic, particularly polyaromatic, hydrocarbon molecules.

3.2 This test method may be used to evaluate the continuity of composition of an oil from shipment to shipment. The NPS impulse breakdown voltage of an oil can also be substantially lowered by contact with materials of construction, by service aging, and by other impurities. Test results lower than those expected for a given fresh oil may also indicate use or contamination of that oil.

3.3 Although polarity of the voltage wave has little or no effect on the breakdown strength of an oil in uniform fields, polarity does have a marked effect on the breakdown voltage of an oil in nonuniform electric fields.

3.4 Transient voltages may also vary over a wide range in both the time to reach crest value and the time to decay to half crest or to zero magnitude. The IEEE standard lightning impulse test (see 2.2) specifies a 1.2 by 50-μs negative polarity wave.

4. Apparatus

4.1 *Impulse Generator*, capable of producing a standard 1.2 by 50-μs full wave adjustable to positive or negative polarity. The generator shall have a nominal voltage rating of at least 300 kV adjustable in 10-kV steps. Generators having a capability of 1000 W·s (1000 J) at 300 kV have been found satisfactory.

4.2 *Voltage-Control Equipment*—The controls shall include a suitable measuring device for predetermining the crest voltage to within ±5 %. A voltage stabilizer is desirable at the input to the d-c power supply used for charging the impulse-generator capacitors.

4.3 *Electrodes*:

4.3.1 The electrodes shall consist of a polished steel or brass sphere of 0.5 in. (12.7 mm) diameter and a steel point. The point may be an ordinary steel phonograph needle with a 0.06 mm ± 20 % radius of curvature of point or a No. 18 Filter Point needle.[4] Needles with drawn tips are *not* recommended.

4.3.2 The effect of variation in the radius of curvature of point is subject to further investigation. Both electrodes shall be easily replaceable.

4.4 *Test Cell*:

4.4.1 The test cell shall be made of a material of high dielectric strength and of such dimensions that the electrical breakdown is restricted to the electrode gap. Test cell materials shall resist attack by, and be insoluble in, any of the cleaning

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

[3] Available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ 08855-1331.

[4] The following steel needle has been found satisfactory for this method: Dean No. 18 Filter Point Needle, available from John Dean, Inc., 20 Mechanic St., Putnam, CT 06260.

or test liquids used. Test cells such as those shown in Fig. 1 and Fig. 2 have been found satisfactory.

4.4.2 The sphere electrode shall be rigidly fixed and the point electrode mounted such that the gap may be adjusted from zero to the required value.

5. Sampling

5.1 Obtain a sample of the liquid to be tested using appropriate ASTM sampling apparatus in accordance with Practices D 923.

6. Adjustments and Care of Electrodes and Test Cell

6.1 *Electrode Spacing*:

6.1.1 For the cell shown in Fig. 1, reduce the electrode gap to zero spacing. Proceed very carefully to avoid damaging the point. The point of contact shall be established electrically with an ohmmeter. Open the gap to the specified spacing using a dial micrometer or other suitable method.

6.1.2 For the cell shown in Fig. 2, the gap may be set with a go-no-go gage.

6.1.3 The gap spacings shall be 1.0 in. (25.4 mm) for point-to-sphere and 0.15 in. (3.8 mm) for sphere-to-sphere electrode configuration.

6.2 *Cleaning*—Degrease the cell and electrodes by rinsing them with reagent grade petroleum ether, washing with detergent and hot water, rinsing thoroughly in hot tap water, and then rinsing them with distilled water. Dry the cell and hardware in an oven for 2 h at approximately 105 to 110°C, remove, and store in a desiccator until needed.

6.3 *Daily Use*—Use new or polished sphere electrodes at the beginning of each day's testing. Discard the point electrode and replace it after each breakdown; replace the sphere electrodes after every five breakdowns when testing point-to-sphere. More frequent replacement may be necessary when testing sphere-to-sphere. Sphere electrodes may be cleaned and polished for reuse in point-to-sphere testing. However, the use of polished spheres is not recommended for sphere-to-sphere testing. When not in use, clean and store the cell in accordance with 6.2.

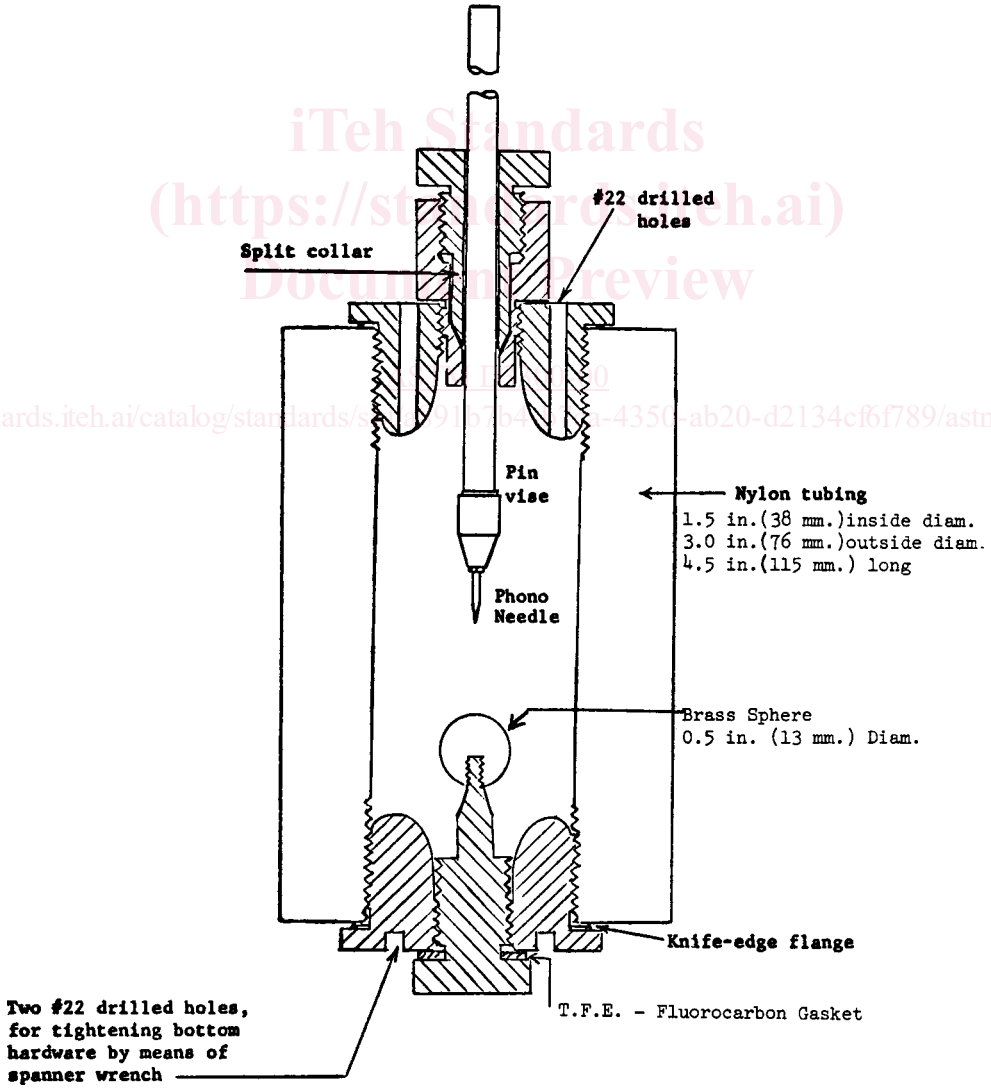

FIG. 1 Test Cell