



Designation: D3300 – 20

# Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Under Impulse Conditions<sup>1</sup>

This standard is issued under the fixed designation D3300; 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 test method covers the determination of the dielectric breakdown voltage of insulating liquids in a highly divergent field under impulse conditions and has been found applicable to liquids of petroleum origin, natural and synthetic esters.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

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>2</sup>

D923 Practices for Sampling Electrical Insulating Liquids  
D2864 Terminology Relating to Electrical Insulating Liquids and Gases

### 2.2 IEEE Documents:

IEEE Standard 4-1995 Techniques for High-Voltage Testing<sup>3</sup>

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ 08855-1331.

## 3. Significance and Use

3.1 This test method is most commonly performed using a negative polarity needle or a sharp defined point to an opposing grounded sphere (NPS). The NPS breakdown voltage of fresh unused liquids measured in the highly divergent field in this configuration depends on the insulating liquid composition, decreasing with increasing concentration of aromatic, particularly polyaromatic, hydrocarbon molecules in liquids of petroleum origin and decreasing with ester molecular structure, either natural or synthetic.

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

3.3 Although polarity of the voltage wave has little or no effect on the breakdown strength of an insulating liquid in uniform fields, polarity does have a marked effect on the breakdown voltage 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- $\mu$ s negative polarity wave.

## 4. Apparatus

4.1 *Impulse Generator*, capable of producing a standard 1.2 by 50- $\mu$ s 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  $\pm 5\%$ . A voltage stabilizer is desirable at the input to the d-c power supply used for charging the impulse-generator capacitors.

### 4.3 Electrodes: