Designation: D3426 – 19

Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials Using Impulse Waves[1]

This standard is issued under the fixed designation D3426; 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 dielectric strength of solid electrical insulating materials under simulated-lightning impulse conditions.

1.2 Procedures are given for tests using standard 1.2 by 50 µs full-wave impulses.

1.3 This test method is intended for use in determining the impulse dielectric strength of insulating materials, either using simple electrodes or functional models. It is not intended for use in impulse testing of apparatus.

1.4 This test method is similar to IEC Publication 243-3. All procedures in this test method are included in IEC 243-3. Differences between this test method and IEC 243-3 are largely editorial.

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.* Specific precaution statements are given in Section 9.

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]

D149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

D374 Test Methods for Thickness of Solid Electrical Insulation (Metric) D0374_D0374M

D2413 Practice for Preparation of Insulating Paper and Board Impregnated with a Liquid Dielectric

2.2 *American National Standard:*

C68.1 Techniques for Dielectric Tests (IEEE Standard No. 4)[3]

2.3 *IEC Standard:*

Pub 243-3 Methods of Test for Electric Strength of Solid Insulating Materials—Part 3: Additional Requirements for Impulse Tests[3]

3. Terminology

3.1 *Definitions:*

3.1.1 Reference Fig. 1 for the symbols mentioned.

3.1.2 *full-impulse-voltage wave, n*—an aperiodic transient voltage that rises rapidly to a maximum value, then falls less rapidly to zero.

3.1.3 *peak value of an impulse voltage wave, n*—the maximum value of voltage.

3.1.4 *virtual-peak value of an impulse voltage wave, n*—a value derived from a recording of an impulse wave on which high-frequency oscillations or overshoot of limited magnitude may be present. If the oscillations have a magnitude of no more than 5 % of the peak value and a frequency of at least 0.5 MHz, a mean curve may be drawn, the maximum amplitude of which is the virtual-peak value. If the oscillations are of greater magnitude, the voltage wave is not acceptable for standard tests.

3.1.5 *virtual-front time of an impulse voltage wave, n*—equal to 1.67 times the interval t_f between the instants when the voltage is 0.3 and 0.9 times the peak value (t_1, Fig. 1).

3.1.6 *virtual origin of an impulse voltage wave, n*—the point of intersection O_1 with the line of zero voltage of a line drawn through the points of 0.3 and 0.9 times the peak voltage on the front of an impulse voltage wave.

[1] This test method is under the jurisdiction of ASTM Committee D09 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.12 on Electrical Tests.

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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 American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

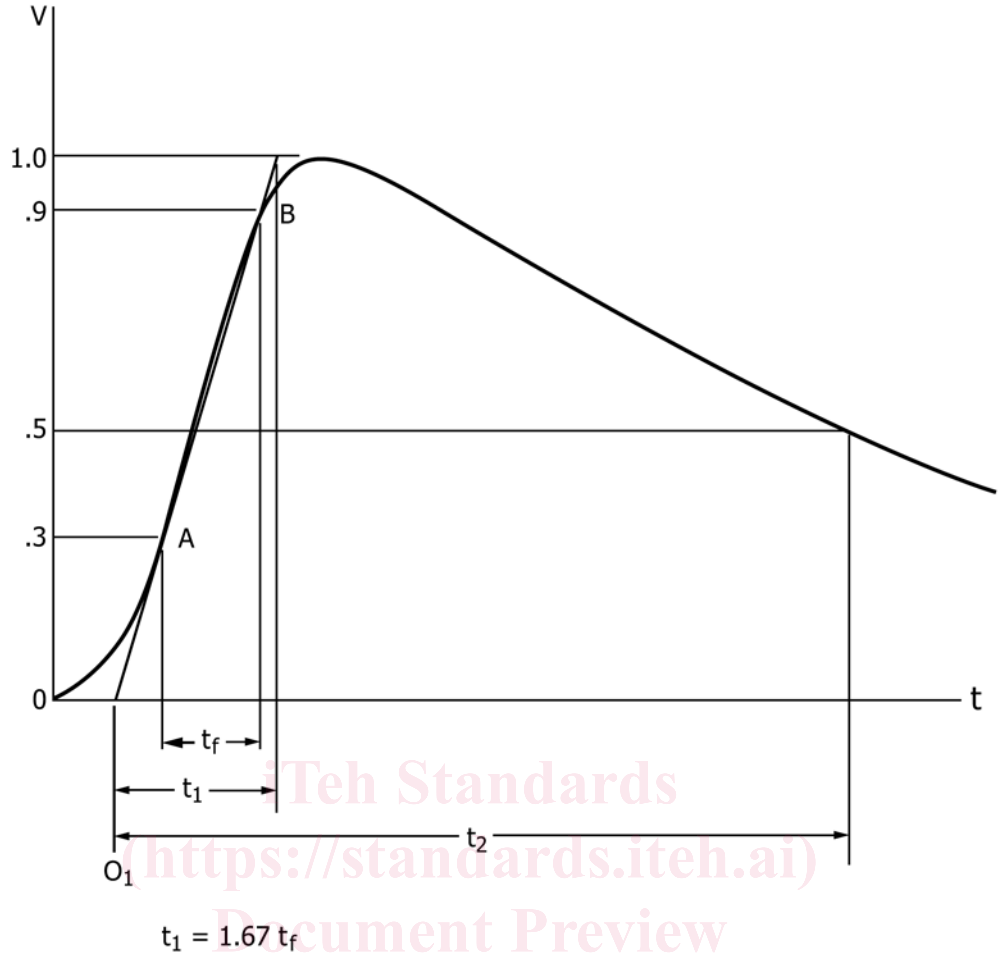

FIG. 1 Full-Impulse Voltage Wave

3.1.7 *virtual time to half-value of an impulse voltage wave, n*—the time interval t_2 between the virtual origin O_1 and the instant on the tail when the voltage has decreased to half the peak value.

4. Summary of Test Method

4.1 A series of sets-of-three voltage waves of a specified shape (see 5.3) is applied to the test specimen. The voltage of successive sets is increased in magnitude until breakdown of the test specimen occurs.

4.2 The procedures for sampling and specimen preparation are as specified in the material specification or other document calling for the use of this test method. The surrounding medium (air or other gas, or oil or other liquid) is also as specified if it differs from the medium in which the specimens are finally conditioned for test.

5. Significance and Use

5.1 It is possible for insulating materials used in high-voltage equipment to be subjected to transient voltage stresses, resulting from such causes as nearby lightning strokes. This is particularly true of apparatus such as transformers and switchgear used in electrical-power transmission and distribution systems. The ability of insulating materials to withstand these transient voltages is important in establishing the reliability of apparatus insulated with these materials.

5.2 Transient voltages caused by lightning will be of either positive or negative polarity. In a symmetrical field between identical electrodes, the polarity has no effect on the breakdown strength. However, with dissimilar electrodes there can be a pronounced polarity effect. It is common practice when using dissimilar electrodes, to make negative that electrode at which the higher gradient will appear. When asymmetrical electrodes are used for testing materials with which the tester has no previous experience or knowledge, it is recommended that he make comparative tests with positive polarity and negative polarity applied to the higher gradient, or smaller electrode, to determine which polarity produces the lower breakdown voltage.

5.3 The standard wave shape is a 1.2 by 50-µs wave, reaching peak voltage in approximately 1.2 µs and decaying to 50 % of peak voltage in approximately 50 µs after the