



Standard Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids¹

This standard is issued under the fixed designation D 924; 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 (€) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

€¹ NOTE—Editorial corrections were made in February 2003.

1. Scope

1.1 This test method covers new electrical insulating liquids as well as liquids in service or subsequent to service in cables, transformers, oil circuit breakers, and other electrical apparatus.

1.2 This test method provides a procedure for making referee tests at a commercial frequency of between 45 and 65 Hz.

1.3 Where it is desired to make routine determinations requiring less accuracy, certain modifications to this test method are permitted as described in Sections 19 to 27.

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 to determine the applicability of regulatory limitations prior to use.* Specific warnings are given in 14.4.2.

2. Referenced Documents

2.1 ASTM Standards:

D 150 Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials²

D 923 Test Method for Sampling Electrical Insulating Liquids³

D 2864 Terminology Relating to Electrical Insulating Liquids and Gases³

E 145 Specification for Gravity-Convection and Forced-Ventilation Ovens⁴

2.2 Other Standard:

IEC 247–1978 Measurement of Relative Permittivity, Dielectric Dissipation Factor (Tan δ) and DC Resistivity of Insulating Liquids⁵

3. Terminology

3.1 Definitions—Definitions of terms used in this test method are given in Terminology D 2864.

4. Significance and Use

4.1 *Dissipation Factor (or Power Factor)*—This is a measure of the dielectric losses in an electrical insulating liquid when used in an alternating electric field and of the energy dissipated as heat. A low dissipation factor or power factor indicates low ac dielectric losses. Dissipation factor or power factor may be useful as a means of quality control, and as an indication of changes in quality resulting from contamination and deterioration in service or as a result of handling.

4.1.1 The loss characteristic is commonly measured in terms of dissipation factor (tangent of the loss angle) or of power factor (sine of the loss angle) and may be expressed as a decimal value or as a percentage. For decimal values up to 0.05, dissipation factor and power factor values are equal to each other within about one part in one thousand. In general, since the dissipation factor or power factor of insulating oils in good condition have decimal values below 0.005, the two measurements (terms) may be considered interchangeable.

4.1.2 The exact relationship between dissipation factor (*D*) and power factor (*PF*) is given by the following equations:

$$PF = \frac{D}{\sqrt{1 + D^2}} \quad D = \frac{PF}{\sqrt{1 - (PF)^2}} \quad (1)$$

The reported value of *D* or *PF* may be expressed as a decimal value or as a percentage. For example:

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 10.01.

³ Annual Book of ASTM Standards, Vol 10.03.

⁴ Annual Book of ASTM Standards, Vol 14.02.

⁵ Available from American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.