



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 reappraisal. A superscript epsilon (ε) indicates an editorial change since the last revision or reappraisal.

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

1. Scope

1.1 This test method describes testing of 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 16 to 24.

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 11.3.3.

2. Referenced Documents

2.1 ASTM Standards:²

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

D 923 Practices for Sampling Electrical Insulating Liquids

D 2864 Terminology Relating to Electrical Insulating Liquids and Gases

D 2865 Practice for Calibration of Standards and Equipment for Electrical Insulating Materials Testing

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.2 IEEE Standard:

Standard 4 IEEE Standard Techniques for High-Voltage Testing³

3. Terminology

3.1 Definitions—Definitions of terms used in this test method are given in Terminology D 2864. Also refer to Test Methods D 150 for detailed discussion of terms.

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:

$$D \text{ or } PF \text{ at } 25^\circ\text{C} = 0.002 \text{ or } 0.2\% \quad (2)$$

4.2 *Relative Permittivity (Dielectric Constant)*—Insulating liquids are used in general either to insulate components of an electrical network from each other and from ground, alone or

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 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 Institute of Electrical and Electronic Engineers, 445 Hoes Lane, Piscataway, NJ 08854.