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Standard Test Methods for Refractive Index and Specific Optical Dispersion of Electrical Insulating Liquids [1]

This standard is issued under the fixed designation D 1807; 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 These test methods cover the determination of the refractive index and the specific optical dispersion of electrical insulating liquids such as are used in capacitors, transformers, circuit breakers, and oil-filled cables.

1.2 Two test methods are described, a routine method and a more precise referee method. Both methods are applicable to transparent, light-colored, insulating liquids.

1.2.1 The routine method is used to determine refractive index and specific optical dispersion as described in these test methods.

1.2.2 The referee method is used when a test of high accuracy is desired. These methods are described in Test Method D 1218. Specific optical dispersion is calculated by dividing the refractive dispersion value determined in Test Method D 1218 by the relative density (specific gravity) (see Practice D 1298) of the liquid under test.

1.3 The values stated in SI units are to be regarded as the standard.

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 determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 1218 Test Method for Refractive Index and Refractive Dispersion of Hydrocarbon Liquids [2]

D 1298 Practice for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method [2]

3. Terminology

3.1 *Definitions:*

3.1.1 *refractive index*, *n*—the ratio of the velocity of light in air to its velocity in the substance under test.

3.1.2 *relative density (specific gravity)*, *n*—the ratio of the mass of a given volume of liquid at 15°C (60°F) to mass of an equal volume of pure water at the same temperature.

3.1.3 *specific optical dispersion*, *n*—the difference between the refractive indexes of light of two different wavelengths, both indexes measured at the same temperature, and divided by the relative density (specific gravity), also measured at the test temperature.

4. Significance and Use

4.1 *Refractive Index*—The refractive index of an insulating liquid varies with its composition and with the nature and amount of contaminants held in solution. Changes of refractive index with time and service may form a basis for estimating any change in composition or the degree of containment acquired in service. For electrical insulating mineral oils, the wavelength of 5893 Å for the spectral line of sodium is commonly used. The test temperature is 25°C.

4.2 *Specific Optical Dispersion*—Specific optical dispersion serves as a quick index to the amount of unsaturated compounds present in an oil. Dispersion values for paraffinic and naphthenic compounds are nearly the same and are essentially independent of molecular weight and structural differences. Values above 97 bear a direct relationship to the amount of aromatic compounds present in insulating oil. For convenience, the specific dispersion value is multiplied by 10^4. For electrical insulating mineral oils, the wavelengths of 6563 and 4861 Å corresponding to the spectral lines of hydrogen are commonly used. Alternatively, the wavelengths of 6678 and 5016 Å corresponding to the spectral lines of helium may be used.

5. Apparatus

5.1 *Refractometer*—The refractometer to be used in the routine method shall have an index range of approximately 1.33 to 1.5 and be readable to ±0.0002 units. The refractometer used in the referee method is described in Test Method D 1218.

[1] These test methods are under the jurisdiction of ASTM Committee D-27 on Electrical Insulating Liquids and Gases and are the direct responsibility of Subcommittee D27.07on Physical Tests.

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[2] *Annual Book of ASTM Standards*, Vol 05.01.

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