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Standard Terminology Relating to Electrical Insulating Liquids and Gases[1]

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INTRODUCTION

The definitions contained in this terminology pertain to terms as they are used in conjunction with fluid insulating materials. Insofar as possible, the definitions are consistent with accepted general usage, and may also contain additional information deemed to be of value in testing of fluid insulating materials.

1. Referenced Documents

1.1 *ASTM Standards:*[2]

D611 Test Methods for Aniline Point and Mixed Aniline Point of Petroleum Products and Hydrocarbon Solvents

D2007 Test Method for Characteristic Groups in Rubber Extender and Processing Oils and Other Petroleum-Derived Oils by the Clay-Gel Absorption Chromatographic Method

D2140 Practice for Calculating Carbon-Type Composition of Insulating Oils of Petroleum Origin

D2300 Test Method for Gassing of Electrical Insulating Liquids Under Electrical Stress and Ionization (Modified Pirelli Method)

D2500 Test Method for Cloud Point of Petroleum Products and Liquid Fuels

D3117 Test Method for Wax Appearance Point of Distillate Fuels (Withdrawn 2010)[3]

E355 Practice for Gas Chromatography Terms and Relationships

2. Terminology

ac, *n*—symbol used to designate an electric voltage or current whose amplitude varies periodically as a function of time, its average value over one complete period being zero. One complete repetition of the wave pattern is referred to as a CYCLE, and the number of cycles occurring in one second is called the FREQUENCY, measured in hertz (Hz). For example, the electricity supplied by commercial utility companies in the United States is, in most localities, 60 Hz, although other frequencies may be encountered.

acid treating, *n*—a refining process in which an unfinished petroleum insulating oil is contacted with sulfuric acid to improve its color, odor, stability, and other properties.

ac loss characteristics, *n*—those properties of a dielectric or insulation system (such as dissipation factor, power factor, and loss index) that may be used as a measure of the power or energy losses that would result from the use of such material in an ac electric field.

additive, *n*—a chemical compound or compounds added to an insulating fluid for the purpose of imparting new properties or altering those properties which the fluid already has.

ambient temperature, *n*—the temperature of the surrounding atmosphere as determined by an instrument shielded from direct or reflected rays of the sun.

aniline point, *n*—the minimum temperature for complete miscibility of equal volumes of aniline and the sample under test. See Test Methods D611. In comparing two samples of similar molecular weight, the aniline point can be used as a means of comparing aromatic content of the two samples. A product of high aniline point will be low in aromatics and naphthenes, and therefore high in paraffins.

API gravity, *n*—an arbitrary scale developed by the American Petroleum Institute and frequently used in reference to petroleum insulating oil. The relationship between API gravity and specific gravity 60/60°F is defined by the following:

$$\text{Deg API Gravity at } 60°\text{F} = 141.5/(\text{sp gr } 60/60°\text{F}) - 131.5$$

aromatics, *n*—that class of organic compounds which behave chemically like benzene. They are cyclic unsaturated organic

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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] The last approved version of this historical standard is referenced on www.astm.org.

compounds that can sustain an induced electronic ring current due to delocalization of electrons around the ring.

DISCUSSION—Empirically, the aromatic portion of a mineral insulating oil can be estimated by correlation with physical properties (See Test Method D2140), or by selective adsorption on clay-gel (See Test Method D2007).

askarel, *n*—a generic term for a group of synthetic, fire-resistant, chlorinated aromatic hydrocarbons used as electrical insulating liquids. They have a property under arcing conditions such that any gases produced will consist predominantly of noncombustible hydrogen chloride with lesser amounts of combustible gases.

atomic absorption, *n*—the absorption of radiant energy by ground state atoms. Substances when dispersed as an atomic vapor will absorb characteristic radiations identical to those which the same substances can emit. This property is the basis for analysis by atomic absorption spectroscopy.

capacitivity, *n*—the same as **permittivity, relative.**

color, *n*—a quality of visible phenomena of insulating fluids, the numerical value for which is derived by comparing this quality using transmitted light with that of a series of numbered reference standards.

combustible gases, *n*—flammable gases formed from breakdown (partial or complete) of some insulating materials subjected to electrical or thermal stress, or both.

conductance, *n*—the ratio of the current carried through a material to the difference in potential applied across the material. It is the reciprocal of *resistance* . The unit is: (ohm) $^{-1}$ or siemens.

DISCUSSION—1—**Conductance** is a general term. Specific reference may be made to **conductance dc** and **conductance ac.**

DISCUSSION—2—For dielectrics the conductance may be dependent on the **electrification time.**

conductance, apparent dc, *n*—the dc conductance measured at the end of a specific electrification time. The "apparent dc conductance" is the reciprocal of the "apparent dc resistance." The unit is: (ohm) $^{-1}$ or siemens.

DISCUSSION—The term "apparent dc conductance" is used to distinguish the current-voltage relationship found in electrical insulating materials, where the current (leakage plus absorption) usually decreases with time, from the relationship found in metallic conductors where the steady-state current is reached in a fraction of a second.

conductance, dc, *n*—the ratio of the total current (in amperes) passing through a material to the dc voltage (in volts) applied between two electrodes that are in contact with, or immersed in a specimen. The "dc conductance" is the reciprocal of the "dc resistance." The unit is: (ohm) $^{-1}$ or siemens.

conductivity, *n*—the ratio of the current density carried through a specimen to the potential gradient paralleling the current. This is numerically equal to the conductance between opposite faces of a unit cube of liquid. It is the reciprocal of **resistivity.**

DISCUSSION—1—**Conductivity** is a general term. Specific reference may be made to **conductivity, dc.**

DISCUSSION—2—For dielectrics the conductivity may be dependent on the **electrification time.** (See also **conductivity, apparent dc volume** and **conductivity, dc volume.**)

conductivity, apparent dc volume, *n*—the "dc volume conductivity" measured at the end of a specified electrification time. It is the reciprocal of the apparent dc volume resistivity. The unit most commonly used is: (ohm-centimetre) $^{-1}$ or siemens per centimetre. The SI unit is (ohm-metre) $^{-1}$.

conductivity, dc, *n*—the ratio of the current density passing through a specimen at a given instant of time and under prescribed conditions, to the dc potential gradient paralleling the current. It is the reciprocal of the dc resistivity. In common practice the "dc conductivity" is numerically equal to the "dc conductance" between opposite faces of a centimetre cube of liquid. The unit is: (ohm-centimetre) $^{-1}$ or siemens per centimetre. The SI unit is: (ohm-metre) $^{-1}$.

DISCUSSION—The "dc conductivity" may contain components of both surface conductance and volume conductance, but, in general, surface effects are not common in measurements on fluid dielectrics. The property most commonly measured is either the "dc volume conductivity" or the "apparent dc volume conductivity."

conductivity, dc volume, *n*—the property of a material that permits the flow of electricity through its volume. It is numerically equal to the ratio of the steady-state current density to the steady direct voltage gradient parallel with the current in the material. The dc volume conductivity is the reciprocal of the dc volume resistivity. The unit commonly used is: (ohm-centimetre) $^{-1}$ or siemens per centimetre. The SI unit is (ohm-metre) $^{-1}$.

DISCUSSION—For electrical insulating materials the time required for the steady-state current to be reached may be very long; from several minutes to several months may be required.

corona, *n*—a luminous discharge due to ionization of the air surrounding an electrode, caused by the high electric field strength in the vicinity of the electrode, exceeding a certain critical (that is, threshold) value.

corona effect, *n*—light emitted in the UV range of the electromagnetic spectrum by electronically excited molecules that have reached a singlet state and have not consumed the absorbed energy by other physical process.

corona (partial discharge) inception voltage, *CIV*, *n*—the lowest voltage at which continuous partial discharge (or corona) exceeding a specified intensity is observed as the applied voltage is gradually increased. Where the applied voltage is alternating, the *CIV* is expressed as $1/\sqrt{2}$ of the peak voltage.

corona (partial discharge) extinction voltage, *CEV*, *n*—the highest voltage at which partial discharge (or corona) no longer exceeds a specified intensity as the applied voltage is gradually decreased from a value above the corona inception voltage. Where the applied voltage is alternating the CEV is expressed as $1/\sqrt{2}$ of the peak voltage.

corrosive sulfur, *n*—elemental sulfur and thermally unstable sulfur compounds in electrical insulating oil that can cause corrosion of certain transformer metals such as copper and silver.