Designation: D1903 – 08 (Reapproved 2017)

Standard Practice for Determining the Coefficient of Thermal Expansion of Electrical Insulating Liquids of Petroleum Origin, and Askarels[1]

This standard is issued under the fixed designation D1903; 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 practice covers the determination of the coef-ficient of thermal expansion of electrical insulating liquids of petroleum origin, and askarels, containing PCBs (polychlorinated biphenyls), when used as an insulating or cooling medium, or both, in cables, transformers, oil circuit breakers, capacitors, or similar apparatus.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *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:*[2]

D941 Test Method for Density and Relative Density (Specific Gravity) of Liquids by Lipkin Bicapillary Pycnometer (Withdrawn 1993)[3]

D1250 Guide for Use of the Petroleum Measurement Tables

D1298 Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method

D1810 Test Method for Specific Gravity of Askarels (Withdrawn 2001)[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *coefficient of thermal expansion of a liquid, n*—the change in volume per unit volume per degree change in temperature. It is commonly stated as the average coefficient over a given temperature range.

4. Significance and Use

4.1 Knowledge of the coefficient of thermal expansion of a liquid is essential to compute the required size of a container to accommodate a volume of liquid over the full temperature range to which it will be subjected. It is also used to compute the volume of void space that would exist in an inelastic device filled with the liquid after the liquid has cooled to a lower temperature.

5. Procedure for Liquids of Petroleum Origin

5.1 The coefficient of thermal expansion used in Guide D1250, is 0.00040/°F for the temperature range from – 17.7 to 65.5°C (0 to 150°F), and petroleum oils ranging from 15.0 to 34.9° API gravity or 0.9659 to 0.8504 relative density (specific gravity). In the preparation of these tables for relative density (specific gravity) values above 0.600, it has been assumed for purposes of standardization that all crude petroleum and petroleum products have uniform coefficients of expansion in the same temperature ranges. When the required accuracy of results falls within these assumptions, this value for coefficient of expansion may be used.

5.2 If closer approximation than that indicated in 5.1 is required, the coefficient of thermal expansion may be calculated by determining observed relative densities (specific gravities). Determine the relative densities at any two temperatures below 90°C (194°F) and not less than 5°C (9°F), nor more than 14°C (25°F) degrees apart by Practice D1298. The difference in the observed relative densities at the two temperatures divided by the product of the relative density at the lower temperature and the difference in the two temperatures may be used as the average coefficient of expansion for the observed temperature range.

6. Procedure for Askarels

6.1 Determine the relative density (specific gravity) of the askarel at any two convenient temperatures below 90°C

[1] This practice is under the jurisdiction of ASTM Committee D27 on Electrical Insulating Liquids and Gasesand is the direct responsibility of Subcommittee D27.07 on Physical Test.

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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.

(194°F) and not less than 14°C (25°F) apart by Test Method D1810. The difference in the observed relative densities at the two temperatures divided by the product of the relative density at the lower temperature and the difference in the two temperatures may be used as the average coefficient of expansion for the observed temperature range.

6.2 If suitably calibrated hydrometers for determining the relative density of an askarel are not available, Test Method D941 may be used.

7. Calculation

7.1 Calculate the coefficient of thermal expansion as follows:

$$\text{Coefficient of thermal expansion} = (S - S_1)/S(T_1 - T)$$

where:

S = relative density (specific gravity) at lower temperature T,
S_1 = relative density (specific gravity) at higher temperature T_1,
T = lower temperature, and
T_1 = higher temperature.

8. Keywords

8.1 askarels; density; electrical insulating liquids; petroleum; specific gravity; volume