



Designation: D 1698 – 03

## Standard Test Method for Sediments and Soluble Sludge in Service-Aged Insulating Oils<sup>1</sup>

This standard is issued under the fixed designation D 1698; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This test method covers the determination of sediment and soluble sludge in service-aged insulating oils of petroleum origin. Also, provision is made for determining organic and inorganic content of the sediment. The method is intended primarily for oils of comparatively low viscosity; for example 5.7 to 13.0 cSt ( $\text{mm}^2/\text{s}$ ) at 40°C (104°F). Suitability for high viscosity oils have not been determined.

1.2 This standard may involve hazardous materials, operations, and equipment. *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 923 Practices for Sampling Electrical Insulating Liquids<sup>2</sup>
- D 2440 Test Method for Oxidation Stability of Mineral Insulating Oil<sup>2</sup>

### 3. Terminology

#### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 *inorganic sediment*—that portion of the total sediment which remains after ignition at 500°C.

3.1.2 *organic sediment*—that portion of the total sediment which is lost during ignition at 500°C.

3.1.3 *sediment*—any solid substance or substances that are insoluble in the oil under test at ordinary room temperatures, and that can be separated by centrifuging under certain prescribed conditions.

3.1.4 *soluble sludge*—oil deterioration products or contaminants, or both, which become insoluble upon dilution with *n*-pentane under prescribed conditions.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D27 on Electrical Insulating Liquids and Gases and is the direct responsibility of Subcommittee D27.07 on Physical Tests.

Current edition approved May 10, 2003. Published July 2003. Originally approved in 1959. Last previous edition approved in 1997 as D 1698 – 97.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 10.03.

### 4. Summary of Test Method

4.1 A sample portion is centrifuged to separate sediment from the oil. The upper, sediment-free portion is decanted and retained for determination of soluble sludge. The sediment is dislodged and filtered through a filtering crucible. After drying and weighing to obtain total sediment the crucible is ignited at 500°C and reweighed. Loss in weight is organic and the remainder is inorganic content of sediment. Soluble sludge is determined on the sediment-free portion by dilution with *n*-pentane to precipitate *n*-pentane insolubles, and filtration through a filtering crucible or 0.45  $\mu\text{m}$  filter membrane.

### 5. Significance and Use

5.1 Sediment in insulating oil may deposit on transformer parts and interfere with heat transfer and may choke oil ducts; thus hindering oil circulation and heat dissipation. Inorganic sediment usually indicates contamination of some type and organic sediment indicates either deterioration of the oil or contamination.

5.2 Soluble sludge indicates deterioration of the oil, presence of contaminants, or both. It serves as a warning that formation of sediment may be imminent.

5.3 The determination of sediment and soluble sludge in a used insulating oil assists in deciding whether the oil may continue to be used in its existing condition or should be replaced, reclaimed, or reconditioned.

### 6. Apparatus

6.1 *Centrifuge Tube*, 30-mL capacity, preferably with round or elliptical bottom to facilitate removal of sediment. Pear-shaped tubes are not recommended.

6.2 *Centrifuge*, capable of whirling two or more filled centrifuge tubes at a speed which can be controlled to give a relative centrifugal force (rcf) between 600 and 700 at the tips of the tubes. The revolving head, trunnion rings, and trunnion cups, including the rubber cushion, shall be soundly constructed to withstand the maximum centrifugal force capable of being delivered by the power source. The trunnion cups and cushions shall firmly support the tubes when the centrifuge is in motion. The centrifuge shall be enclosed by a metal shield or