Designation: ~~D971 – 12~~ D971 – 20

Standard Test Method for Interfacial Tension of ~~Oil~~ Insulating Liquids Against Water by the Ring Method[1]

This standard is issued under the fixed designation D971; 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.

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

1. Scope

1.1 This test method covers the measurement of the interfacial tension between ~~mineral oil~~ insulating liquid that has a relative density (specific gravity) less than water and water, under non-equilibrium conditions.

1.2 *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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.* See 7.2 for a specific warning statement.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

~~D117 Guide for Sampling, Test Methods, and Specifications for Electrical Insulating Liquids~~

D923 Practices for Sampling Electrical Insulating Liquids

~~D2285 Test Method for Interfacial Tension of Electrical Insulating Oils of Petroleum Origin Against Water by the Drop-Weight Method (Withdrawn 2008)[3]~~

3. Summary of Test Method

3.1 *Interfacial Tension* is determined by measuring the force necessary to detach a planar ring of platinum wire from the surface of the liquid of higher surface tension, that is, upward from the ~~water-oil~~ water insulating liquid interface. To calculate the interfacial tension, the force so measured is corrected by an empirically determined factor which depends upon the force applied, the densities of both ~~oil~~ the insulating liquid and water, and the dimensions of the ring. Measurements are made under rigidly standardized nonequilibrium conditions in which the measurement is completed within 60 s after formation of the interface.

4. Significance and Use

4.1 Interfacial tension measurements on electrical insulating ~~oils~~liquids provide a sensitive means of detecting small amounts of soluble polar contaminants and products of oxidation. A high value for new mineral insulating oil indicates the absence of most undesirable polar contaminants. The test is frequently applied to service-aged mineral oils as an indication of the degree of deterioration.

NOTE 1—Different liquid matrixes are reviewed in Appendix X1.

5. Apparatus (Figs. 1 and 2)

5.1 *Tensiometer*[3]—Force measurement on the tensiometer may be made using a torsion wire, load cell, or any other means of linearly determining tension in the range of 0 to 100 mN/m.

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[1] This test method 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] Tensiometers that use the Du Nouy principle for measuring interfacial and surface tension should be used.

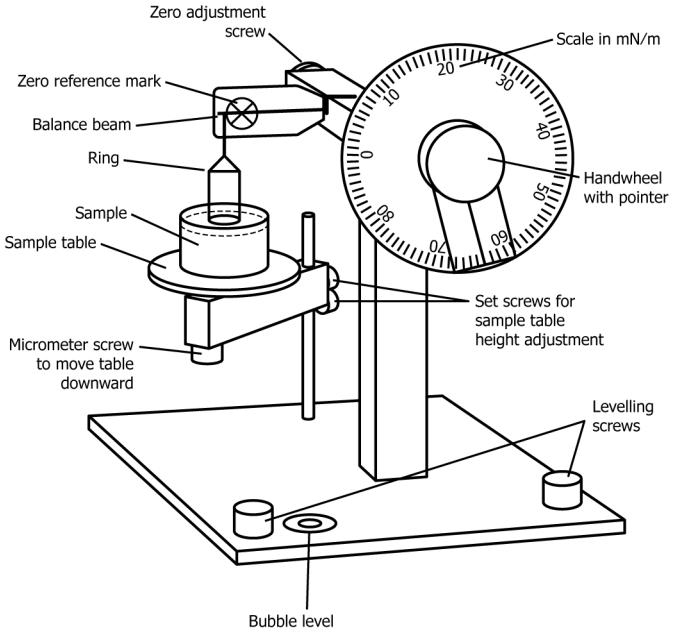

FIG. 1 Manual Interfacial Tensiometer

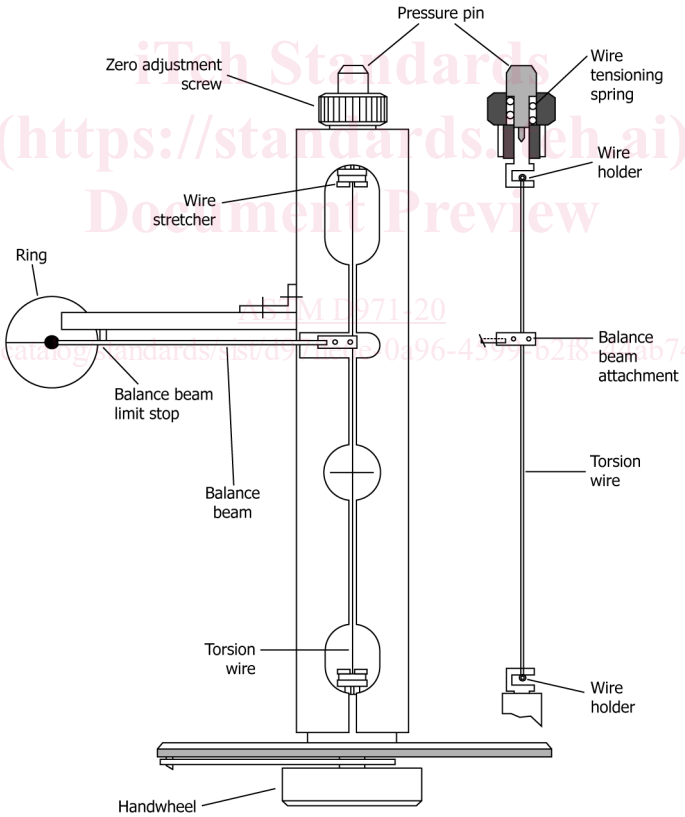

FIG. 2 Top View of Manual Interfacial Tensiometer

5.1.1 Horizontal platform to hold the sample container should be capable of movement upward or downward using a mechanical screw, lever mechanism, electronic drive, or any other means of precisely changing vertical position of the sample.

5.2 Rings made of platinum or platinum-iridium alloy may be used. The ring should be welded into a continuous circle and attached to at least two parallel stirrups. Circumference of the ring should be minimum 40 mm and diameter of the ring wire should be about 0.3 mm. Ratio of the ring major radius (R) and the wire radius (r) should be known (R/r) to at least three significant figures. Stirrups should be at least 25 mm long.