



Standard Test Method for Oxidation Stability of Mineral Insulating Oil ¹

This standard is issued under the fixed designation D 2440; 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 Department of Defense.

1. Scope

1.1 This test method determines the resistance of mineral transformer oils to oxidation under prescribed accelerated aging conditions. Oxidation stability is measured by the propensity of oils to form sludge and acid products during oxidation. This test method is applicable to new oils, both uninhibited and inhibited, but is not well defined for used or reclaimed oils.

NOTE 1—A shorter duration oxidation test for evaluation of inhibited oils is available in Test Method D 2112.

NOTE 2—For those interested in the measurement of volatile acidity, reference is made to the work of IEC Subcommittee 10A. ²

1.2 The values stated in metric units are to be regarded as the 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:

- B 1 Specification for Hard-Drawn Copper Wire³
- D 664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration⁴
- D 974 Test Method for Acid and Base Number by ColorIndicator Titration⁴
- D 2112 Test Method for Oxidation Stability of Inhibited Mineral Insulating Oil by Rotating Bomb⁵
- D 2272 Test Method for Oxidation Stability of Steam Turbine Oils by Rotating Pressure Vessel⁴
- D 3487 Specification for Mineral Insulating Oil Used in Electrical Apparatus⁵

2.2 IEC Publication:

¹ This test method is under the jurisdiction of ASTM Committee D-27 on Electrical Insulating Liquids and Gases and is the direct responsibility of Subcommittee D27.06 on Chemical Test.

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² ASTM Research Report No. RR: D-27-1001, available from ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

³ Annual Book of ASTM Standards, Vol 02.03.

⁴ Annual Book of ASTM Standards, Vol 05.01.

⁵ Annual Book of ASTM Standards, Vol 10.03.

CEI/IFC 61125: 1992 Unused Hydrocarbon-Based Insulating Liquids—Test Methods for Evaluating the Oxidation Stability⁶

3. Summary of Test Method

3.1 A test specimen of mineral transformer oil is oxidized at a bath temperature of 110°C, in the presence of a copper catalyst coil, by bubbling oxygen through duplicate test specimens for 72 and 164 h, respectively. The oil is evaluated at the end of each aging period by measuring the amount of sludge and acid formed. The test specimen is diluted with *n*-heptane and the solution filtered to remove the sludge. The sludge is dried and weighed. The sludge-free solution is titrated at room temperature with standard alcoholic base to the end point indicated by the color change (green-brown) of the added *p*-naphthol-benzene solution.

4. Significance and Use

4.1 The oxidation stability test of mineral transformer oils is a method for assessing the amount of sludge and acid products formed in a transformer oil when the oil is tested under prescribed conditions. Good oxidation stability is necessary in order to maximize the service life of the oil by minimizing the formation of sludge and acid. Oils that meet the requirements specified for this test in Specification D 3487 tend to minimize electrical conduction, ensure acceptable heat transfer, and preserve system life. There is no proven correlation between performance in this test and performance in service, since the test does not model the whole insulation system (oil, paper, enamel, wire). However, the test can be used as a control test for evaluating oxidation inhibitors and to check the consistency of oxidation stability of production oils.

5. Apparatus

5.1 *Aging (Oxidation) Bath*—An oil bath, wax bath, or aluminum block heater (see IEC Standard 61125) of a suitable type capable of controlling the temperature at $110 \pm 0.5^\circ\text{C}$ with a temperature gradient of less than 1°C in the body of the liquid. Use any nontoxic liquid having low volatility at 110°C and containing no volatile additives and having a flash point above the test temperature. Mineral oils, waxes and silicone

⁶ International Electrotechnical Commission. Available from American National Standards Institute, 1430 Broadway, New York, NY 10018.

