



Standard Test Method for Determination of the Sludging and Corrosion Tendencies of Inhibited Mineral Oils¹

This standard is issued under the fixed designation D 4310; 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 test method is used to evaluate the tendency of inhibited mineral oil based steam turbine lubricants and mineral oil based anti-wear hydraulic oils to corrode copper catalyst metal and to form sludge during oxidation in the presence of oxygen, water, and copper and iron metals at an elevated temperature. The test method is also used for testing circulating oils having a specific gravity less than that of water and containing rust and oxidation inhibitors.

NOTE 1—During round robin testing copper and iron in the oil, water and sludge phases were measured. However, the values for the total iron were found to be so low (that is, below 0.8 mg), that statistical analysis was inappropriate. The results of the cooperative test program are available.²

1.2 This test method is a modification of Test Method D 943 where the oxidation stability of the same kinds of oils is determined by following the acid number of oil. The number of test hours required for the oil to reach an acid number of 2.0 mg KOH/g is the *oxidation lifetime*.

1.3 The values stated in acceptable metric units are to be regarded as the standard.

1.4 *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.* For specific warning statements, see Section 7 and X1.1.5.

2. Referenced Documents

2.1 ASTM Standards:

- A 510 Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel³
- B 1 Specification for Hard-Drawn Copper Wire⁴

D 874 Test Method for Sulfated Ash from Lubricating Oils and Additives⁵

D 943 Test Method for Oxidation Characteristics of Inhibited Mineral Oils⁵

D 1193 Specification for Reagent Water⁶

D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products⁷

E 1 Specification for ASTM Thermometers⁸

2.2 IP Standard:⁹

Specification for IP Standard Thermometers

2.3 British Standard:¹⁰

BS 1829

3. Terminology

3.1 Definition:

3.1.1 *sludge*—a precipitate or sediment from oxidized mineral oil and water.

4. Summary of Test Method

4.1 An oil sample is contacted with oxygen in the presence of water and an iron-copper catalyst at 95°C for 1000 h. The weight of insoluble material is determined gravimetrically by filtration of the oxidation tube contents through 5-μm pore size filter disks. The total amount of copper in the oil, water, and sludge phases is also determined.

NOTE 2—Optionally, some operators may choose to: (a) assess the change in weight of the catalyst coil, or (b) determine the acid number at 1000 h, or both. The acid number may serve as a criterion to determine if measurement of insoluble material is warranted. Normally, further testing is not recommended on a highly oxidized oil (that is an oil which has attained an acid number >2.0 mg KOH/gm). Instructions for these optional tests are not included in this test method.

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.09 on Oxidation.

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² Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR: D02-1291.

³ *Annual Book of ASTM Standards*, Vol 01.03.

⁴ *Annual Book of ASTM Standards*, Vol 02.03.

⁵ *Annual Book of ASTM Standards*, Vol 05.01.

⁶ *Annual Book of ASTM Standards*, Vol 11.01.

⁷ *Annual Book of ASTM Standards*, Vol 05.02.

⁸ *Annual Book of ASTM Standards*, Vol 14.03.

⁹ Available from The Institute of Petroleum, 61 New Cavendish St., London W1M, 8AR, England.

¹⁰ Available from British Standards Institute (BSI), 389 Chiswick High Rd., London W4 4AL, U.K.