



Standard Test Method for Oxidation and Thermal Stability Characteristics of Gear Oils Using Universal Glassware¹

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1. Scope

1.1 This test method covers the determination of the oxidation characteristics of extreme pressure and non-extreme pressure gear oils and includes the quantitative determination of total sludge, viscosity change, and oil loss.

NOTE 1—While the round-robin tests used ISO VG 220 extreme pressure gear oils for developing precision data, the test method can be extended to other viscosity grades and to non-extreme pressure gear oils. Refer to Classification D 2422 for viscosity grades.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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:

- D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)²
- D 2422 Classification of Industrial Fluid Lubricants by Viscosity System²
- D 2893 Test Method for Oxidation Characteristics of Extreme Pressure Lubricating Oils³
- D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products³
- D 4871 Guide for Universal Oxidation/Thermal Stability Test Apparatus⁴
- E 1 Specification for ASTM Thermometers⁵

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

- 3.1.1 *adherent sludge, n*—sludge that is formed on the walls

of a container and is not easily removed.

3.1.2 *aliquot, n*—portion of sample being tested that is a representative portion of the whole.

3.1.3 *extreme pressure gear oil, n*—gear oil that contains chemical additives, such as sulfur and phosphorus compounds, which produce a protective film on the metal surface to provide anti-scuffing and anti-scoring properties.

3.1.4 *filterable sludge, n*—sludge that is formed in the oil.

3.1.5 *non-extreme pressure gear oil, n*, *n*—gear oil that contains no extreme pressure additives.

3.1.6 *oxidation, n*—the process by which oxygen chemically reacts with materials.

3.1.7 *sludge, n—in gear oils*, a precipitate that sometimes forms as the oil ages or oxidizes.

3.1.8 *universal glassware, n*—the glassware that is described in the universal oxidation thermal stability test. Refer to Guide D 4871.

4. Summary of Test Method

4.1 The viscosity of the gear oil being tested is determined. A 100-g aliquot of the oil in a weighed apparatus is subjected to a temperature of 120°C for 312 h while dry air is passed through the aliquot at 3 L/h.

4.2 At the end of the stress period, the aliquot is cooled to room temperature. The apparatus is reweighed to determine oil loss. Filterable sludge is recovered by vacuum filtration using a 2.8-μm glass fiber filter medium. The viscosity of the filtered oil is determined. Sludge adhering to the oxidation cell and associated glassware is rinsed with heptane and the washings passed through the same filter used to filter the filterable sludge. The filter is dried in an oven to a constant weight to determine the total filterable sludge.

4.3 The apparatus is dried and weighed to determine the amount of adherent sludge. The sum of the filterable sludge and adherent sludge is reported as total sludge. The percentage change in viscosity and percent oil loss are also reported.

5. Significance and Use

5.1 Degradation of gear oils by oxidation or thermal breakdown, or both, can result in sludge buildup and render the oil unsuitable for further use as a lubricant.

5.2 This is the only test method that employs glassware to measure the amount of sludge produced during oxidation and thermal degradation. This test method is a modification of Test

¹ This test method is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.09 on Oxidation.

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² *Annual Book of ASTM Standards*, Vol 05.01.

³ *Annual Book of ASTM Standards*, Vol 05.02.

⁴ *Annual Book of ASTM Standards*, Vol 05.03.

⁵ *Annual Book of ASTM Standards*, Vol 14.03.