Designation: D4742 – 23

Standard Test Method for Oxidation Stability of Gasoline Automotive Engine Oils by Thin-Film Oxygen Uptake (TFOUT)[1]

This standard is issued under the fixed designation D4742; 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 evaluates the oxidation stability of engine oils for gasoline automotive engines. This test, run at 160 °C, utilizes a high pressure reactor pressurized with oxygen along with a metal catalyst package, a fuel catalyst, and water in a partial simulation of the conditions to which an oil may be subjected in a gasoline combustion engine. This test method can be used for engine oils with viscosity in the range from 4 mm^2/s (cSt) to 21 mm^2/s (cSt) at 100 °C, including re-refined oils.

1.2 This test method is not a substitute for the engine testing of an engine oil in established engine tests, such as Sequence IIID.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3.1 *Exception*—Pressure units are provided in psig, and dimensions are provided in inches in Annex A1, because these are the industry accepted standard and the apparatus is built according to the figures shown.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* For specific warning statements, see Sections 7 and 8.

1.5 *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]

A314 Specification for Stainless Steel Billets and Bars for Forging

B211 Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric) B0211_B0211M

D664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration

D1193 Specification for Reagent Water

D2272 Test Method for Oxidation Stability of Steam Turbine Oils by Rotating Pressure Vessel

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

E1 Specification for ASTM Liquid-in-Glass Thermometers

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *break point, n*—the precise point of time at which rapid oxidation of the oil begins.

3.1.2 *oxidation induction time, n*—the time until the oil begins to oxidize at a relatively rapid rate as indicated by the decrease of oxygen pressure.

3.1.3 *oxygen uptake, n*—oxygen absorbed by oil as a result of oil oxidation.

4. Summary of Test Method

4.1 The test oil is mixed in a glass container with three other liquids that are used to simulate engine conditions: (*1*) an oxidized/nitrated fuel component (Annex A2), (*2*) a mixture of soluble metal naphthenates (lead, copper, iron, manganese, and stannous octoate (Annex A3)), and (*3*) Type I reagent water.

4.2 The glass container holding the oil mixture is placed in a high pressure reactor equipped with a pressure gauge. The high pressure reactor is sealed, charged with oxygen to a pressure of 620 kPa (90 psig), and placed in an oil or dry

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.09.0G on Oxidation Testing of Engine Oils.

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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.

***A Summary of Changes section appears at the end of this standard**

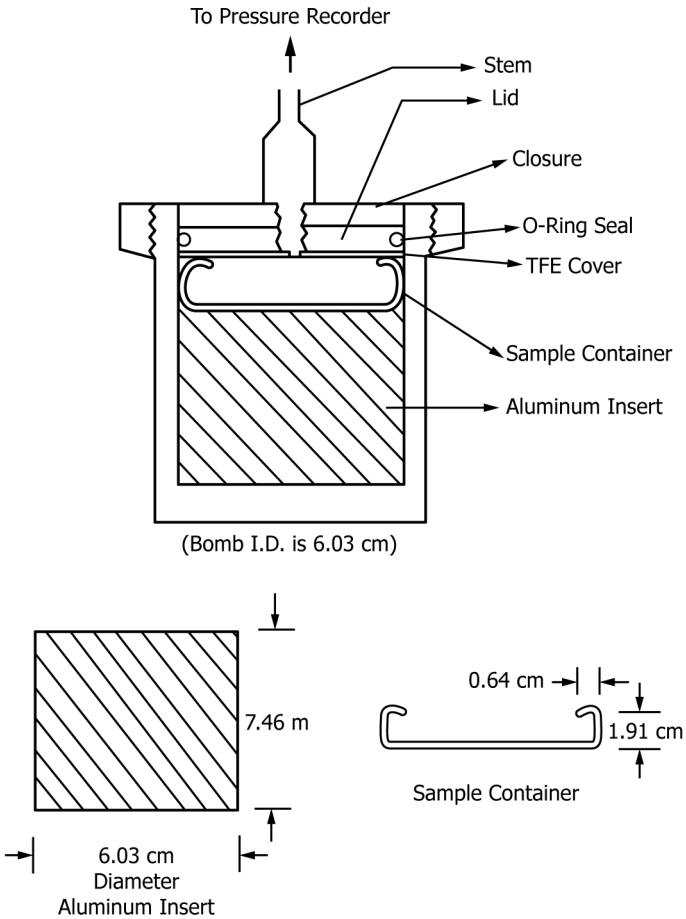

FIG. 1 Schematic Drawing of Oxidation Test Apparatus

bath[3,4] at 160 °C at an angle of 30° from the horizontal. The high pressure reactor is rotated axially at a speed of 100 r/min forming a thin film of oil within the glass container resulting in a relatively large oil-oxygen contact area.

NOTE 1—A pressure sensing device can be used in place of a pressure gauge.

4.3 The pressure of the high pressure reactor is recorded continuously from the beginning of the test and the test is terminated when a rapid decrease of the high pressure reactor pressure is observed (Point B, Fig. A1.2). The period of time that elapses between the time when the high pressure reactor is placed in the oil or dry bath and the time at which the pressure begins to decrease rapidly is called the oxidation induction time and is used as a measure of the relative oil oxidation stability.

5. Significance and Use

5.1 This test method is used to evaluate oxidation stability of lubricating base oils with additives in the presence of chemistries similar to those found in gasoline engine service. Test results on some ASTM reference oils have been found to correlate with sequence IIID engine test results in hours for a 375 % viscosity increase.[5] The test does not constitute a substitute for engine testing, which measures wear, oxidation stability, volatility, and deposit control characteristics of lubricants. Properly interpreted, the test may provide input on the oxidation stability of lubricants under simulated engine chemistry.

5.2 This test method is intended to be used as a bench screening test and quality control tool for lubricating base oil manufacturing, especially for re-refined lubricating base oils. This test method is useful for quality control of oxidation stability of re-refined oils from batch to batch.

5.3 This test method is useful for screening formulated oils prior to engine tests. Within similar additive chemistry and base oil types, the ranking of oils in this test appears to be predictive of ranking in engine tests. When oils having completely different additive chemistry or base oil type are compared, oxidation stability results may not reflect the actual engine test result.

5.4 Other oxidation stability test methods have demonstrated that soluble metal catalyst supplies are very inconsistent

[3] The sole source of supply of the catalyst and dry bath known to the committee at this time is Tannas Co., 4800 James Savage Rd., Midland, MI 48642.

[4] If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

[5] Ku, C. S. and Hsu, S. M., "A Thin Film Uptake Test for the Evaluation of Automotive Lubricants," *Lubrication Engineering*, 40, 2, 1984, pp. 75–83.