



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

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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 mm²/s (cSt) to 21 mm²/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 the standard. The values given in parentheses are provided for information purposes only.

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 Sections 7 and 8.

2. Referenced Documents

2.1 ASTM Standards:

A 314 Specification for Stainless Steel Billets and Bars for Forging²

B 211 Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire³

D 664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration⁴

D 1193 Specification for Reagent Water⁵

D 2272 Test Method for Oxidation Stability of Steam Turbine Oils by Rotating Pressure Vessel⁴

D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products⁶

E 1 Specification for ASTM Thermometers⁷

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

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

3.1.2 *oxidation induction time*—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*—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 tin naphthenates (Annex A3)), and (3) Type II reagent water.

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

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 bath and the time at which the pressure begins

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² *Annual Book of ASTM Standards*, Vol 01.03.

³ *Annual Book of ASTM Standards*, Vol 02.02.

⁴ *Annual Book of ASTM Standards*, Vol 05.01.

⁵ *Annual Book of ASTM Standards*, Vol 11.01.

⁶ *Annual Book of ASTM Standards*, Vol 05.02.

⁷ *Annual Book of ASTM Standards*, Vol 14.03.