Designation: D4871 – 11 (Reapproved 2022)

Standard Guide for Universal Oxidation/Thermal Stability Test Apparatus[1]

This standard is issued under the fixed designation D4871; 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 guide covers an apparatus used to measure the oxidation or thermal stability of liquids by subjecting them to temperatures in the range from 50 °C to 375 °C in the presence of air, oxygen, nitrogen, or other gases at flow rates of 1.5 L/h to 13 L/h, or in the absence of gas flow. Stability may be measured in the presence or absence of water or soluble or insoluble catalysts. Gases evolved may be allowed to escape, condensed and collected, or condensed and returned to the test cell.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *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]

D91 Test Method for Precipitation Number of Lubricating Oils

D156 Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method)

D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

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

D974 Test Method for Acid and Base Number by Color-Indicator Titration

D1500 Test Method for ASTM Color of Petroleum Products (ASTM Color Scale)

D3339 Test Method for Acid Number of Petroleum Products by Semi-Micro Color Indicator Titration

D5763 Test Method for Oxidation and Thermal Stability Characteristics of Gear Oils Using Universal Glassware

D5770 Test Method for Semiquantitative Micro Determination of Acid Number of Lubricating Oils During Oxidation Testing

D5846 Test Method for Universal Oxidation Test for Hydraulic and Turbine Oils Using the Universal Oxidation Test Apparatus

D6514 Test Method for High Temperature Universal Oxidation Test for Turbine Oils

3. Summary of Guide

3.1 An apparatus is described in which a sample of test fluid, typically from 100 mL or 100 g, is subjected to thermal or oxidative degradation or both. Insoluble or soluble catalyst may be added. Gas may be bubbled through the liquid to provide agitation or to promote oxidation or both. Water or water vapor may be added. At the end of the test or at intervals throughout the test, the liquid is monitored for change in neutralization number, viscosity, weight loss, formation of sludge, or for other parameters. The corrosivity of the fluid toward any catalyst metals can be determined from the appearance and weight change of the metal test specimens, if present, or by monitoring the oil and any sludge or water for metal content. The test is terminated after a fixed time period or when a selected parameter reaches a condemning value.

NOTE 1—The volume of liquid at test temperature should be sufficient to cover the catalysts and should not extend beyond the heated portion of the bath.

4. Significance and Use

4.1 This standard describes an apparatus that provides the versatility required to conduct oxidation or thermal stability tests on liquids using a wide variety of test conditions. It is sufficiently flexible so that new test conditions can be chosen in response to the changing demands of the marketplace.

[1] This guide is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.09.0D on Oxidation of Lubricants.

Current edition approved April 1, 2022. Published April 2022. Originally approved in 1988. Last previous edition approved in 2016 as D4871 – 11 (2016). DOI: 10.1520/D4871-11R22.

[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.

FIG. 1 Universal Oxidation Test Apparatus

4.2 Procedures using this apparatus are described in the following ASTM standard test methods: D5763, D5846, and D6514. Other procedures may be in use, but they have not been developed as ASTM standard test methods.

5. Apparatus

5.1 *Heating Block,* as shown at the lower right in Fig. 1, to provide a controlled constant temperature for conducting tests.

5.1.1 Test cells are maintained at constant elevated temperature by means of a heated aluminum block which surrounds each test cell.

5.1.2 Holes in the aluminum block to accommodate the test cells shall provide 1.0 mm max clearance for 38 mm outside diameter glass tubes. The glass test cells shall fit into the block to a depth of 225 mm ± 5 mm.

NOTE 2—The original test blocks were made with spaces for ten test cells. Blocks with different number of holes are acceptable if other requirements are met.

5.1.3 The heating system shall be geometrically and thermally balanced. For thermal balance, sizes and locations of the heaters are proportioned against heat losses.

5.1.4 The block is cylindrical and constructed from forged aluminum. The block has a minimum thickness of 38 mm of insulation on all sides, top and bottom. An insulation of thermally efficient ceramic fiber material is suggested.

5.1.5 The exterior jacket, sides and top are stainless steel or equivalent.

5.1.6 The block is equipped with a well for a temperature measuring device and a thermometer.

5.2 *Temperature Control System,* as shown at lower left in Fig. 1, to maintain the heating block at a set temperature.

5.2.1 The temperature controller shall be capable of maintaining the block temperature within ±0.5 °C of the desired test temperature for the duration of the test. The preferred controller shall have proportional and integral control modes, and a heater malfunction alarm.