



Designation: D6971 – 22

Standard Test Method for Measurement of Hindered Phenolic and Aromatic Amine Antioxidant Content in Non-zinc Turbine Oils by Linear Sweep Voltammetry¹

This standard is issued under the fixed designation D6971; 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 covers the voltammetric determination of hindered phenol and aromatic amine antioxidants in new or in-service type non-zinc turbine oils in concentrations from 0.0075 % by mass up to concentrations found in new oils by measuring the amount of current flow at a specified voltage in the produced voltammogram.

1.2 *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.*

1.3 *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

- 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
- D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants
- D4378 Practice for In-Service Monitoring of Mineral Turbine Oils for Steam, Gas, and Combined Cycle Turbines
- D6224 Practice for In-Service Monitoring of Lubricating Oil

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 D02.09.0C on Oxidation of Turbine 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.

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2.2 ISO Standards:³

ISO 6743 Part 4, Lubricants, Industrial Oils, and Related Products

3. Terminology

3.1 Definitions:

3.1.1 See Terminology D4175 for a more extensive list of terms used in this test method.

3.1.2 *electrolytic cell, n*—an electrochemical cell in which chemical reactions are caused by applying an external potential difference greater than, and opposite to, the galvanic electromotive force of the cell. IUPAC⁴

3.1.3 *linear sweep voltammetry, n*—a technique applied to the monitoring of antioxidant additive content in lubricants, where the current is detected as an applied potential is increased linearly over a period of time.

3.1.4 *voltammogram, n*—the plot of current versus voltage.

4. Summary of Test Method

4.1 A measured quantity of sample is dispensed into a vial containing a measured quantity of acetone based electrolyte test solution and a layer of sand. When the vial is shaken, the hindered phenol and aromatic amine antioxidants and other test solution soluble oil components present in the sample are extracted into the test solution and the remaining droplets suspended in the test solution are agglomerated by the sand. The sand/droplet suspension is allowed to settle out and the hindered phenol and aromatic amine antioxidants dissolved in the test solution are quantified by voltammetric analysis. The results are calculated and reported as mass % of antioxidant or

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ Inczedy, J., Lengyel, T., and Ure, A. M., *Orange Book: IUPAC Compendium on Analytical Nomenclature, Definitive Rules 1997*, 3rd Edition, Blackwell Science, 1998.

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