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Standard Specification for Biodegradable, Low Aquatic Toxicity Hydraulic Fluids¹

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1. Scope*

1.1 This specification covers performance requirements for biodegradable hydraulic fluids with low aquatic toxicity used in industrial/mobile hydraulic applications.

1.2 In some cases, biodegradable fluids have been found to perform differently than traditional mineral oils, thus separate performance requirements are desirable.

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

1.4 *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.*

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

- D92 Test Method for Flash and Fire Points by Cleveland Open Cup Tester
- D97 Test Method for Pour Point of Petroleum Products
- D130 Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
- 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
- D665 Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water
- D892 Test Method for Foaming Characteristics of Lubricating Oils
- D943 Test Method for Oxidation Characteristics of Inhibited Mineral Oils
- D974 Test Method for Acid and Base Number by Color-Indicator Titration
- D1298 Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
- D1401 Test Method for Water Separability of Petroleum Oils and Synthetic Fluids
- D2070 Test Method for Thermal Stability of Hydraulic Oils
- D2270 Practice for Calculating Viscosity Index from Kinematic Viscosity at 40 °C and 100 °C
- D2422 Classification of Industrial Fluid Lubricants by Viscosity System
- D2983 Test Method for Low-Temperature Viscosity of Automatic Transmission Fluids, Hydraulic Fluids, and Lubricants using a Rotational Viscometer
- D3427 Test Method for Air Release Properties of Hydrocarbon Based Oils
- D4052 Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter
- D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants
- D4310 Test Method for Determination of Sludging and Corrosion Tendencies of Inhibited Mineral Oils
- D5864 Test Method for Determining Aerobic Aquatic Biodegradation of Lubricants or Their Components
- D6081 Practice for Aquatic Toxicity Testing of Lubricants: Sample Preparation and Results Interpretation
- D6731 Test Method for Determining the Aerobic, Aquatic Biodegradability of Lubricants or Lubricant Components in a Closed Respirometer
- D6866 Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis
- D7042 Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)

¹ This specification is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.N0 on Hydraulic Fluids.

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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

D7043 Test Method for Indicating Wear Characteristics of Non-Petroleum and Petroleum Hydraulic Fluids in a Constant Volume Vane Pump

D7373 Test Method for Predicting Biodegradability of Lubricants Using a Bio-kinetic Model (Withdrawn 2021)³

D7752 Practice for Evaluating Compatibility of Mixtures of Hydraulic Fluids

2.2 *EPA Standards*:⁴

OPPTS 835.3110 Ready Biodegradability

OPPTS 850.1010 Aquatic Invertebrate Acute Toxicity Test, Freshwater Daphnids

OPPTS 850.1075 Fish Acute Toxicity Test, Freshwater and Marine

OPPTS 850.5400 Algal Toxicity, Tiers I and II

2.3 *OECD Standards*:⁵

OECD Test No. 107 Partition Coefficient (N-Octanol/Water), Shake Flask Method

OECD Test No. 117 Partition Coefficient (N-Octanol/Water), High Performance Liquid Chromatography Method

OECD Test No. 123 Partition Coefficient (1-Octanol/Water): Slow-Stirring Method

OECD Test No. 201 Freshwater Alga and Cyanobacteria, Growth Inhibition Test

OECD Test No. 202 Daphnia sp. Acute Immobilisation Test

OECD Test No. 203 Fish, Acute Toxicity Test

OECD Test No. 301 Ready Biodegradability

OECD Test No. 305 Bioaccumulation in Fish: Aqueous and Dietary Exposure

2.4 *CEC Standards*:⁶

CEC Test Method L-45-99 Viscosity Shear Stability of Transmission Lubricants

2.5 *ISO Standards*:⁷

ISO 6072 Rubber—Compatibility between hydraulic fluids and standard elastomeric materials

ISO 9408 Water quality—Evaluation of ultimate aerobic biodegradability of organic compounds in aqueous medium by determination of oxygen demand in a closed respirometer

ISO 9439 Water quality—Evaluation of ultimate aerobic biodegradability of organic compounds in aqueous medium—Carbon dioxide evolution test

ISO 14593 Water quality—Evaluation of ultimate aerobic biodegradability of organic compounds in aqueous

medium—Method by analysis of inorganic carbon in sealed vessels (CO₂ headspace test)

ISO 17025 General requirements for the competence of testing and calibration laboratories

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this specification, refer to Terminology **D4175**.

3.1.2 *acute ecotoxicity, n*—the propensity of a test material to produce adverse behavioral, biochemical, or physiological effects in non-human organisms or populations in a short period, usually not constituting a substantial portion of their life span.

3.1.3 *acute ecotoxicity test, n*—a comparative ecotoxicity test in which a representative subpopulation of organisms is exposed to different treat rates of a test material and is observed for a short period, usually not constituting a substantial portion of their life span.

3.1.4 *bioaccumulation, n*—the net accumulation of a substance by an organism as a result of uptake from all environmental sources.

3.1.5 *biodegradation, n*—the process of chemical breakdown or transformation of a material caused by organisms or their enzymes.

3.1.5.1 *Discussion*—Biodegradation is only one mechanism by which materials are transformed in the environment.

3.1.6 *hydraulic fluid, n*—a liquid used in hydraulic systems for lubrication and transmission of power.

4. Biodegradable Hydraulic Fluid Performance Requirements

4.1 **Table 1** summarizes the environmental behavior requirements.

4.2 **Table 2** summarizes the physical property and performance requirements.

4.3 This specification assumes that all biodegradable hydraulic fluids shall have a minimum impact on human health, which is documented in the safety data sheet offering a labeling-free product in accordance with globally harmonized system (GHS) regulation.

5. Compatibility of Mixtures of Hydraulic Fluids

5.1 As a general guideline, different fluids should not be mixed.

5.2 Compatibility should be evaluated according to Practice **D7752**.

6. Keywords

6.1 aquatic toxicity; bioaccumulation; biodegradable; environmentally acceptable lubricants (EAL); fluids; hydraulics

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ U.S. EPA Prevention, Pesticides, and Toxic Substances (7101); available from United States Environmental Protection Agency (EPA), William Jefferson Clinton Bldg., 1200 Pennsylvania Ave., NW, Washington, DC 20460, <http://www.epa.gov>.

⁵ Available from Organisation for Economic Cooperation and Development (OECD), 2 rue André Pascal, 75775 Paris Cedex 16, France, <http://www.oecd.org>.

⁶ Available from Coordinating European Council (CEC), Services provided by Kellen Europe, Avenue Jules Bordet 142 - 1140, Brussels, Belgium, <http://www.cectests.org>.

⁷ Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.