Designation: ~~D7665 – 10~~ D7665 – 10 (Reapproved 2014)

Standard Guide for Evaluation of Biodegradable Heat Transfer Fluids[1]

This standard is issued under the fixed designation D7665; 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[2] covers general information, without specific limits, for selecting standard test methods for evaluating heat transfer fluids for quality and aging. These test methods are considered particularly useful in characterizing biodegradable water free heat transfer fluids in closed systems.

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

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D86 Test Method for Distillation of Petroleum Products at Atmospheric Pressure
D91 Test Method for Precipitation Number of Lubricating Oils
D92 Test Method for Flash and Fire Points by Cleveland Open Cup Tester
D93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
D95 Test Method for Water in Petroleum Products and Bituminous Materials by Distillation
D97 Test Method for Pour Point of Petroleum Products
D189 Test Method for Conradson Carbon Residue of Petroleum Products
D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
D471 Test Method for Rubber Property—Effect of Liquids
D524 Test Method for Ramsbottom Carbon Residue of Petroleum Products
D664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration
D893 Test Method for Insolubles in Used Lubricating Oils
D1160 Test Method for Distillation of Petroleum Products at Reduced Pressure
D1298 Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
D1500 Test Method for ASTM Color of Petroleum Products (ASTM Color Scale)
D2270 Practice for Calculating Viscosity Index from Kinematic Viscosity at 40 and 100°C
D2717 Test Method for Thermal Conductivity of Liquids
D2766 Test Method for Specific Heat of Liquids and Solids
D2887 Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography
D2879 Test Method for Vapor Pressure-Temperature Relationship and Initial Decomposition Temperature of Liquids by Isoteniscope
D4530 Test Method for Determination of Carbon Residue (Micro Method)
D5864 Test Method for Determining Aerobic Aquatic Biodegradation of Lubricants or Their Components
D6384 Terminology Relating to Biodegradability and Ecotoxicity of Lubricants
D6743 Test Method for Thermal Stability of Organic Heat Transfer Fluids
D7044 Specification for Biodegradable Fire Resistant Hydraulic Fluids
E659 Test Method for Autoignition Temperature of Liquid Chemicals

[1] This guide is under the jurisdiction of ASTM Committee D02 on Petroleum ~~Products~~ Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.L0.06 on Non-Lubricating Process Fluids.

Current edition approved ~~Oct. 1, 2010~~Dec. 1, 2014. Published ~~October 2010~~February 2015. Originally approved in 2010. Last previous edition approved in 2010 as D7665 – 10. DOI: ~~10.1520/D7665-10.~~10.1520/D7665-10R14.

[2] The background for this standard was developed by a questionnaire circulated by ASTM-ASLE technical division L-VI-2 and reported in *Lubrication Engineering*, Vol 32, No. 8, August 1976, pp. 411–416.

[3] 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.

G4 Guide for Conducting Corrosion Tests in Field Applications

2.2 *OECD Standards:*[4]

Test No. 203 : Fish, Acute Toxicity Test

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *fluid aging*—process of fluid degradation associated with the loss of intended performance of the fluid, which includes fluid composition changes, soot formation, and the deposit of materials on a surface (fouling).

3.1.2 *fluid quality*—describes the fluid's appropriateness for the intended application including factors necessary for safety and environmental awareness or compliance.

3.1.3 *heat transfer fluid*—fluid that remains essentially a liquid while transferring heat to or from an apparatus or process, although this guide does not preclude the evaluation of a heat transfer fluid that may be used in its vapor state. Heat transfer fluids may be hydrocarbon– or petroleum–based, such as polyglycols, esters, hydrogenated terphenyls, alkylated aromatics, diphenyl-oxide/biphenyl blends, and mixtures of di- and triaryl-ethers. Small percentages of functional components such as antioxidants, antiwear and anti-corrosion agents, TBN, acid scavengers, or dispersants, or a combination thereof, can be present.

4. Significance and Use

4.1 The significance of each test method depends upon the system in use and the purpose of the test method as listed under Section 5. Use the most recent editions of ASTM test methods.

5. Recommended Test Procedures

5.1 *Pumpability of the Fluid:*

5.1.1 *Flash Point, Closed Cup (Test Method D93)*—This test method detects low flash ends which are one cause of cavitation during pumping. In closed systems, especially when fluids are exposed to temperatures of 225°C or higher, the formation of volatile hydrocarbons by breakdown of the oil may require venting through a pressure relief system to prevent dangerous pressure build-up.

5.1.2 *Pour Point (Test Method D97)*—The pour point can be used as an approximate guide to the minimum temperature for normal pumping and as a general indication of fluid type and low temperature properties. Should a heat transfer system be likely to be subjected to low temperatures when not in use, the system should be trace heated to warm the fluid above minimum pumping temperature before start-up.

5.1.3 *Viscosity (Test Method D445)*—Fluid viscosity is important for determining Reynolds and Prandtl numbers for heat transfer systems, to estimate fluid turbulence, heat transfer coefficient, and heat flow. Generally, a fluid that is above approximately 200 cSt is difficult to pump. The pump and system design determine the viscosity limit required for pumping. The construction of a viscosity/temperature curve using determined viscosities can be used to estimate minimum pumping temperature.

5.1.4 *Specific Gravity (Test Method D1298)*—Hydraulic shock during pumping has been predicted via the use of a combination of density and compressibility data.

5.1.5 *Water Content (Test Method D95)*—The water content of a fresh heat transfer fluid can be used to indicate how long the heat transfer system shall be dried out during commissioning, while raising the bulk oil temperature through the 100°C plus region, with venting, before the system can be safely used at higher temperatures. The expansion tank should be full during the operations to ensure that moisture is safely vented in the lowest pressure part of the systems. Positive nitrogen pressure on the heat exchange systems minimizes entry of air or moisture. Heat transfer systems operating at temperatures of 120°C or greater shall, for reasons of safety, be dry, because destructive high pressures are generated when water enters the high temperature sections of the system. Heating the oil before it is placed in service also removes most of the dissolved air in the oil. If not removed, the air can cause pump cavitation. The air can also accumulate in stagnant parts of the system at high pressure and could cause an explosion.

5.1.6 *Vapor Pressure (Test Method D2879)*—Vapor pressure, which normally increases with increasing operating temperature, is an important design parameter. Organic heat transfer fluids exhibiting high vapor pressures should be used only in systems with sufficient structural integrity. Operation of vapor phase systems requires knowledge of the equilibrium vapor pressure.

5.2 *Safety in Use:*

5.2.1 *Autoignition Temperature (Test Method E659)*—This test relates to the autoignition temperature of a bulk fluid. Hydrocarbon fluids absorbed on porous inert surfaces can ignite at temperatures more than 50°C lower than indicated by Test Method E659. An open flame ignites leaking hydrocarbon fluids exposed on a porous surface at any temperature.

5.2.2 *Flash Point (Test Methods D92 and D93)*—Some heat transfer fluids are volatile and present a fire hazard at slightly elevated temperatures, or even below 25°C.

[4] Organisation for Economic Co-operation and Development (OECD), 2, rue André Pascal, 75775 Paris Cedex 16, France.