Designation: D8092 – 22

Standard Test Method for Field Determination of Kinematic Viscosity Using a Microchannel Viscometer[1]

This standard is issued under the fixed designation D8092; 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 describes a means for measuring the kinematic viscosity of transparent and opaque liquids such as new and in-service lubricating oils using a miniature microchannel viscometer at 40 °C in the range of 12.9 mm^2/s to 174 mm^2/s

1.2 The precision has only been determined for those materials and viscosity ranges, as indicated in Section 17 on Precision and Bias.

1.3 This test method is specifically tailored to obtaining a rapid, direct, temperature- stabilized measure of the kinematic viscosity of new and in-service lubricants in the field in real-time without the use of solvents or chemical cleaning agents. The measurement takes place at 40 °C and kinematic viscosity is directly obtained. No temperature extrapolations or density corrections are necessary.

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

1.5 *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. Some specific hazards statements are given in Section 9 on Hazards.*

1.6 *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]

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

D2162 Practice for Basic Calibration of Master Viscometers and Viscosity Oil Standards

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants

D5854 Practice for Mixing and Handling of Liquid Samples of Petroleum and Petroleum Products

D6708 Practice for Statistical Assessment and Improvement of Expected Agreement Between Two Test Methods that Purport to Measure the Same Property of a Material

2.2 *ISO Standard:*[3]

ISO/IEC 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 test method, refer to Terminology D4175.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *Hele-Shaw cell, n*—a liquid cell wherein Stokes flow is present between two parallel plates.

3.2.1.1 *Discussion*—The unbounded microchannel capillary acts as a Hele-Shaw cell in this test method, which enables a simple relationship between kinematic viscosity and fluid velocity to be established.

3.2.2 *loading funnel, n*—the cavity in Fig. 1 that the liquid is placed into upon sample introduction; the sample then travels out of this funnel and enters the capillary.

[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 D02.07.0A on Newtonian Viscosity.

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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.

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

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

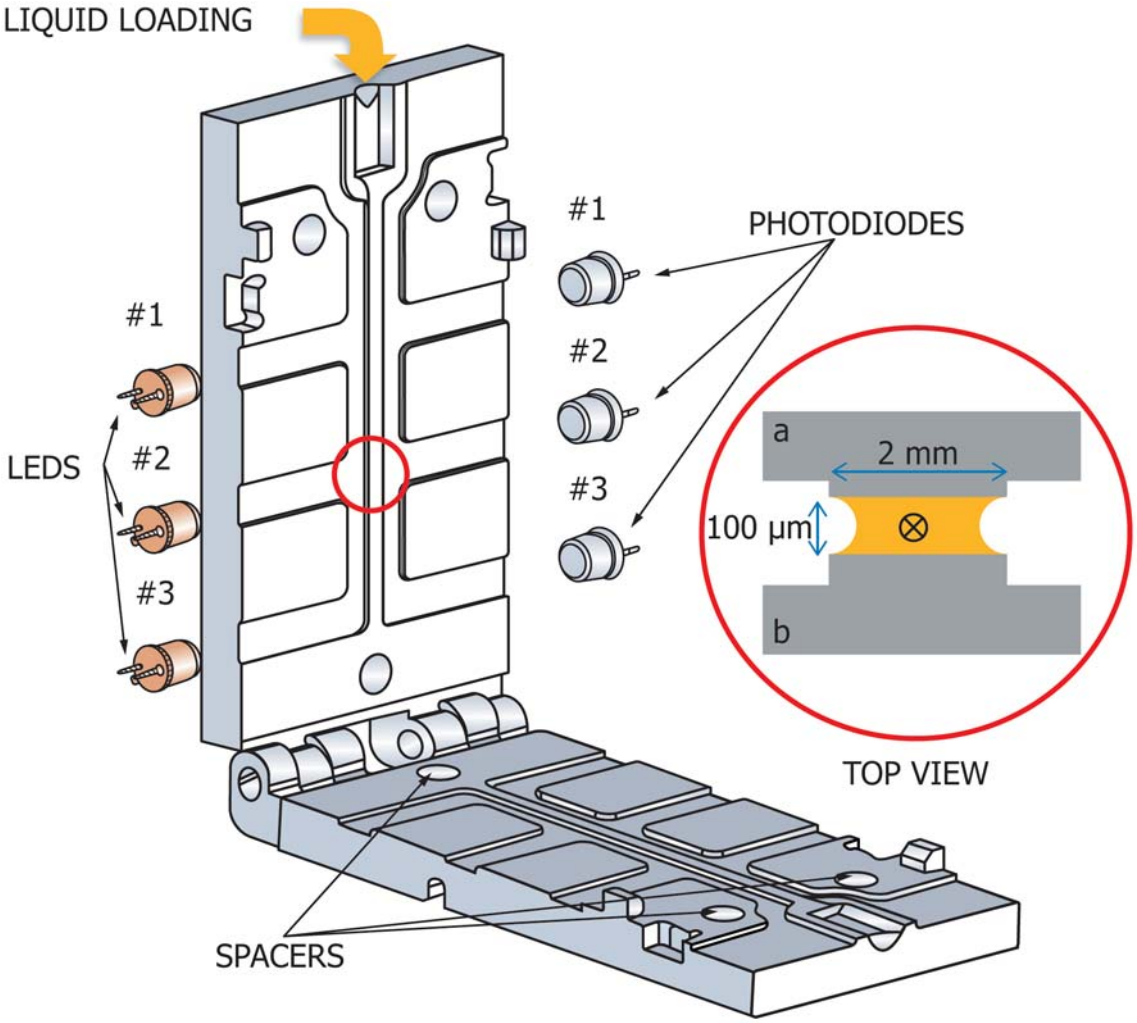

FIG. 1 Miniature Capillary Viscometer Schematic

3.2.3 *miniature capillary viscometer, n*—a viscometer, as shown in Fig. 1, which utilizes an unbounded microchannel capillary in order to enable the direct measurement of kinematic viscosity.

3.2.4 *unbounded microchannel capillary, n*—a rectangular channel, approximately 100 µm by 2 mm, which comprises the capillary for this test method.

3.2.4.1 *Discussion*—The channel, whose top view can be seen in Fig. 1, is unbounded because it is open to air on two sides. The sample stays in the capillary and does not leak through the unbounded portion due to the inherent surface tension at the boundary between the capillary and air. The capillary is repeatedly assembled for the purpose of the viscosity measurement and then disassembled immediately after the viscosity measurement to allow for cleaning. This is accomplished by having two mirror sides, which comprise the capillary, coupled by means of a clamshell arrangement. The integrity of the capillary is ensured by spacers which guarantee the distance between the two mirror sides when closing the clamshell.

4. Summary of Test Method

4.1 A liquid sample is placed into the loading funnel (see Fig. 1) of the miniature capillary viscometer and kinematic viscosity at 40 °C is determined by measuring the time in seconds (Δt) it takes this liquid to travel between the beam produced by LED (light-emitting diode) #1 and LED #3.

4.2 These times associated with the liquid passing each LED are determined by monitoring the voltage of the corresponding photodiodes: The starting time (t=0) is defined as when the operator initiates by means of button push the test sequence; a built-in clock then tracks the travel time. When the liquid enters the vicinity of the LED beam, the time, from the test starting time, at which the liquid is determined to have passed this beam is defined as the photodiode voltage falling by a factor of 0.5.

4.3 The liquid sample thermalizes rapidly to 40 °C as the entire unbounded microchannel capillary is constructed of aluminum which is stabilized at 40 °C. Thus when the 60 µL liquid is placed into the microchannel capillary it immediately