Designation: D 5293 – 04

An American National Standard

Standard Test Method for Apparent Viscosity of Engine Oils Between −5 and −35°C Using the Cold-Cranking Simulator[1]

This standard is issued under the fixed designation D 5293; 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 laboratory determination of apparent viscosity of engine oils by cold cranking simulator (CCS) at temperatures between −5 and −35°C at shear stresses of approximately 50 000 to 100 000 Pa and shear rates of approximately 10^5 to 10^4 s^{-1} and viscosities of approximately 500 to 25 000 mPa·s. The range of an instrument is dependent on the instrument model and software version installed. These results are related to engine-cranking characteristics of engine oils.

1.2 A special procedure is provided in Annex A1 for highly viscoelastic oils.

1.3 Procedures are provided for both manual and automated determination of the apparent viscosity of engine oils using the cold-cranking simulator.

1.4 A special manual procedure is provided in Annex A1 for highly viscoelastic oils.

1.5 The values stated in SI units are to be regarded as the standard.

1.6 *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 and health practices and determine the applicability of regulatory limitations prior to use.* Specific warning statements are given in 7.1, 7.2, 7.3, and Section 8.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 2602 Test Method for Apparent Viscosity of Engine Oils at Low Temperature Using the Cold-Cranking Simulator[3]

D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products

3. Terminology

3.1 *Definitions:*

3.1.1 *Newtonian oil or fluid*, *n*—one that exhibits a constant viscosity at all shear rates.

3.1.2 *non-Newtonian oil or fluid*, *n*—one that exhibits a viscosity that varies with changing shear stress or shear rate.

3.1.3 *viscosity*, η, *n*—the property of a fluid that determines its internal resistance to flow under stress, expressed by:

$$\eta = \tau/\dot{\gamma} \quad (1)$$

where:

τ = the stress per unit area, and

$\dot{\gamma}$ = the rate of shear.

3.1.3.1 *Discussion*—It is sometimes called the coefficient of dynamic viscosity. This coefficient is thus a measure of the resistance to flow of the liquid. In the SI, the unit of viscosity is the pascal-second; for practical use, a submultiple (millipascal-second) is more convenient and is customarily used. The millipascal second is 1 cP.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *apparent viscosity*, *n*—the viscosity obtained by use of this test method.

3.2.1.1 *Discussion*—Since many engine oils are non-Newtonian at low temperature, apparent viscosity can vary with shear rate.

3.2.2 *calibration oils*, *n*—oils with known viscosity and viscosity/temperature functionality that are used to define the calibration relationship between viscosity and cold-cranking simulator rotor speed.

3.2.3 *test oil*, *n*—any oil for which the apparent viscosity is to be determined by use of this test method.

3.2.4 *viscoelastic oil*, *n*—a non-Newtonian oil or fluid that climbs up the rotor shaft during rotation.

4. Summary of Test Method

4.1 An electric motor drives a rotor that is closely fitted inside a stator. The space between the rotor and stator is filled with oil. Test temperature is measured near the stator inner wall and maintained by regulated flow of refrigerated coolant through the stator. The speed of the rotor is calibrated as a

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.07 on Flow Properties.

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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] Withdrawn.

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

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