



Standard Test Method for Rotational Viscosity of Heavy Duty Diesel Drain Oils at 100°C¹

This standard is issued under the fixed designation D6895; 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 determination of the rotational viscosity and the shear thinning properties of heavy duty diesel engine drain oils at 100°C, in the shear rate range of approximately 10 to 300 s⁻¹, in the shear stress range of approximately 0.1 to 10 Pa and the viscosity range of approximately 12 to 35 mPa·s. Rotational viscosity values can be compared at a shear rate of 100 s⁻¹ by this test method.^{2,3}

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:⁴

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

D5967 Test Method for Evaluation of Diesel Engine Oils in T-8 Diesel Engine

D6299 Practice for Applying Statistical Quality Assurance and Control Charting Techniques to Evaluate Analytical Measurement System Performance

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

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 on Flow Properties.

Current edition approved Nov. 1, 2012. Published November 2012. Originally approved in 2003. Last previous edition approved in 2006 as D6895–06. DOI: 10.1520/D6895-06R12.

² Selby, K., “Rheology of Soot-thickened Diesel Engine Oils,” SAE 981369, May 1998.

³ George, H. F., Bardasz, E. A., and Soukup, B., “Understanding SMOT through Designed Experimentation Part 3: An Improved approach to Drain Oil Viscosity Measurements—Rotational Rheology,” SAE 97692, May 1997.

⁴ 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.

3.1.1 *maximum point time*—instrument setting that limits the amount of time the instrument will maintain a constant shear stress or shear rate before accepting the value as the equilibrium value.

3.1.2 *rate index*—the exponent, c , in these expressions relating shear rate and shear stress:

$$\text{shear stress} = b(\text{shear rate})^c \quad (1)$$

$$\ln(\text{shear stress}) = \ln b + c \ln(\text{shear rate}) \quad (2)$$

3.1.2.1 *Discussion*—A rate index of $c = 1$ signifies Newtonian fluid behavior. Values less than one indicate increasing non-Newtonian, shear thinning behavior.³

3.1.3 *rotational viscosity*—the viscosity obtained by use of this test method.

3.1.4 *VIS100 DEC*—rotational viscosity at shear rate of 100 s⁻¹, decreasing shear stress or shear rate sweep.

3.1.5 *VIS100 INC*—rotational viscosity at shear rate of 100 s⁻¹, increasing shear stress or shear rate sweep.

4. Summary of Test Method

4.1 The sample is placed in a controlled stress or controlled shear rate rheometer/viscometer at 100°C. The sample is presheared at 10 s⁻¹ for 30 s followed by heating at 100°C for 10 min. An increasing shear rate (approximately 10 to 300 s⁻¹) or shear stress (0.1 to 10 Pa) sweep is run followed by a decreasing sweep. The rotational viscosity for each step (increasing and decreasing) at 100 s⁻¹ shear rate is interpolated from the viscosity versus shear rate data table. The rate index, as a measure of shear thinning, is calculated from a plot of $\ln$ (shear stress) versus $\ln$ (shear rate).

5. Significance and Use

5.1 Rotational viscosity measurements allow the determination of the non-Newtonian, shear thinning property of drain oil. Rotational viscosity values can be compared at a shear rate of 100 s⁻¹ by this test method.^{2,3}

6. Apparatus

6.1 This test method uses rheometers/viscometers of the controlled stress or controlled rate mode of operation. The test method requires the use of concentric cylinder measuring geometry or cone and plate measuring geometries, with a