



Designation: D6895 – 21

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 s⁻¹ to 300 s⁻¹, in the shear stress range of approximately 0.1 Pa to 10 Pa and the viscosity range of approximately 12 mPa·s 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.3 *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:*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

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.

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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.

and Control Charting Techniques to Evaluate Analytical Measurement System Performance

3. Terminology

3.1 *Definitions:*

3.1.1 *shear rate, n*—the velocity gradient perpendicular to the direction of flow.

3.1.1.1 *Discussion*—For a Newtonian fluid in a concentric cylinder rotary viscometer in which the shear stress is measured at the inner or outer cylinder surface and ignoring any end effects, the shear rate is given as follows:

$$\dot{\gamma} = \frac{2\Omega R_o^2}{R_o^2 - R_i^2} \quad (1)$$

$$= \frac{4\pi R_o^2}{t(R_o^2 - R_i^2)}$$

where:

$\dot{\gamma}$ = shear rate at the surface of the rotor in reciprocal seconds, s⁻¹,

Ω = angular velocity, rad/s,

R_o = outer radius, mm,

R_i = inner radius, mm, and

t = time for one revolution of the rotor, s.

3.1.1.2 *Discussion*—For a fluid in a cone and plate viscometer in which the shear stress is measured in a controlled-stress or controlled strain mode of operation, the shear rate is given as follows:

$$\dot{\gamma} = \frac{\Omega}{B} \quad (2)$$

where:

$\dot{\gamma}$ = shear rate at the surface of the rotor or stator in reciprocal seconds, s⁻¹,

Ω = angular velocity, rad/s,

B = cone angle, rad.

3.1.2 *shear stress, n*—the force per unit area in the direction of the flow.

3.1.2.1 *Discussion*—For a Newtonian fluid in a concentric cylinder rotary viscometer in which the shear stress is measured at the inner or outer cylinder surface and ignoring any end effects, the shear stress is given as follows:

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