



Standard Test Method for Apparent Viscosity of Asphalt Emulsion Residues and Non-Newtonian Bitumens by Vacuum Capillary Viscometer¹

This standard is issued under the fixed designation D4957; 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 procedures primarily designed to determine the apparent viscosities of residues obtained by distilling asphalt emulsions according to Test Method D6997. It is also recommended for use on non-Newtonian asphalts at any temperature within the capability of the apparatus. This test method is useful in characterizing rheological properties of non-Newtonian bitumens as a function of shear rate under the conditions of the test method. This test is run in straight open-end tube viscometers, normally at 60°C (140°F), but is suitable for use at other temperatures. It is applicable over the range from 5 to 50 000 Pa·s (50 to 500 000 P).

NOTE 1—The precision for this test method is based on determinations made at 60°C (140°F).

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:²

D2171 Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer

D6997 Test Method for Distillation of Emulsified Asphalt

E1 Specification for ASTM Liquid-in-Glass Thermometers

E77 Test Method for Inspection and Verification of Thermometers

3. Terminology

3.1 Definitions:

¹ This test method is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.44 on Rheological Tests.

Current edition approved Jan. 1, 2008. Published February 2008. Originally approved in 1989. Last previous edition approved in 1995 as D4957 – 95 which was withdrawn March 2005 and reinstated in January 2008. DOI: 10.1520/D4957-08.

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.

3.1.1 *apparent viscosity*—the determined viscosity obtained by the test method under description. Viscosity is the resistance to deformation or internal friction of a liquid expressed as the ratio of the shear stress to shear rate, whether this ratio is constant or not. The unit of viscosity obtained by dividing the shearing stress in N/m² by the rate of shear in reciprocal seconds is called the pascal second (Pa·s). The English unit of viscosity is the poise (P) with dimensions of 0.1 N·s/m², (dynes/cm²/s) and is equivalent to 0.1 Pa·s.

3.1.2 *Newtonian liquid*—a liquid in which the rate of shear is proportional to the shearing stress. The constant ratio of the shearing stress to rate of shear is the viscosity of the liquid. If the ratio is not constant, the liquid is non-Newtonian.

NOTE 2—A power law fluid is a material in which the relation between the log of the shear stress is linear with the log of the shear rate. The slope of this relation is called the shear susceptibility, C . If C is less than unity, the material is classified as pseudoplastic and the apparent viscosity decreases with increased stress. If C is greater than one, the material is dilatant and the apparent viscosity increases with stress. If C is unity the material shows Newtonian flow. Most real materials show some non-Newtonian behavior and the apparent viscosity, computed as stress divided by the shear rate, is reported.

3.1.3 *rheogram*—a rheological diagram which shows how the apparent viscosity of a material varies with the shear rate. An apparent viscosity at a specific shear rate, normally 1 s⁻¹ can be estimated from this plot. A typical rheogram with an example is shown in Fig. 1.

4. Summary of Test Method

4.1 The time is measured for a fixed volume of the liquid to be drawn up through a straight open-end capillary tube by means of vacuum, under closely controlled conditions of vacuum and temperature. The apparent viscosity in poises is calculated by multiplying the flow time in seconds by the appropriate viscometer calibration factor or calculated viscometer constant.

5. Significance and Use

5.1 This test method is useful for characterizing the flow behavior of asphalt emulsion residues and non-Newtonian bitumens. However, since non-Newtonian viscosity values depend on the level of shearing stress, its duration, and the shear history of the material, a non-Newtonian viscosity is not