INTERNATIONAL

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Standard Test Method for Apparent Viscosity of Hot Melt Adhesives and Coating Materials[1]

This standard is issued under the fixed designation D3236; 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 apparent viscosity of hot melt adhesives and coating materials compounded with additives and having apparent viscosities up to 200 000 millipascal second (mPa·s) (Note 3) at temperatures up to 175 °C (347 °F).

NOTE 1—Although precision has not been studied, this procedure may be adaptable to viscosities higher than the present 200 000 mPa·s limit and temperatures above 175 °C (347 °F). Equipment described in this test method permits testing of materials having viscosities as high as 16×10^6 mPa·s and provides temperatures up to 260 °C (500 °F).

NOTE 2—For petroleum waxes and their blends having apparent viscosities below 15 mPa·s, Test Method D445 is especially applicable.

NOTE 3—One pascal second (Pa·s) = 1000 centipoise (cP); one millipascal-second = one centipoise.

1.2 The values stated in SI units are to be regarded as the standard. The values in parentheses are for information only.

1.3 *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.*

1.4 *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)

3. Terminology

3.1 *Definitions:*

3.1.1 *apparent viscosity, n*—the viscosity determined by this test method and expressed in millipascal seconds. Its value may vary with the spindle and rotational speed selected because many hot melts are non-Newtonian.

3.1.2 *viscosity, n*—the ratio of shear stress to shear rate. The viscosity of a liquid is a measure of the internal friction of the liquid in motion. The unit of dynamic viscosity is the pascal second. For a Newtonian liquid, the viscosity is constant at all shear rates. For a non-Newtonian liquid, viscosity will vary depending on shear rate.

4. Summary of Test Method

4.1 A representative sample of the molten material to be tested is maintained in a thermally controlled sample chamber. Apparent viscosity is determined under temperature equilibrium conditions using a precision rotating spindle type viscometer. Data obtained at several temperatures can be plotted on appropriate semi-logarithmic graph paper and apparent viscosity at intermediate temperatures can be estimated.

5. Significance and Use

5.1 This test method distinguishes between hot melts having different apparent viscosities. It is believed that apparent viscosity determined by this procedure is related to flow performance in application machinery operating under conditions of low shear rate. Apparent viscosity as determined by this test method may not correlate well with end-use applications where high shear rates are encountered.

5.2 Materials of the type described in this procedure may be quite non-Newtonian and as such, the apparent viscosity will be a function of shear rate under the conditions of test. Although the viscometer described in this test method generally operates under conditions of relatively low shear rate, differences in shear effect can exist depending upon the spindle and rotational speed conditions selected for the test program. Maximum correlation between laboratories, therefore, depends upon testing under conditions of equivalent shear.

[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 D02.10.0A on Physical/Chemical 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.

6. Apparatus

6.1 *Viscometer, Concentric Cylinder Rotational*—The essential instrumentation required providing the minimum rational viscometer analytical capabilities include:

6.1.1 *Drive motor,* to apply a unidirectional rotational displacement to the specimen at a rate of 0.5 r/min to 60 r/min constant to ±1 %.

6.1.2 *Force sensor,* to measure the torque developed by the specimen in response to the rotational displacement.

6.1.3 *Coupling shaft,* or other means to transmit the rotational displacement from the motor to the specimen.

NOTE 4—It is helpful to have a mark on the shaft to indicate appropriate test fluid level.

6.1.4 *Stainless steel rotational element, spindle, or tool,* for the type shown in Fig. 1 to fix the specimen between the draft shaft and a stationary position.

6.1.5 *Data collection device,* to provide a means of acquiring, storing, and displaying measured or calculated signals, or both. The minimum output signals required for rotational viscometry are torque, rotational speed, temperature, and time.

NOTE 5—Manual observation and recording of data are acceptable.

6.1.6 *Temperature measuring device,* to provide an indication of the specimen temperature over their range of 100 °C to 200 °C to within ±0.2 °C.

6.1.7 *Stand,* to support, level, and adjust the height of the drive motor, shaft and rotational element.

6.1.8 *Specimen container,* fitted with an insulated cover, to contain the test specimen during testing.

6.1.9 Auxiliary instrumentation considered necessary or useful in conducting this method includes:

6.1.9.1 Data analysis capability to provide viscosity, stress, or other useful parameters derived from measured signals.

6.1.9.2 Level to indicate the vertical plumb of the drive motor, shaft, and rotational element.

6.1.9.3 A guard to protect the rotational element from mechanical damage.

6.2 *Temperature Bath* and precision proportional temperature controller[3] that provides a controlled isothermal temperature environment over the range of 100 °C to 200 °C (212 °F to 392 °F) constant to accuracy of ±1.0 °C (1.8 °F).

6.3 *Graph paper,* semi-logarithmic.

7. Calibration

7.1 The viscometer is precalibrated using Newtonian fluids by the manufacturer. No zero adjustment is provided, since experience has shown that the zero point will not vary due to changes in the torque sensor. The viscometer and spindles are precision equipment and should be kept from undue shock and mishandling. Physical damage to the instrument will often reveal itself as erratic torque indication or no oscillation of the shaft when the instrument, with or without the spindle in place, is operated in air. When operating normally, the torque indication will be stable and have free oscillation about the zero point in air.

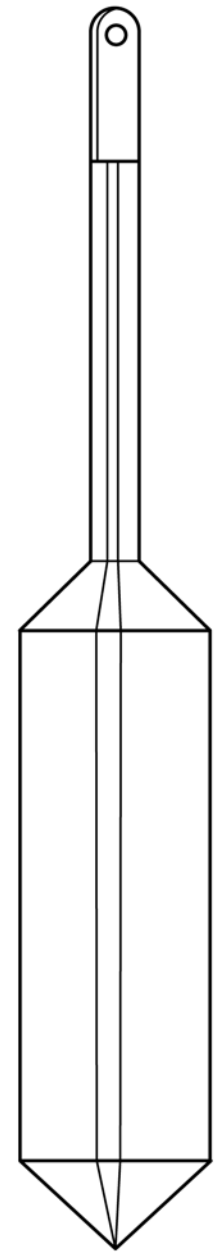

FIG. 1 Spindle Configuration

7.2 The instrument may be further calibrated using standard reference fluids. Suitable fluids are available in nominal viscosities up to 15 000 mPa·s at 149 °C (300 °F).[4] The procedure for instrument calibration using standard reference

[3] The sole source of supply of the temperature controller known to the committee at this time is Athena Controls, Inc., 2 Union Rd., West Conshohocken, PA 19428. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

[4] The sole source of supply of the calibration fluids known to the committee at this time is Brookfield Engineering Laboratories, Inc., Stoughton, MA 02072 or Cannon Instrument Co., P. O. Box 16, State College, PA 16801. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.