



SURFACE VEHICLE RECOMMENDED PRACTICE

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Method of Viscosity Test for Automotive Type Adhesives,
Sealers, and Deadeners

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Documents

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1. **Scope**—This SAE Recommended Practice contains a series of test methods for use in measuring the viscosity of automotive-type adhesives, sealers, and deadeners.

The test methods which are contained in this document are as follows:

- 1.1 Brookfield® Method
- 1.2 Castor-Severs Rheometer or Pressure Flowmeter
- 1.3 Penetrometer
- 1.4 Capillary Rheometer
- 1.5 Plate Rheometers

2. **References**

- 2.1 **Applicable Documents**—The following publications form a part of this specification to the extent specified herein.

- 2.1.1 ANSI/ASME PUBLICATION—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI/ASME B40.1—Pressure Gauge

- 2.1.2 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 5—Needle Penetrometer

ASTM D 217—Cone Penetrometer

ASTM D 1823—Standard Test Method for Apparent Viscosity of Plastics and Organosols at High Shear Rates by Extrusion Viscometer

ASTM D 1824—Standard Test Method for Apparent Viscosity of Plastics and Organosols at Low Shear Rates

ASTM D 2196—Standard Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield®) Viscometer

ASTM D 2240—Durometer

ASTM D 3364—Standard Test Method for Flow Rates for Poly(Vinyl Chloride) and Rheologically Unstable Thermoplastics

ASTM D 3835—Standard Test Method for Determination of Properties of Polymeric Materials by Means of a Capillary Rheometer

ASTM D 4440—Standard Practice for Rheological Measurement of Polymer Melts Using Dynamic Mechanical Procedures

3. **Principle of Methods**—The viscosity of a material is a measurement of the shear stress that must be applied before a change of form (shear rate) can be accomplished. For the purpose of this test method, however, viscosity refers to a finished product parameter that is quantified in various ways and used by the automotive industry as a means of identifying and assigning a minimum and maximum value for the application characteristics of a material.

The use of these values should be tempered by the knowledge that the numbers generated are quality control aids and may not fully address the plant-to-plant variations encountered in application systems.

Each piece of equipment is best suited to a particular viscosity and shear rate range, although there are no sharp viscosity demarcations between the various viscometers. Each method has its own idiosyncrasies and limitations and therefore must be evaluated with the particular material being tested. The rheometers (1.4 and 1.5) have the ability to compare results under a range of conditions, and thus determine the sensitivity of the material to shear rate, shear history, and temperature. The following suggestions are intended as general guidelines for use of these viscosity measuring devices. They may be used outside the suggested ranges if desired.

Generally, a Brookfield® viscometer is used for low viscosity materials in the 0.025 to 200 Pa·s (Pa·s = 1000 cP) range with limited shear thinning. The pressure flowmeter is usually used for materials with viscosities up to 80 Pa·s at 50 s⁻¹. Since these materials are highly shear thinning they may exceed 1000 Pa·s at 1 s⁻¹. The penetrometer is used for very high viscosity materials such as putties and highly gelled compounds.

The capillary rheometer is used for materials from 1 to 10 000 Pa·s at shear rates from 10 to 50 000 s⁻¹. The plate rheometers are used for materials from 0.025 to 1000 Pa·s at shear rates from 10⁻⁷ to 200 s⁻¹.

4. **Sample Temperature Conditioning**—Prior to the actual viscosity measurement, the sample to be tested must be conditioned thermally.
- 4.1 **As Received Viscosity**—Unless specified otherwise, as received viscosity shall refer to material stored at "room temperature" and tested at 23 °C ± 1 °C (75 °F ± 2 °F) and 50% ± 5% R.H.
- 4.2 **Aged Viscosity**—Aged viscosity refers to a value obtained by subjecting a sample prior to testing to a specified temperature for 72 h. The sample is then conditioned to 23 °C ± 1 °C and the viscosity is measured. The size of the sample to be tested should be 500 mL (1 pt). Samples smaller than this conditioned at elevated temperatures may give different results.
5. **Sample Mechanical Conditioning**—Prior to the actual viscosity measurement, the sample to be tested must be conditioned mechanically.
- 5.1 **Conditioning Method A—Unagitated**—Unagitated testing refers to the transfer of materials from the shipping container to the testing apparatus with the minimum amount of agitation. This viscosity is supposed to be indicative of a compound in its shipping container prior to use. The tester should be aware that the very act of removing a sample for test can affect the rheology of thixotropic materials and, in so doing, may substantially alter the value measured.

5.2 Conditioning Method B—Moderate Agitation—Moderate agitation of a sample is achieved by stirring a 500 mL sample 50 stirs in 60 s with a 25 x 150 mm (1 x 6 in) steel bladed spatula. This agitation can also be used to assure the uniform 23 °C necessary for testing.

5.3 Conditioning Method C—Grease Working—Grease working refers to subjecting a sample to 150 cycles, unless otherwise specified, in a standard mechanical grease-worker, as outlined in ASTM D 217.

5.4 Conditioning Method D—Pre-shear—Steady shear rheometers including Brookfield® and Plate devices allow the sample to be pre-sheared at a fixed shear rate for a known time before testing. Ten s⁻¹ for 10 min is a suggested condition.

6. Brookfield® Method

6.1 Application—This procedure is used to determine the viscosity of adhesives, sprayable sound deadeners, and thin body sealers. The values obtained are expressed in Pa•s (Pa•s = 1000 cP) and are a measure of the resistance a rotating spindle encounters when immersed in the compound to be tested. Due to secondary flows, this method provides only relative values for shear thinning materials. Refer to ASTM D 1824 and ASTM D 2196 for additional details and reproducibility data.

6.2 Equipment—Commercially available Brookfield® Viscometer (see Figure 1), or equivalent.

6.3 Procedure—Test equipment and sample shall be maintained at 23 °C ± 1 °C.

6.3.1 Set viscometer at specified rpm.

6.3.2 Attach specified spindle.

6.3.3 Lower viscometer into 500 mL of test material so that the groove cut in the spindle is flush with the fluid's level.

6.3.4 Level the viscometer.

6.3.5 Depress the clutch, turn on the viscometer, and release the clutch. Take the reading and record the time after the indicator has stabilized or after a specified time, typically 60 s. (When measuring thixotropic materials at specific times, other than stable readings, it will be necessary to test separate samples in order to obtain reproducible values.)

6.3.6 Use conversion table to convert to centipoise.

6.3.7 Take the average of three readings and report the viscosity, spindle, rpm, time of recording, and the model of the viscometer used.

6.3.8 Repeat the procedure at a second rpm, and note extent of shear thinning. (Note that Brookfield® results are a relative measure for thixotropic or shear thinning materials.)

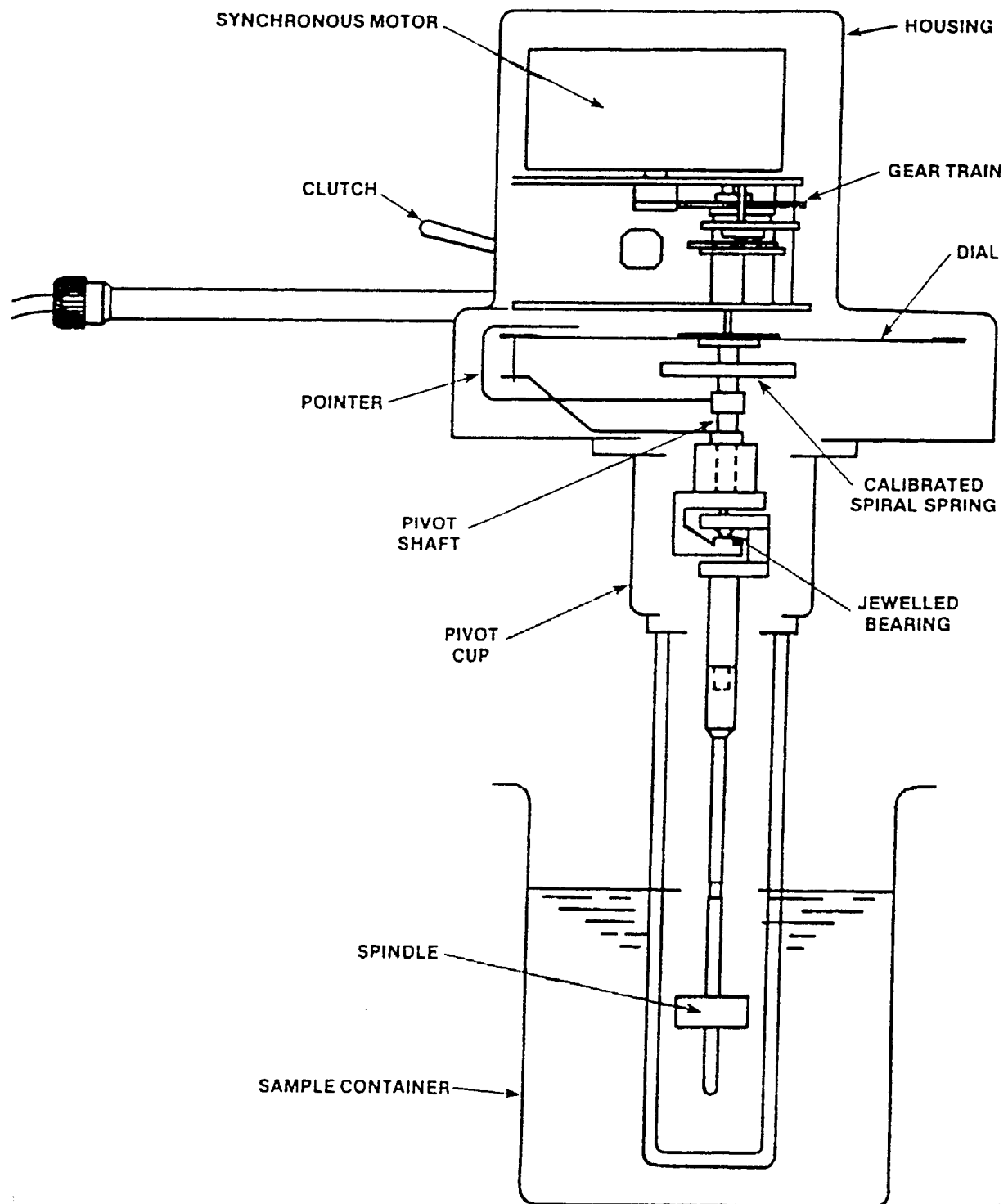


FIGURE 1—BROOKFIELD® VISCOMETER