Designation: D4287 – 00 (Reapproved 2019)

Standard Test Method for High-Shear Viscosity Using a Cone/Plate Viscometer[1]

This standard is issued under the fixed designation D4287; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This test method covers the determination of the viscosity of paints, varnishes, and related products at a rate of shear of 12 000 s^{-1}.

1.2 Paints and varnishes that dry very rapidly may not give reproducible results with this test method. Measurements made at elevated temperatures may also give poor precision due to loss of volatiles and to drying.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *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.*

1.5 *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]

D1210 Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage

D3925 Practice for Sampling Liquid Paints and Related Pigmented Coatings

D4958 Test Method for Comparison of the Brush Drag of Latex Paints

3. Summary of Test Method

3.1 The material to be tested is placed between the cone and plate of a cone/plate viscometer, then subjected to a high shear rate while the viscosity is determined.

4. Significance and Use

4.1 The viscosity value obtained by this test method gives information about the flow properties of the material under high-shear conditions similar to those encountered during application: brushing (see Test Method D4958), spraying, electrostatic disk, or roll coating.

4.2 This test method is suitable for all paints and varnishes whether they are Newtonian in behavior or not. However, due to the narrow gap between the stationary and rotary parts of high-shear viscometers, this test method is more reproducible for paints having finer pigment dispersions as determined by Test Method D1210.

5. Apparatus

5.1 *Cone/Plate Type Viscometer,* with cone/speed combination producing a rate of shear of 12 000 s^{-1}. The viscometer must provide a viscosity measurement rage of either 0 to 10 (P) or 0 to 5 (P) at the above mentioned shear rate. With higher viscosity materials, other cones and speeds may be used upon agreement between the producer and the user, but it should be noted that these may give lower shear rates not truly representative of application conditions. Refer to Fig. 1 and Fig. 2 of an analog and digital cone and plate viscometer.

NOTE 1—The SI units for viscosity are pascal-seconds (Pa·s = 10 P, 1 mPa·s = 1 cP).

6. Reagents and Materials

6.1 *Water or Solvent*—The viscometer should be zeroed according to the manufacturer's specification. Zeroing procedures that require liquid may be satisfied with water or a low viscosity solvent such as xylene or mineral spirits.

[1] This test method is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.24 on Physical Properties of Liquid Paints & Paint Materials.

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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.

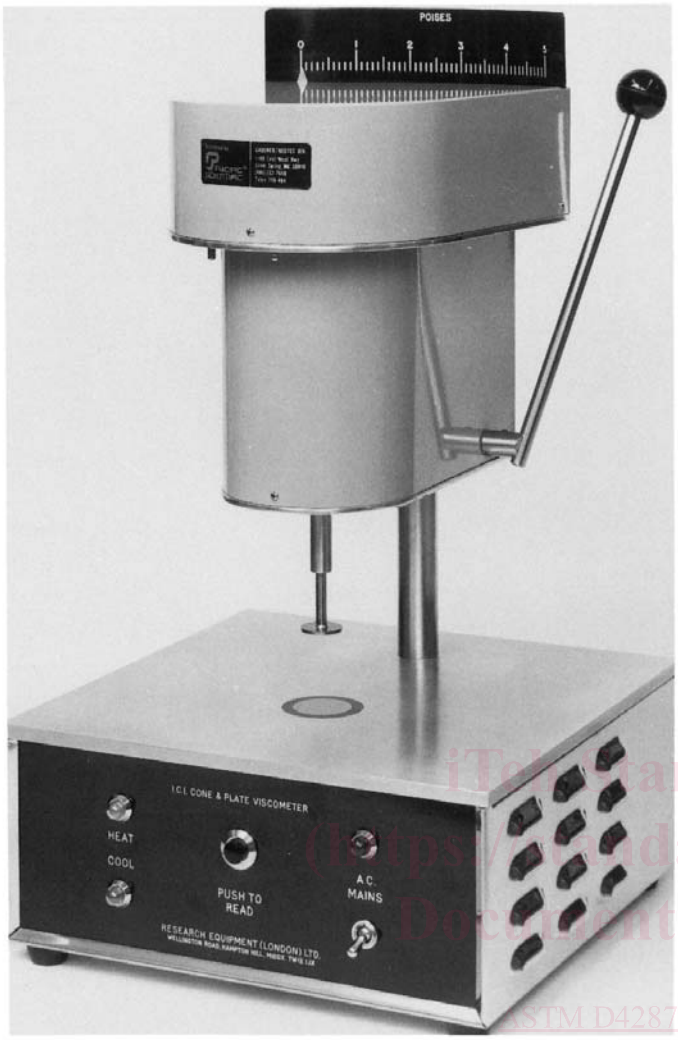

FIG. 1 Analog Cone and Plate Viscometer

FIG. 2 Digital Cone and Plate Viscometer

6.2 *Mineral Oils*—Three standard mineral oils with known viscosities (certified by an approved laboratory) lying between 10 and 90 % of full scale to be used for calibrating the instrument.[3]

NOTE 2—Silicone oils should be avoided because of their tendency to contaminate instruments, containers and other equipment and because of the possibility of shear thinning behavior at high shear rates.

7. Sampling

7.1 Take a representative sample of the product to be tested in accordance with Practice D3925. If the sample has a tendency to settle or separate on standing, it must be stirred or shaken until homogeneous before a test specimen is taken from it. The specimen must be free of any foreign matter or air bubbles and its volume must be sufficient to cover the portion of the viscometer plate under the cone when the latter is brought into contact with the plate.

8. Preparation of Apparatus

8.1 The viscometer should be zeroed on a daily basis when in regular use or otherwise before use, according to the viscometer operating manual. With the analog-type viscometer, if the pointer does not indicate zero, it may be adjusted by means of a lever on the left-hand side of the upper part of the instrument housing. If the instrument cannot be zeroed, adjustment should take place according to the manufacturer's suggestions.

8.2 Verify the calibration of the apparatus by following the procedure in Section 9, but using standard refined mineral oils having Newtonian characteristics and known viscosities. If the viscometer reads the correct viscosity (or within 5 % of that value) with two or more oils whose viscosities bracket those of specimens to be tested, then the viscometer readings may be used as is. If the viscometer readings do not give the correct viscosities for the oils, then a calibration curve must be constructed by taking viscometer readings for three oils and plotting measured viscosity versus specified (correct) viscosity for the oils. Subsequent measurements are corrected to true viscosities through use of the curve.

8.3 Check the cones periodically for wear. Replace any cone that shows a definite flattening of the apex. Some users have found it necessary to replace cones every year. Others have had to do so more often when abrasive paints or pastes were being tested.

8.4 The determination must be made at a closely controlled temperature of 25 ± 0.3°C, unless otherwise agreed. In order to check the temperature control, carry out the test as outlined

[3] Such oils are available from The Cannon Instrument Co., P.O. Box 16, State College, PA 16801.