



Designation: D1823 – 24

Standard Test Method for Apparent Viscosity of Plasticsols and Organosols at High Shear Rates by Extrusion Viscometer¹

This standard is issued under the fixed designation D1823; 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 measurement of plastisol and organosol viscosity at high shear rates by means of an extrusion viscometer.

1.2 Apparent viscosity at low shear rates is covered in Test Method [D1824](#).

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

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.*

NOTE 1—This standard and ISO 4575-2007 address the same subject matter, but differ in technical content.

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

[D883 Terminology Relating to Plastics](#)

[D1475 Test Method for Density of Liquid Coatings, Inks, and Related Products](#)

[D1755 Specification for Poly\(Vinyl Chloride\) Resins](#)

[D1824 Test Method for Apparent Viscosity of Plasticsols and Organosols at Low Shear Rates](#)

[E1 Specification for ASTM Liquid-in-Glass Thermometers](#)

[E456 Terminology Relating to Quality and Statistics](#)

[E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method](#)

[E2935 Practice for Evaluating Equivalence of Two Testing Processes](#)

2.2 ISO Standard:

[ISO 4575-2007 Poly Vinyl Chloride Pastes—Determination of Apparent Viscosity Using the Severs Rheometer](#)³

3. Terminology

3.1 For definitions of terms used in this test method and associated with plastics issues refer to the terminology contained in [D883](#).

3.2 For terms relating to precision and bias and associated issues, the terms used in this test method are in accordance with the definitions in Terminology [E456](#).

3.3 Definitions:

3.3.1 *organosol*, *n*—a suspension of a finely divided polymer in a plasticizer, together with a volatile organic liquid.

3.3.2 *plasticizer*, *n*—a substance incorporated in a material to increase its workability, flexibility, or distensibility.

3.3.3 *plastisol*, *n*—a liquid suspension of a finely divided PVC polymer or copolymer in a plasticizer.

3.3.4 *poly(vinyl chloride)*, *n*—a polymer prepared by the polymerization of vinyl chloride as the sole monomer (vinyl chloride content in monomer not less than 99 %).

3.3.5 *viscosity*, *n*—the property of resistance of flow exhibited within the body of a material.

3.3.5.1 *Discussion*—In testing, the ratio of the shearing stress to the rate of shear of a fluid. Viscosity is usually taken to mean “Newtonian viscosity,” in which case the ratio of shearing stress to rate of shearing strain is constant. In non-Newtonian behavior which is the usual case with plastics materials, the ratio varies with the shearing rate. Such ratios are often called the “apparent viscosities” at the corresponding shear rates. (See **viscosity coefficient**.) (IUPAC symbol: η .) (ISO)

¹ This test method is under the jurisdiction of ASTM Committee [D20](#) on Plastics and is the direct responsibility of Subcommittee [D20.15](#) on Thermoplastic Materials (Section D20.15.08).

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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.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

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

4. Summary of Test Method

4.1 The sample is conditioned to the proper temperature, placed into an extrusion chamber, and extruded under standard conditions. The viscosity is calculated from the extrusion pressure and the rate of flow through the orifice.

5. Significance and Use

5.1 The suitability of a dispersion resin for any given application is dependent upon its viscosity characteristics.

5.2 The extrusion viscosity defines the flow behavior of a plastisol or organosol under high shear. This viscosity relates to the conditions encountered in mixing, pumping, knife coating, roller coating, and spraying processes.

6. Apparatus

6.1 *Extrusion Rheometer*.⁴

6.2 *Orifice*, 3.17 ± 0.13 mm (0.125 ± 0.005 in.) inside diameter and 50 ± 1.0 mm (1.97 ± 0.04 in.) long.

6.3 *Sample Containers, Tin Cans, or Glass Jars*, 1-pt (500-mL) capacity.

6.4 *Paper Cups*, 8-oz (250-mL) capacity.

6.5 *Nitrogen Cylinder*, equipped with pressure regulator and gage.

6.6 *Thermometer*—ASTM Solvents Distillation Thermometer having a range from -2 to $+52^{\circ}\text{C}$ (28 to 126°F) and conforming to the requirements for Thermometer 37C as prescribed in Specification E1. Use of temperature measuring devices such as liquid-in-glass thermometers, thermocouples, or platinum resistance thermometers having equivalent or better accuracy and precision, while covering the temperature range of Thermometer 37C shall be permitted. (**Warning**—Thermometers referenced in Specification E1 contain mercury, mercury thallium eutectic alloy, or toluene or other suitable liquid colored with a permanent red dye. Mercury has been designated by EPA and many state agencies as a hazardous material that can cause central nervous system, kidney and liver damage. Mercury, or its vapor, may be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury containing products. See the applicable product Safety Data Sheet (SDS) for details and EPA's website- <http://www.epa.gov/mercury/faq.htm> - for additional information. Users should be aware that selling mercury and/or mercury containing products into your state may be prohibited by state law.)

6.7 *Timer*.

7. Conditioning

7.1 Maintain the plastisol or organosol samples at $23 \pm 1^{\circ}\text{C}$ ($73 \pm 2^{\circ}\text{F}$) and 50 ± 10 % relative humidity at all times after mixing and throughout the period of viscosity determinations.

⁴ The described apparatus is known as Burrell Severs, Model A-120 extrusion rheometer, which is no longer manufactured by Burrell Scientific. The equipment is still widely available in the market place and suppliers of comparable equipment are under consideration. 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.

8. Procedure

8.1 *Set Up Rheometer*—Attach the pressure regulator to the nitrogen tank. Connect the nitrogen supply to the rheometer by means of the copper tubing. Do not use oxygen or liquid pressure sources (Note 2). Set the three-way quick-acting valve to the IN position. Regulate the tank pressure to give 1.04 MPa (150 psi) pressure to the instrument. Do not use input or line pressure over 1.38 MPa (200 psi). Insert the medium-size orifice (approximately 3.2 mm ($\frac{1}{8}$ in.) inside diameter) in the orifice retaining cap, with the orifice and the barrel, then screw the cap solidly in place. Mount the barrel in the instrument.

NOTE 2—Air may be used instead of nitrogen.

8.2 Weigh four empty paper cups for each sample to be tested. Record tare weight of each cup to the nearest 0.1 g. Fill the barrel with the sample to be tested to within 13 mm ($\frac{1}{2}$ in.) from the top of the barrel. Measure the sample temperature.

8.3 Insert the top air cap and gasket into the air cap ring, screw it in place on top of the barrel, and connect the air supply quick-connector.

8.4 Set the rheometer regulator gage (on the right side of the instrument) to 0.069 MPa (10 psi) pressure. Open the three-way quick-acting valve to the OUT position and allow the mix to extrude into an unweighed paper cup for 10 s. Adjust the gage pressure back to 0.069 MPa (10 psi).

8.5 Quickly place a preweighed and labeled paper cup under the nozzle and at the same time start the timer. Collect the extrudate until approximately 50 g of sample have entered the cup. Simultaneously remove the cup and stop the timer, again placing the unweighed cup under the nozzle. (Use a maximum flow time of 200 s for extremely viscous samples.)

8.6 Push the three-way quick-acting valve to the IN position to turn off the nitrogen supply to the chamber.

8.7 Record the extrudate weight to the nearest 0.1 g and efflux time to the nearest second.

8.8 Increase the gage pressure to 0.28 MPa (40 psi) and repeat 8.4 – 8.7. Increase to 0.48 MPa (70 psi) and repeat. Make a fourth determination at 0.69 MPa (100 psi). Report the exact efflux time for each determination. After all tests have been completed, turn off the nitrogen supply at the tank. Release the pressure in the instrument by pulling the three-way valve to the OUT position.

8.9 Clean the orifice between runs using pipe cleaners that have been wetted with mineral spirits. Take care that the inner surface of the orifice does not become scratched. After rinsing with mineral spirits, dry the orifice in air.

9. Calculation

9.1 Calculate the shear stress, shear rate, and viscosity as follows:

$$\text{Shear stress, MPa (or psi)} = PR/2L \quad (1)$$

where:

P = pressure in rheometer, MPa (or psi),

R = radius of orifice, cm (in.), and

L = length of orifice, cm (in.)