Designation: D 1824 – 95 (Reapproved 2002)

# Standard Test Method for Apparent Viscosity of Plastisols and Organosols at Low Shear Rates[1]

This standard is issued under the fixed designation D 1824; 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 Department of Defense.*

## 1. Scope

1.1 This test method covers the measurement of plastisol and organosol viscosity at low shear rates.

1.2 Apparent viscosity at high shear rates is covered in Test Method D 1823.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are 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 and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—This test method resembles ISO 3219-1977 in title only. The content is significantly different.

## 2. Referenced Documents

2.1 *ASTM Standards:*

D 1755 Specification for Poly(Vinyl Chloride) Resins[2]

D 1823 Test Method for Apparent Viscosity of Plastisols and Organosols at High Shear Rates by Extrusion Viscometer[2]

E 1 Specification for ASTM Thermometers[3]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[4]

2.2 *ISO Standard:*

ISO 3219-1977: Polymers in the Liquid, Emulsified, or Dispersed State—Determination of Viscosity With a Rotational Viscometer Working at a Defined Shear Rate[5]

## 3. Summary of Test Method

3.1 The sample is conditioned to the proper temperature and its viscosity is determined.

## 4. Significance and Use

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

4.2 The viscosity defines the flow behavior of a plastisol or organosol under low shear. This viscosity relates to the conditions encountered in pouring, casting, molding, and dipping processes.

## 5. Apparatus

5.1 *Viscometer.*[6]

5.2 *Sample Containers, Tin Cans, or Glass Jars*, 1-pt (500-mL) capacity. Minimum dimensions of containers should be 80-mm (3.15-in.) inside diameter by 80 mm (3.15 in.) deep.

5.3 *Thermometer*, ASTM Solvents Distillation Thermometer having a range from − 2 to + 52°C (28 to 126°F) and conforming to the requirements for Thermometer 37C as prescribed in Specification E 1.

5.4 *Timer*.

## 6. Conditioning

6.1 Maintain the plastisol or organosol samples at 23 ± 1°C (73 ± 2°F) and 50 ± 5 % relative humidity at all times after mixing and throughout the period of viscosity determinations.

## 7. Procedure

7.1 Select a spindle that will read in the middle or upper portion of the viscometer dial at the highest rotational speed to be used. Insert the spindle into the sample at approximately a 45° angle. Withdraw the spindle and attach it to the viscometer. Taking care not to entrap an air bubble, lower the viscometer to immerse the spindle near the edge of the sample. Move the sample so as to center the spindle. Adjust its depth to the immersion mark.

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[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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This edition contains changes in Sections 1, 2, and 11 to include an ISO equivalency statement, to reference a high shear rate test method, and to include Keywords.

[2] *Annual Book of ASTM Standards*, Vol 08.01.

[3] *Annual Book of ASTM Standards*, Vol 14.03.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

[5] Available from American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.

[6] Brookfield model RVF or LVF, or equivalent has been found satisfactory for this purpose. Brookfield Engnrg. Labs, Inc., Stoughton, MA 02072.

7.2 Start the viscometer at its lowest speed. Allow it to run 2 min. Record the scale reading during the next rotation. Without stopping the viscometer, switch to the next higher speed. Record the scale readings after 2 min at each speed in order from the lowest to the highest speeds.

7.3 Record the sample temperature at the conclusion of viscosity readings.

## 8. Calculation

8.1 Calculate the viscosity using the factors provided with the viscometer.

## 9. Report

9.1 Report the following information:

9.1.1 Complete sample identification.

9.1.2 Temperature of the sample.

9.1.3 Viscometer model and spindle number used for test.

9.1.4 Viscosity at each spindle speed used.

9.1.5 Sample conditioning time.

NOTE 2—If only one viscosity is to be reported, record as the viscosity, the poises at 20 rpm for Model RVF, or at 60 rpm for Model LVF, together with the aging period, viscometer model and spindle number, for example, "Viscosity, 20 rpm, 2-h aging, Model RVF, No. 6 spindle = *X* poises." In all cases when only one value is reported, the test shall be run at each of the speeds in the order indicated in the procedure.

## 10. Precision and Bias [7]

10.1 Table 1 and Table 2 are based on a round robin conducted in 1983 involving six PVC dispersion resins tested by five laboratories at 2 RPM and 20 RPM. For each resin, all the samples were prepared at one source, but the individual plastisols were prepared according to Specification D 1755 at the laboratories which tested them. Each test result consisted of one individual determination at the stated RPM. Each laboratory obtained five test results for each resin at 2 RPM and 20 RPM.

**TABLE 1 Precision of Viscosity Data at 2 RPM**

| | Average Viscosity | Values expressed as % of the Average | | | |
|---|---|---|---|---|---|
| Resin | (Poises) | $\nu_r$ [A] | $\nu_R$ [B] | $r$ [C] | $R$ [D] |
| I | 33.20 | 8.1 | 12.0 | 22.7 | 33.7 |
| IV | 62.00 | 4.2 | 13.7 | 11.8 | 38.4 |
| II | 141.76 | 8.2 | 31.0 | 23.0 | 86.7 |
| V | 197.04 | 13.2 | 44.4 | 37.0 | 124.2 |
| III | 265.36 | 18.6 | 35.9 | 52.1 | 100.6 |
| VI | 607.68 | 23.6 | 45.1 | 66.1 | 126.3 |

[A] $\nu_r$ is the within-laboratory coefficient of variation of the average.
[B] $\nu_R$ is the between-laboratories coefficient of variation of the average.
[C] $r$ is the within-laboratory Repeatability Limit ( = 2.8 $\nu$r).
[D] $R$ is the between-laboratories Reproducibility Limit ( = 2.8 $\nu$R).

**TABLE 2 Precision of Viscosity Data at 20 RPM**

| | Average Viscosity | Values expressed as % of the Average | | | |
|---|---|---|---|---|---|
| Resin | (Poises) | $\nu_r$ [A] | $\nu_R$ [B] | $r$ [C] | $R$ [D] |
| V | 24.72 | 8.5 | 12.1 | 23.8 | 34.0 |
| IV | 38.36 | 3.9 | 12.8 | 10.9 | 35.8 |
| II | 82.24 | 6.3 | 26.8 | 17.6 | 74.9 |
| I | 92.52 | 6.9 | 14.5 | 19.3 | 40.6 |
| III | 102.40 | 11.8 | 22.6 | 33.0 | 63.2 |
| VI | 226.05 | 11.6 | 27.1 | 32.5 | 75.9 |

[A] $\nu_r$ is the within-laboratory coefficient of variation of the average.
[B] $\nu_R$ is the between-laboratories coefficient of variation of the average.
[C] $r$ is the within-laboratory Repeatability Limit ( = 2.8 $\nu$r).
[D] $R$ is the between-laboratories Reproducibility Limit ( = 2.8 $\nu$R).

NOTE 3—**Caution:** The following explanations of *r* and *R* (10.2-10.2.3) are only intended to present a meaningful way of considering the approximate precision of this test method. With data from only five laboratories, the between-laboratories results, in particular, should be viewed with extreme caution! The data in Table 1 through 4 should not be rigorously applied to acceptance or rejection of material, as those data are specific to the round robin and may not be representative of other lots, conditions, materials, or laboratories. Users of this test method should apply the principles outlined in the 1987 edition of Practice E 691 to generate data specific to their laboratory and materials, or between specific laboratories. The principles of 10.2-10.2.3 would then be valid for such data.

10.2 *Concept of r and R*—If $S_r$ and $S_R$ were calculated from a large enough body of data, and for test results consisting of one determination per test result:

10.2.1 *Repeatability Limit, r*—In comparing two test results for the same material, obtained by the same operator using the same equipment on the same day, the two test results should be judged not equivalent if they differ by more than the *r* value for that material.

10.2.2 *Reproducibility Limit, R*—In comparing two test results for the same material, obtained by different operators using different equipment in different laboratories on different days, the two test results should be judged not equivalent if they differ by more than the *R* value for that material.

10.2.3 Any judgment in accordance with 10.2.1 or 10.2.2 would have an approximate 95 % (0.95) probability of being correct.

10.3 There are no recognized standards by which to estimate bias of this test method.

## 11. Keywords

11.1 apparent viscosity; low shear rate viscometry; PVC organosol; PVC plastisol; rotational viscometer

[7] Supporting data are available from ASTM Headquarters. Request RR: D20—1137.