



Standard Test Method for Intrinsic Viscosity of Cellulose¹

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1. Scope

1.1 This test method covers the determination of the intrinsic viscosity of purified celluloses such as bleached wood pulps, cotton linters, and regenerated cellulose. It is applicable to all cellulose samples with an intrinsic viscosity of 15 dl/g or less. Most native (unpurified) celluloses have intrinsic viscosity values too high for measurement by this test method.

NOTE 1—The use of cuprammonium hydroxide solution for regular viscosity determination is described in Test Methods D 539, Method T 206 m-55 of the Technical Association of Pulp and Paper Industry on “Cuprammonium Disperse Viscosity of Pulp,” and Joint Army-Navy Specifications JAN-C-206.

1.2 *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.*

2. Referenced Documents

2.1 ASTM Standards:

- D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)²
- D 539 Test Methods for Apparent Fluidity of Dispersions of Cellulose Fibers³
- D 629 Test Methods for Quantitative Analysis of Textiles⁴
- E 1 Specification for ASTM Thermometers⁵

3. Summary of Test Method

3.1 A weighed sample of the material is dissolved in a 0.5 M cupriethylenediamine hydroxide solution. The viscosity of this solution, and also that of the solvent, is determined at 25°C by means of a calibrated glass capillary-type viscometer. The relative viscosity is calculated and the corresponding intrinsic viscosity is read from a table.

4. Significance and Use

4.1 This test is a sensitive measure of the degradation of cellulose resulting from the action of heat, light, acids, alkalis, oxidizing and reducing agents, and the like, used in its processing or purification. The intrinsic viscosity value may be converted to degree of polymerization (DP) or to intrinsic fluidity, if desired.

4.2 Solutions of cellulose are not Newtonian liquids; that is, their viscosity depends upon the rate-of-shear or velocity gradient during measurement. This effect is smaller for samples of low molecular mass (DP) and at low concentrations than for high- DP samples and at high concentrations. For the celluloses and concentrations included within the limits set forth in this test method, the effect of rate-of-shear is assumed to be negligible for referee purposes. For other conditions and for research purposes this assumption may be invalid, but to discuss ways of accounting for this effect is beyond the scope of the present test method.

5. Apparatus

5.1 *Viscometer, Glass, Capillary Type*— The Cannon-Fenske, Ubbelohde, or similar capillary type instrument as described in Test Method D 445 is recommended. Viscometers described in Test Methods D 539 are also suitable. In order to avoid correction for the kinetic energy effect, choose a viscometer with a small enough capillary to give an outflow time of 80 s or more for the Cannon-Fenske type. (A size 100 viscometer is normally used for the sample solution and a size 50 for the solvent.)

5.2 *Thermometer*—ASTM Kinematic Viscosity Thermometer for use at 25°C, having a range from 19 to 27°C and conforming to the requirement for Thermometer 17C as prescribed in Specification E 1.

5.3 *Bath*—A constant-temperature bath at 25°C suitable for immersion of the viscometer so that the reservoir or the top of the capillary, whichever is uppermost, is immersed at least 50 mm, and with provision for visibility of the instrument and the thermometer. Firm supports for the viscometer shall be provided; or the viscometer may be sealed in as an integral part of the bath. Either a liquid bath with thermostatic regulation and a stirrer or a vapor bath with pressure regulation is permissible. The efficiency of the stirring and the balance between heat losses and heat input must be such that the temperature of the bath medium does not vary by more than $\pm 0.1^\circ\text{C}$ over the

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² *Annual Book of ASTM Standards*, Vol 05.01.

³ Discontinued, see 1973 *Annual Book of ASTM Standards*, Part 24.

⁴ *Annual Book of ASTM Standards*, Vol 07.01.

⁵ *Annual Book of ASTM Standards*, Vol 14.03.