



Designation: D 3835 – 96

Standard Test Method for Determination of Properties of Polymeric Materials by Means of a Capillary Rheometer¹

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1. Scope

1.1 This test method covers measurement of the rheological properties of polymeric materials at various temperatures and shear rates common to processing equipment. It covers measurement of melt viscosity, sensitivity, or stability of melt viscosity with respect to temperature and polymer dwell time in the rheometer, die swell ratio (polymer memory), and shear sensitivity when extruding under constant rate or stress. The techniques described permit the characterization of materials that exhibit both stable and unstable melt viscosity properties.

1.2 This test method has been found useful for quality control tests on both reinforced and unreinforced thermoplastics, cure cycles of thermosetting materials, and other polymeric materials having a wide range of melt viscosities.

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

NOTE 1—There is no similar or equivalent ISO 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²

D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer²

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method³

2.2 ANSI Standard:

B46.1 Surface Texture⁴

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *apparent values*—viscosity, shear rate, and shear stress values calculated assuming Newtonian behavior and that all pressure drops occur within the capillary.

3.1.2 *critical shear rate*—the shear rate corresponding to the critical shear stress (1/s).

3.1.3 *critical shear stress*—the value of the shear stress at which there is a discontinuity in the slope of log shear stress versus log shear rate plot or periodic roughness of the polymer strand occurs as it exits the rheometer die (MPa).

3.1.4 *delay time*—the time delay between piston stop and start when multiple data points are acquired from a single charge(s).

3.1.5 *melt density*—the density of the material in the molten form expressed in g/mL.

3.1.6 *melt time*—the time interval between the completion of polymer charge and beginning of piston travel(s).

3.1.7 *percent extrudate swell*—the percentage change in the extrudate diameter relative to the die diameter.

3.1.8 *shear rate*—rate of shear strain or velocity gradient in the melt, usually expressed as reciprocal time such as second⁻¹ (s⁻¹).

3.1.9 *shear stress*—force per area, usually expressed in pascals (Pa).

3.1.10 *swell ratio*—the ratio of the diameter of the extruded strand to the diameter of the capillary (die).

3.1.11 *viscosity*—ratio of shear stress to shear rate at a given shear rate or shear stress. It is usually expressed in pascal seconds (Pa·s).

3.1.11.1 Viscosity determined on molten polymers is sometimes referred to as melt viscosity.

3.1.11.2 Viscosity determined on materials exhibiting non-Newtonian flow behavior is referred to as apparent viscosity unless corrections are made as specified in Section 11.

3.1.12 *zero shear viscosity*, η_0 —the limiting viscosity as the

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

³ *Annual Book of ASTM Standards*, Vol 14.02.

⁴ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.