



Designation: D5422 – 17

Standard Test Method for Measurement of Properties of Thermoplastic Materials by Screw-Extrusion Capillary Rheometer¹

This standard is issued under the fixed designation D5422; 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.

INTRODUCTION

This test method uses capillary rheometry to measure the rheological properties of thermoplastics and thermoplastic compounds. This test method utilizes a screw-extrusion-type capillary rheometer.

1. Scope*

1.1 This test method covers the use of a screw-extrusion-type capillary rheometer for the measurement of flow properties of thermoplastics and thermoplastic compounds. The measured flow properties, which are obtained through laboratory investigation, may help to describe the material behavior that occurs in factory processing.

1.2 Since a screw-type capillary rheometer imparts shear energy to the material during testing, the measurements will usually differ from those obtained with a piston-type capillary rheometer (see Test Method D3835).

1.3 Capillary rheometer measurements for thermoplastics and thermoplastic compounds are described in Test Method D3835.

1.4 The values stated in SI units are to be regarded as standard.

1.5 *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—There is no known ISO equivalent to this standard. The scope of this standard is mentioned in ISO 11443:2014, Plastics—Determination of the fluidity of plastics using capillary and slit-die rheometers,” Annex C, “Uncertainties in the determination of shear viscosity by capillary extrusion.”

1.6 *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 Recom-*

mendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 *ASTM Standards:*²

D618 Practice for Conditioning Plastics for Testing

D883 Terminology Relating to Plastics

D1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

D3835 Test Method for Determination of Properties of Polymeric Materials by Means of a Capillary Rheometer

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions:* (See Terminology D883):

3.1.1 *apparent shear rate* ($\dot{\gamma}_a$)—shear strain rate (or velocity gradient) of the thermoplastic or thermoplastic compound extrudate as it passes through the capillary die.

3.1.1.1 *Discussion*—This velocity gradient is not uniform through the cross-section of the capillary die. The shear rate is calculated for the region of highest shear, which is at the wall of the capillary. By selecting a die diameter and controlling the volume flow per unit time through the die, a specific level of apparent shear rate is achieved. Alternately, the shear stress (entrance pressure) is controlled, and the apparent shear rate measured.

3.1.1.2 *Discussion*—Mathematically, the apparent shear rate at the wall of the capillary for a Newtonian fluid at the capillary wall is given by the following:

$$\dot{\gamma}_a = \frac{32 \cdot Q}{\pi \cdot D^3} \quad (1)$$

¹ This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.30 on Thermal Properties (Section D20.30.08).

Current edition approved Dec. 1, 2017. Published January 2018. Originally approved in 1993. Last previous edition approved in 2009 as D5422 – 09. DOI: 10.1520/D5422-17.

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.

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