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.

Designation: D5099 – 08 (Reapproved 2022)

Standard Test Methods for Rubber—Measurement of Processing Properties Using Capillary Rheometry[1]

This standard is issued under the fixed designation D5099; 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 These test methods describe how capillary rheometry may be used to measure the rheological characteristics of rubber (raw or compounded). Two methods are addressed: Method A—using a piston type capillary rheometer, and Method B—using a screw extrusion type capillary rheometer. The two methods have important differences, as outlined in 7 – 10 and 11 – 14, respectively.

1.2 These test methods cover the use of a capillary rheometer for the measurement of the flow properties of thermoplastic elastomers, unvulcanized rubber, and rubber compounds. These material properties are related to factory processing.

1.3 Since piston type capillary rheometers impart only a small amount of shearing energy to the sample, these measurements directly relate to the state of the compound at the time of sampling. Piston type capillary rheometer measurements will usually differ from measurements with a screw extrusion type rheometer, which imparts shearing energy just before the rheological measurement.

1.4 Capillary rheometer measurements for plastics are described in Test Method D3835.

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

1.6 *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.*

1.7 *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]

D1349 Practice for Rubber—Standard Conditions for Testing

D1418 Practice for Rubber and Rubber Latices—Nomenclature

D1485 Practice for Rubber from Natural Sources—Sampling and Sample Preparation

D3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets

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

D3896 Practice for Rubber From Synthetic Sources—Sampling

D4483 Practice for Evaluating Precision for Test Method Standards in the Rubber and Carbon Black Manufacturing Industries

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 The following terms appear in logical order for the sake of clarity:

3.1.2 *capillary rheometer*—an instrument in which rubber can be forced from a reservoir through a capillary die; the temperature, pressure entering the die, and flow rate through the die can be controlled and accurately measured.

3.1.3 *die entrance pressure (P)*—the pressure in the reservoir at the die entrance, in Pa.

3.1.4 *volumetric flow rate (Q)*—the flow rate through the capillary die, in mm^3/s.

3.1.5 *apparent (uncorrected) shear rate ($\dot{\gamma}_a$)*—shear strain rate (or velocity gradient) of the rubber extrudate as it passes through the capillary die (Eq 1), in s^{-1}.

3.1.5.1 *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, at the wall of the

[1] These test methods are under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and are the direct responsibility of Subcommittee D11.12 on Processability Tests.

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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.

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