Designation: D5289 – 12

Standard Test Method for Rubber Property—Vulcanization Using Rotorless Cure Meters[1]

This standard is issued under the fixed designation D5289; 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 This test method covers a method for the measurement of selected vulcanization characteristics of rubber compounds using unsealed and sealed torsion shear cure meters. The two types of instruments may not give the same results.

NOTE 1—An alternative method for the measurement of vulcanization characteristics is given in Test Method D2084.

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

1.3 *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:*[2]

D1349 Practice for Rubber—Standard Conditions for Testing

D1566 Terminology Relating to Rubber

D2084 Test Method for Rubber Property—Vulcanization Using Oscillating Disk Cure Meter

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 *rotorless cure meter, n*—a name for a class of cure meters that uses one of the two specimen shaping members or dies to sense the torque or stress during strain application. Rotorless cure meters do not have a third member in the form of a rotor (see definitions of cure meter in Terminology D1566 and Test Method D2084).

3.1.2 *S' torque, n—for an oscillating shear rotorless cure meter*, the value measured by a torque transducer at the peak strain amplitude of the oscillating cycle; represents the elastic response of the test material.

3.1.3 The following measurements may be taken from the recorded curve of torque as a function of time (see Fig. 1):

3.1.3.1 *minimum S' torque*—measure of the elastic stiffness of the unvulcanized test specimen at the specified vulcanizing temperature, taken at the lowest point in the vulcanization curve.

3.1.3.2 *maximum, plateau,* or *highest S' torque*—measure of the elastic stiffness of the vulcanized test specimen at the specified vulcanizing temperature, measured within a specified period of time.

3.1.3.3 *time to a percentage of full cure*—measure of cure based on the time to develop some percentage of the difference in S' torque from the minimum to the maximum.

3.1.3.4 *time to incipient cure (scorch time)*—measure of the time at which a specified small increase in S' torque has occurred; it indicates the beginning of vulcanization.

3.1.4 *S" torque, n—for an oscillating shear rotorless cure meter*, the value measured by a torque transducer at zero strain amplitude of the oscillating cycle; represents the viscous response of the test material (see Fig. 2).

3.1.5 *S* torque, n—for an oscillating shear rotorless cure meter*, the maximum value measured by a torque transducer during the oscillating cycle (see Fig. 2).

3.1.6 The relationship between S*, S', and S" for any oscillating cycle is:

$$S^* = \sqrt{(S')^2 + (S'')^2} \quad (1)$$

3.1.7 *phase angle δ, n—for an oscillating shear cure meter*, the angle of shift between the sinusoidal strain and the sinusoidal S* torque during the oscillating cycle (see Fig. 2).

3.1.8 *Tan δ, n—for an oscillating shear rotorless cure meter*, the tangent of the phase angle δ.

3.1.8.1 *Discussion*—The relationship between Tan δ, S', and S" is:

[1] This test method is under the jurisdiction of ASTM Committee D11 on Rubber and is the direct responsibility of Subcommittee D11.12 on Processability Tests.

Current edition approved May 1, 2012. Published June 2012. Originally approved in 1992. Last previous edition approved in 2007 as D5289 – 07a. DOI: 10.1520/D5289-12.

[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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