



Designation: D6601 – 19

Standard Test Method for Rubber Properties—Measurement of Cure and After-Cure Dynamic Properties Using a Rotorless Shear Rheometer¹

This standard is issued under the fixed designation D6601; 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 the use of a rotorless oscillating shear rheometer for measuring after cure dynamic properties at predetermined temperature(s) below the cure temperature.

1.2 Specified cure conditions that approximate a “static cure” also are covered to minimize effects on cured rubber compound dynamic properties. This test method is not intended to replace Test Method D5289.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 **Warning**—Compounds based on silicone or fluoroelastomers may have high levels of thermal contraction or poor adhesion to the dies when cooled after the cure portion of this test method, causing slippage during strain sweeps. If this occurs, the results will not be reliable.

1.5 *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

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

¹ This test method is under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and is the direct responsibility of Subcommittee D11.10 on Physical Testing.

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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.

D5289 Test Method for Rubber Property—Vulcanization Using Rotorless Cure Meters

D5992 Guide for Dynamic Testing of Vulcanized Rubber and Rubber-Like Materials Using Vibratory Methods

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *complex shear modulus, G^* , n* —the ratio of peak amplitude shear stress to peak amplitude shear strain; mathematically, $G^* = (G'^2 + G''^2)^{1/2}$.

3.1.2 *complex torque, S^* , n* —the peak amplitude torque response measured by a reaction torque transducer for a sinusoidally applied strain; mathematically, S^* is computed by $S^* = (S'^2 + S''^2)^{1/2}$.

3.1.3 *dynamic cure, n* —any cure condition which oscillates or moves the die.

3.1.4 *elastic torque, S' , n* —the peak amplitude torque component, which is in phase with a sinusoidally applied strain.

3.1.5 *loss angle, δ , n* —the phase angle by which the complex torque (S^*) leads a sinusoidally applied strain.

3.1.6 *loss factor, $\tan \delta$, n* —the ratio of loss modulus to storage modulus, or the ratio of viscous torque to elastic torque; mathematically, $\tan \delta = G''/G' = S''/S'$.

3.1.7 *loss shear modulus, G'' , n* —the component of applied stress that is 90° out-of-phase with the shear strain, divided by the strain.

3.1.8 *static cure, n* —the cure conditions of 0.0° arc strain and 0.0 Hz in frequency, that is, no movement of the dies during the cure test.

3.1.9 *storage shear modulus, G' , n* —the component of applied stress that is in phase with the shear strain, divided by the strain.

3.1.10 *viscous torque, S'' , n* —the peak amplitude torque component, which is 90° out of phase with a sinusoidally applied strain.

4. Summary of Test Method

4.1 A rubber test specimen is contained in a die cavity that is closed and maintained at an elevated cure temperature. The