



Standard Test Method for Shear Modulus at Room Temperature¹

This standard is issued under the fixed designation E143; 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 determination of shear modulus of structural materials. This test method is limited to materials in which, and to stresses at which, creep is negligible compared to the strain produced immediately upon loading. Elastic properties such as shear modulus, Young's modulus, and Poisson's ratio are not determined routinely and are generally not specified in materials specifications. Precision and bias statements for these test methods are therefore not available.

1.2 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *This standard may involve hazardous materials, operations, and equipment. 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

E6 Terminology Relating to Methods of Mechanical Testing
E8/E8M Test Methods for Tension Testing of Metallic Materials

E111 Test Method for Young's Modulus, Tangent Modulus, and Chord Modulus

E1012 Practice for Verification of Testing Frame and Specimen Alignment Under Tensile and Compressive Axial Force Application

3. Terminology

3.1 *Definitions: Terms common to mechanical testing.*

¹ This test method is under the jurisdiction of ASTM Committee E28 on Mechanical Testing and is the direct responsibility of Subcommittee E28.04 on Uniaxial 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.

3.1.1 *angle of twist (torsion test)*— the angle of relative rotation measured in a plane normal to the torsion specimen's longitudinal axis over the gauge length.

3.1.2 *shear modulus, G , [FL⁻²], n* —the ratio of shear stress to corresponding shear strain below the proportional limit, also called torsional modulus and modulus of rigidity. (See Fig. 1.)

3.1.2.1 *Discussion*—The value of shear modulus may depend on the direction in which it is measured if the material is not isotropic. Wood, many plastics and certain metals are markedly anisotropic. Deviations from isotropy should be suspected if the shear modulus, G , differs from that determined by substituting independently measured values of Young's modulus, E , and Poisson's ratio, μ in the relation

$$G = \frac{E}{2(1+\mu)} \quad (1)$$

3.1.2.2 *Discussion*—In general, it is advisable, in reporting values of shear modulus to state the stress range over which it is measured.

3.1.3 *torque, [FL], n* —a moment (of forces) that produces or tends to produce rotation or torsion.

3.1.4 *torsional stress [FL⁻²], n* —the shear stress in a body, in a plane normal to the axis of rotation, resulting from the application of torque.

4. Summary of Test Method

4.1 The cylindrical or tubular test specimen is loaded either incrementally or continuously by applying an external torque so as to cause a uniform twist within the gauge length.

4.1.1 Changes in torque and the corresponding changes in angle of twist are determined either incrementally or continuously. The appropriate slope is then calculated from the shear stress-strain curve, which may be derived under conditions of either increasing or decreasing torque (increasing from pretorque to maximum torque or decreasing from maximum torque to pretorque).

5. Significance and Use

5.1 Shear modulus is a material property useful in calculating compliance of structural materials in torsion provided they follow Hooke's law, that is, the angle of twist is proportional to the applied torque. Examples of the use of shear modulus are in the design of rotating shafts and helical compression springs.

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