



Designation: D 2236 – 81

AMERICAN SOCIETY FOR TESTING AND MATERIALS



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Standard Test Method for DYNAMIC MECHANICAL PROPERTIES OF PLASTICS BY MEANS OF A TORSIONAL PENDULUM¹

This standard is issued under the fixed designation D 2236; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This method covers determination of the elastic and nonelastic components of the complex shear modulus of plastics of logarithmic decrement less than or equal to 1. The method is primarily useful when conducted over a range of temperatures and is known to be valid at frequencies from at least 0.1 to 10.0 Hz (cycles per second).

1.2 The method is intended for materials that have tensile moduli in the range from 345 MPa to 13.8 GPa (5×10^4 to 2×10^6 psi), as determined by Method D 638.

1.3 The scope of the method does not include tests in a region where the logarithmic decrement of a material is greater than a value of 1. This limitation is not a function of the technique, but will depend on the mass of the particular specimen and the apparatus inertial member and gripping arrangement. The test has been shown to be valid and useful where the logarithmic decrement is greater than 1 and for materials of tensile modulus up to 34.5 GPa (5×10^6 psi).

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

2. Applicable Documents

2.1 ASTM Standards:

D 618 Conditioning Plastics and Electrical Insulating Materials for Testing²

D 638 Test for Tensile Properties of Plastics³

D 1898 Recommended Practice for Sampling of Plastics³

3. Summary of Method

3.1 This method is intended to provide a means of determining the elastic and loss mod-

ulus of plastics over a range of temperatures by a free decay technique at about 1 Hz (cycle per second). A plot of these moduli is indicative of the thermo-mechanical characteristics of a plastic. The specimen is an integral part of an inertial system, thus determining the frequency and rate of decay of the system from which moduli may be determined. These moduli are a function of temperature and frequency in plastics and change rapidly at particular temperatures in the torsion pendulum analysis. The temperatures of rapid moduli change are normally referred to as transition temperatures.

4. Significance

4.1 The elastic component, G' , and nonelastic component, G'' , of the complex shear modulus, G^* , are two of the fundamental constants of any viscoelastic material. These two constants largely determine the dynamic mechanical performance of the material in shear provided that the maximum strain is relatively low. They are defined by the equation: $G^* = G' + iG''$. G^* is referred to as the complex shear modulus, G' the elastic shear modulus, and G'' the loss modulus of a material. The ratio G''/G' is a measure of the capacity of a viscoelastic material to damp mechanical vibrations.

4.2 Plotting the dynamic elastic and nonelastic moduli of a material versus temperature provides a graphic representation of rigidity

¹ This method is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D 20.10 on Mechanical Properties.

Current edition approved June 26, 1981. Published October 1981. Originally published as D 2236 – 64T. Last previous edition D 2236 – 70 (1976).

² Annual Book of ASTM Standards, Parts 22, 35, and 39.

³ Annual Book of ASTM Standards, Part 35.