



Standard Test Method for Assignment of the Glass Transition Temperature By Dynamic Mechanical Analysis¹

This standard is issued under the fixed designation E1640; 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 assignment of a glass transition temperature (T_g) of materials using dynamic mechanical analyzers.

1.2 This test method is applicable to thermoplastic polymers, thermoset polymers, and partially crystalline materials which are thermally stable in the glass transition region.

1.3 The applicable range of temperatures for this test method is dependent upon the instrumentation used, but, in order to encompass all materials, the minimum temperature should be about -150°C .

1.4 This test method is intended for materials having an elastic modulus in the range of 0.5 MPa to 100 GPa.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 This standard is similar to IEC 61006 except that standard uses the peak temperature of the loss modulus peak as the glass transition temperature while this standard uses the extrapolated onset temperature of the storage modulus change.

1.7 *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

D4092 Terminology for Plastics: Dynamic Mechanical Properties

¹ This test method is under the jurisdiction of ASTM Committee E37 on Thermal Measurements and is the direct responsibility of Subcommittee E37.10 on Fundamental, Statistical and Mechanical Properties.

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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.

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

E1142 Terminology Relating to Thermophysical Properties

E1363 Test Method for Temperature Calibration of Thermomechanical Analyzers

E1545 Test Method for Assignment of the Glass Transition Temperature by Thermomechanical Analysis

E1867 Test Method for Temperature Calibration of Dynamic Mechanical Analyzers

E2254 Test Method for Storage Modulus Calibration of Dynamic Mechanical Analyzers

E2425 Test Method for Loss Modulus Conformance of Dynamic Mechanical Analyzers

2.2 Other Standards:

IEC 61006 Methods of Test for the Determination of the Glass Transition Temperature of Electrical Insulating Materials³

3. Terminology

3.1 Definitions:

3.1.1 Specific technical terms used in this document are defined in Terminology **D4092** and **E1142** including Celsius, dynamic mechanical analyzer, glass transition, glass transition temperature, loss modulus, storage modulus, tangent delta, and viscoelasticity.

4. Summary of Test Method

4.1 A specimen of known geometry is placed in mechanical oscillation at either fixed or resonant frequency and changes in the viscoelastic response of the material are monitored as a function of temperature. Under ideal conditions, during heating, the glass transition region is marked by a rapid decrease in the storage modulus and a rapid increase in the loss modulus and tangent delta. The glass transition of the test specimen is indicated by the extrapolated onset of the decrease in storage modulus which marks the transition from a glassy to a rubbery solid.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.