



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

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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 Electronic instrumentation or automated data analysis and data reduction systems or treatments equivalent to this test method may also be used.

NOTE 1—The user bears the responsibility for determining the precision, accuracy, and validity of the techniques and measurements made using dynamic mechanical analyzers in accordance with this standard. If disputes arise, only the manual procedures described in this standard are to be considered valid.

1.6 *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:

D 4065 Practice for Determining and Reporting Dynamic Mechanical Properties of Plastics²

D 4092 Terminology Relating to Dynamic Mechanical Measurements in Plastics²

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method³

E 1142 Terminology Relating to Thermophysical Properties³

¹ This test method is under the jurisdiction of ASTM Committee E-37 on Thermal Measurements and is the direct responsibility of Subcommittee E37.01 on Test Methods and Recommended Practices.

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² Annual Book of ASTM Standards, Vol 08.02.

³ Annual Book of ASTM Standards, Vol 14.02.

E 1356 Test Method for Glass Transition Temperatures by Differential Scanning Calorimetry or Differential Thermal Analysis³

E 1363 Test Method for Temperature Calibration of Thermomechanical Analyzers³

E 1545 Test Method for the Determination of Glass Transition Temperatures by Thermomechanical Analysis³

2.2 Other Standard:

SRM 18R-94 Recommended Method for Glass Transition Temperature (T_g) Determination by DMA of Oriented Fiber-Resin Composites⁴

3. Terminology

3.1 Definition:

3.1.1 Specific technical terms used in this document are defined in Terminology D 4092 and E 1142.

3.1.2 *dynamic mechanical analyzer*—any of various commercial or experimental devices used to study the viscoelastic response of a specimen under a forced or free resonant oscillatory load. The force may be applied in torsion, flexure, or a combination of tension and compression.

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, the glass transition region is marked by a rapid decrease in the storage modulus and a rapid increase in the loss modulus. 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.

5. Significance and Use

5.1 This test method can be used to locate the glass transition region and assign a glass transition temperature of amorphous and semi-crystalline materials.

5.2 Dynamic mechanical analyzers monitor changes in the viscoelastic properties of a material as a function of temperature and frequency, providing a means to quantify these changes. In ideal cases, the temperature of the onset of the

⁴ Available from Suppliers of Advanced Composite Materials Association, Arlington, VA.