INTERNATIONAL

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Standard Test Method for Assignment of a Glass Transition Temperature Using Thermomechanical Analysis Under Tension[1]

This standard is issued under the fixed designation E 1824; 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 a procedure for the assignment of a glass transition temperature of materials on heating using thermomechanical measurements under tension under prescribed experimental conditions.

1.2 This test method may be used as a complement to Test Method E 1545 and is applicable to amorphous or to partially crystalline materials in the form of films, fibers, wires, etc. that are sufficiently rigid to inhibit extension during loading at ambient temperature.

1.3 The generally applicable temperature range for this test method is − 100 to 600°C. This temperature range may be altered depending upon the instrumentation used.

1.4 Computer or electronic-based instruments, techniques, or data treatment equivalent to this test method may also be used.

NOTE 1—Users of this test method are expressly advised that all such instruments or techniques may not be equivalent. It is the responsibility of the user of this test method to determine the necessary equivalency prior to use.

1.5 There is no ISO method equivalent to this method.

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:*

E 473 Terminology Relating to Thermal Analysis[2]

E 1142 Terminology Relating to Thermophysical Properties[2]

E 1545 Test Method for Glass Transition Temperatures by Thermomechanical Analysis[2]

3. Terminology

3.1 *Definitions:*

3.1.1 The following terms are applicable to this test method and can be found in Terminology E 473 and Terminology E 1142: *thermomechanical analysis (TMA), thermodilatometry, glass transition, glass transition temperature*.

4. Summary of Test Method

4.1 This test method uses thermomechanical analysis equipment (thermomechanical analyzer, dilatometer, or similar device) in the tensile mode to determine the change in dimension of a thin specimen observed when the material is subjected to a constant heating rate through the glass transition regime. This change in dimension associated with the change from vitreous solid to amorphous liquid is observed as movement of a sensing probe in direct contact with the specimen and is recorded as a function of temperature. The intersection of the extrapolation of the slope of the probe displacement curve before and after the transition is used to determine a temperature that is assigned as the glass transition temperature.

5. Significance and Use

5.1 The glass transition is dependent on the thermal history, softening agents or additives of the material to be tested. For amorphous and semicrystalline materials the assignment of a glass transition temperature may lead to important information about thermal history, processing conditions, stability, progress of chemical reactions, and mechanical and electrical behavior.

5.2 Thermomechanical analysis provides a rapid means of detecting changes in hardness or linear dimensional change associated with the glass transition. Dimensional changes measured as a specimen is heated over the T_g region may include the interaction of several effects: an increase in the coefficient of expansion, a decrease in the modulus, which under a constant stress leads to increased extension, stress relief leading to irreversible dimensional change (shrinkage in one dimension, expansion in another dimension), and physical aging effects which change the kinetics of the dimensional change.

[1] This test method is under the jurisdiction of ASTM Committee E37 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 14.02.