



Standard Test Method for Distortion Temperature in Three-Point Bending by Thermomechanical Analysis¹

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1. Scope

1.1 This test method describes the determination of the temperature at which the specific modulus of a test specimen is realized by deflection in three-point bending. This temperature is identified as the distortion temperature measured. The distortion temperature is that temperature at which a test specimen of defined geometry deforms to a level of strain under applied stress of 0.455 and 1.82 MPa (66 and 264 psi) equivalent to those used in Test Method D 648. The test may be performed over the range of temperature from ambient to 300°C.

NOTE 1—Results may or may not agree with those obtained by Test Method D 648.

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

NOTE 2—Since all electronic data treatments are not equivalent, the user shall verify equivalency to this test method.

1.3 SI values are the standard.

1.4 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.*

1.5 There is no ISO standard equivalent to this test method.

2. Referenced Documents

2.1 ASTM Standards:

D 648 Test Method for Deflection Temperature of Plastics Under Flexural Load²

E 473 Terminology Relating to Thermal Analysis³

E 1142 Terminology Relating to Thermophysical Properties³

¹ This test method is under the jurisdiction of 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 08.01.

³ Annual Book of ASTM Standards, Vol 14.02.

E 1363 Test Method for Temperature Calibration of Thermomechanical Analyzers³

3. Terminology

3.1 *Definitions*—Specific technical terms used in this standard are defined in Terminologies E 473 and E 1142.

3.1.1 *distortion temperature* [$^{\circ}\text{C}$], n —the temperature at which an arbitrary strain level is obtained in three-point bending under an arbitrary load.

3.1.2 *strain*, r [mm/m], n —the dimension change in normalizing dimension due to an applied force.

3.1.3 *stress*, S [$\text{Pa} = \text{N/m}^2$], n —force per unit area.

4. Summary of Test Method

4.1 A test specimen of known dimensions is tested in three-point bending mode. A known stress is applied to the center of a test specimen supported near its ends, as it is heated at a constant rate from ambient temperature to the upper temperature limit for the material. The deflection of the test specimen is recorded as a function of temperature. The temperature at which a predetermined level of strain is observed in the test specimen is analyzed as the distortion temperature.

5. Significance and Use

5.1 Data obtained by this test method shall not be used to predict the behavior of materials at elevated temperatures except in applications in which the conditions of time, temperature, method of loading, and stress are similar to those specified in the test.

5.2 This standard is particularly suited for quality control and development work. The data are not intended for use in design or predicting endurance at elevated temperatures.

6. Apparatus

6.1 A thermomechanical analyzer consisting of:

6.1.1 *Rigid Specimen Holder*, of inert, low expansivity material $<20 \mu\text{m m}^{-1} \cdot ^{\circ}\text{C}^{-1}$ to center the specimen in the furnace and to fix the specimen to mechanical ground.

6.1.2 *Flexure Fixture*, of inert, low expansivity material $<20 \mu\text{m m}^{-1} \cdot ^{\circ}\text{C}^{-1}$, to support the test specimen in a three-point bending mode (see Fig. 1).