



Designation: E 831 – 00

## Standard Test Method for Linear Thermal Expansion of Solid Materials by Thermomechanical Analysis<sup>1</sup>

This standard is issued under the fixed designation E 831; 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 approval. A superscript symbol (n) indicates an editorial change since the last revision or approval.

### 1. Scope

1.1 This test method covers determination of linear thermal expansion of solid materials using thermomechanical analysis techniques. Related information can be found in Refs. (1-2)<sup>2</sup>.

1.2 This test method is applicable to solid materials that exhibit sufficient rigidity over the test temperature range such that the sensing probe does not produce indentation of the specimen.

1.3 The lower limit of coefficient of linear thermal expansion measured with this test method is 5  $\mu\text{m}/(\text{m}\cdot^\circ\text{C})$ . The test method may be used at lower (or negative) expansion levels with decreased accuracy and precision (see Section 11).

1.4 This test method is applicable to the temperature range from  $-120$  to  $600^\circ\text{C}$ . The temperature range may be extended depending upon the instrumentation and calibration materials used.

1.5 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 to determine the necessary equivalency prior to use.

1.6 SI values are the standard.

1.7 This test method is related to ISO 11359-2 but is significantly different in technical detail.

1.8 *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 determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:

D 696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between  $-30^\circ\text{C}$  and  $30^\circ\text{C}$ <sup>3</sup>

D 3386 Test Method for Coefficient of Linear Thermal

#### Expansion of Electrical Insulating Materials<sup>4</sup>

E 228 Test Method for Linear Thermal Expansion of Solid Materials with a Viscous Silica Dilatometer<sup>5</sup>

E 473 Terminology Relating to Thermal Analysis<sup>6</sup>

E 1142 Terminology Relating to Thermophysical Properties<sup>7</sup>

E 1363 Test Method for Temperature Calibration of Thermomechanical Analyzers<sup>8</sup>

2.2 ISO Standards:<sup>9</sup>

ISO 11359-2 Plastics—Thermomechanical Analysis (TMA)—Part 2: Determination of Coefficient of Linear Thermal Expansion and Glass Transition Temperature

### 3. Terminology

3.1 *Definitions*—Thermal analysis terms in Terminologies E 473 and E 1142 shall apply to this test method.

### 4. Summary of Test Method

4.1 This test method uses a thermomechanical analyzer or similar device to determine the linear thermal expansion of solid materials when subjected to a constant heating rate.

4.2 The change of the specimen length is electronically recorded as a function of temperature. The coefficient of linear thermal expansion can be calculated from these recorded data.

### 5. Significance and Use

5.1 Coefficients of linear thermal expansion are used, for example, for design purposes and to determine if failure by thermal stress may occur when a solid body composed of two different materials is subjected to temperature variations.

5.2 This test method is comparable to Test Method D 3386 for testing electrical insulation materials, but it covers a more general group of solid materials and it defines test conditions more specifically. This test method uses a smaller specimen than Test Methods E 228 and D 696.

### 6. Apparatus

6.1 *Thermomechanical Analyzers (TMA)*—The essential instrumentation required providing minimum thermomechanical

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee E-27 on Thermal Measurements and is the direct responsibility of Subcommittee E27.01 on Test Methods and Recommended Practices.

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<sup>2</sup> The boldface numbers in parentheses refer to the list of references at the end of this standard.

<sup>3</sup> Annual Book of ASTM Standards, Vol 08.01.

<sup>4</sup> Annual Book of ASTM Standards, Vol 10.02.

<sup>5</sup> Annual Book of ASTM Standards, Vol 14.02.

<sup>6</sup> Available from the American National Standards Institute, 11 W. 42nd St., 15th Floor, New York, NY 10018.

# Astm E831

**J Dewey**



## **Astm E831 :**

**Polymer Matrix Composites: Guidelines for Characterization of Structural Materials** Composite Materials Handbook - 17 (CMH-17),2022-09-06 The first volume of this six volume compendium contains guidelines for determining the properties of polymer matrix composite material systems and their constituents as well as the properties of generic structural elements including test planning test matrices sampling conditioning test procedure selection data reporting data reduction statistical analysis and other related topics Special attention is given to the statistical treatment and analysis of data Volume 1 contains guidelines for general development of material characterization data as well as specific requirements for publication of material data in CMH 17 The primary purpose of this volume of the handbook is to document industry best practices for engineering methodologies related to testing data reduction and reporting of property data for current and emerging composite materials It is used by engineers worldwide in designing and fabricating products made from composite materials The Composite Materials Handbook referred to by industry groups as CMH 17 is a six volume engineering reference tool that contains thousands of records of the latest test data for polymer matrix metal matrix ceramic matrix and structural sandwich composites CMH 17 provides information and guidance necessary to design analyze fabricate certify and support end items using composite materials It includes properties of composite materials that meet specific data requirements as well as guidelines for design analysis material selection manufacturing quality control and repair

Handbook of Polymers for Electronics George Wypych,2021-01-30 Polymers used in electronics and electrical engineering are essential to the development of high tech products with applications in space aviation health automotive communication robotics consumer products and beyond Typical features of mainstream polymers such as mechanical performance optical behavior and environmental stability frequently need to be enhanced to perform in these demanding applications creating the need to develop special grades or use completely new chemistry for their synthesis Similarly the typical set of properties included in the description of mainstream polymers are not sufficient for polymer selection for these applications as they require different data data that is meticulously detailed in the Handbook of Polymers for Electronics The book provides readers with the most up to date information from the existing literature manufacturing data and patent filings Presenting data for all polymers based on a consistent pattern of arrangement the book provides details organized into the following sections General history synthesis structure commercial polymers physical properties electrical properties mechanical properties chemical resistance flammability weather stability thermal stability biodegradation toxicity environmental impact processing blends analysis The contents scope treatment and novelty of the data makes this book an essential resource for anyone working with polymeric materials used in modern electronic applications Synthesizes the most recent literature available on various grades of polymers plastics finished products and patents Provides data on general information synthesis structure physical properties electrical properties mechanical properties chemical resistance

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