



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

**Annelies Wilder-Smith**



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### **Table of Contents Astm E831**

1. Understanding the eBook Astm E831
  - The Rise of Digital Reading Astm E831
  - Advantages of eBooks Over Traditional Books
2. Identifying Astm E831
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Astm E831
  - User-Friendly Interface
4. Exploring eBook Recommendations from Astm E831

- 
- Personalized Recommendations
  - Astm E831 User Reviews and Ratings
  - Astm E831 and Bestseller Lists
5. Accessing Astm E831 Free and Paid eBooks
    - Astm E831 Public Domain eBooks
    - Astm E831 eBook Subscription Services
    - Astm E831 Budget-Friendly Options
  6. Navigating Astm E831 eBook Formats
    - ePub, PDF, MOBI, and More
    - Astm E831 Compatibility with Devices
    - Astm E831 Enhanced eBook Features
  7. Enhancing Your Reading Experience
    - Adjustable Fonts and Text Sizes of Astm E831
    - Highlighting and Note-Taking Astm E831
    - Interactive Elements Astm E831
  8. Staying Engaged with Astm E831
    - Joining Online Reading Communities
    - Participating in Virtual Book Clubs
    - Following Authors and Publishers Astm E831
  9. Balancing eBooks and Physical Books Astm E831
    - Benefits of a Digital Library
    - Creating a Diverse Reading Collection Astm E831
  10. Overcoming Reading Challenges
    - Dealing with Digital Eye Strain
    - Minimizing Distractions
    - Managing Screen Time
  11. Cultivating a Reading Routine Astm E831
    - Setting Reading Goals Astm E831
    - Carving Out Dedicated Reading Time
  12. Sourcing Reliable Information of Astm E831

- Fact-Checking eBook Content of Astm E831
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning
- Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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