



Designation: E228 – 17

Standard Test Method for Linear Thermal Expansion of Solid Materials With a Push- Rod Dilatometer¹

This standard is issued under the fixed designation E228; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This test method covers the determination of the linear thermal expansion of rigid solid materials using push-rod dilatometers. This method is applicable over any practical temperature range where a device can be constructed to satisfy the performance requirements set forth in this standard.

NOTE 1—Initially, this method was developed for vitreous silica dilatometers operating over a temperature range of -180°C to 900°C . The concepts and principles have been amply documented in the literature to be equally applicable for operating at higher temperatures. The precision and bias of these systems is believed to be of the same order as that for silica systems up to 900°C . However, their precision and bias have not yet been established over the relevant total range of temperature due to the lack of well-characterized reference materials and the need for interlaboratory comparisons.

1.2 For this purpose, a rigid solid is defined as a material that, at test temperature and under the stresses imposed by instrumentation, has a negligible creep or elastic strain rate, or both, thus insignificantly affecting the precision of thermal-length change measurements. This includes, as examples, metals, ceramics, refractories, glasses, rocks and minerals, graphites, plastics, cements, cured mortars, woods, and a variety of composites.

1.3 The precision of this comparative test method is higher than that of other push-rod dilatometry techniques (for example, Test Method [D696](#)) and thermomechanical analysis (for example, Test Method [E831](#)) but is significantly lower than that of absolute methods such as interferometry (for example, Test Method [E289](#)). It is generally applicable to materials having absolute linear expansion coefficients exceeding $0.5\ \mu\text{m}/(\text{m}\cdot^{\circ}\text{C})$ for a 1000°C range, and under special circumstances can be used for lower expansion materials when special precautions are used to ensure that the produced expansion of the specimen falls within the capabilities of the measuring system. In such cases, a sufficiently long specimen was found to meet the specification.

¹ This test method is under the jurisdiction of ASTM Committee [E37](#) on Thermal Measurements and is the direct responsibility of Subcommittee [E37.05](#) on Thermophysical Properties.

Current edition approved April 1, 2017. Published April 2017. Originally approved in 1963. Last previous edition approved in 2016 as E228 – 11 (2016). DOI: 10.1520/E0228-17.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *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.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- [D696](#) Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer
- [E220](#) Test Method for Calibration of Thermocouples By Comparison Techniques
- [E230/E230M](#) Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- [E289](#) Test Method for Linear Thermal Expansion of Rigid Solids with Interferometry
- [E473](#) Terminology Relating to Thermal Analysis and Rheology
- [E644](#) Test Methods for Testing Industrial Resistance Thermometers
- [E831](#) Test Method for Linear Thermal Expansion of Solid Materials by Thermomechanical Analysis
- [E1142](#) Terminology Relating to Thermophysical Properties

3. Terminology

3.1 *Definitions*—The following terms are applicable to this test method and are listed in Terminologies [E473](#) and [E1142](#):

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.