



Designation: D6745 – 22

Standard Test Method for Linear Thermal Expansion of Electrode Carbons¹

This standard is issued under the fixed designation D6745; 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 reappraisal. A superscript epsilon (ε) indicates an editorial change since the last revision or reappraisal.

1. Scope*

1.1 This test method covers the determination of the coefficient of linear thermal expansion (CTE) for carbon anodes and cathodes used in the aluminum industry, in baked form, by use of a vitreous silica dilatometer.

1.2 The applicable temperature range for this test method for research purposes is ambient to 1000 °C. The recommended maximum use temperature for product evaluation is 500 °C.

1.3 This test method and procedure is based on Test Method E228, which is a generic all-encompassing method. Specifics dictated by the nature of electrode carbons and the purposes for which they are used are addressed by this procedure.

1.4 Electrode carbons in the baked form will only exhibit primarily reversible dimensional changes when heated.

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

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *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

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.05 on Properties of Fuels, Petroleum Coke and Carbon Material.

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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.

E228 Test Method for Linear Thermal Expansion of Solid Materials With a Push-Rod Dilatometer

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 Definitions:

3.1.1 *linear thermal expansion, n*—the change in length per unit length resulting from a temperature change. Linear thermal expansion is symbolically represented by $\Delta L/L_0$, where ΔL is the length change of the specimen ($L_1 - L_0$), L_0 and L_1 are the specimens lengths at reference temperature T_0 and test temperature T_1 , respectively. Linear thermal expansion is often expressed as a percentage or in parts per million (such as $\mu\text{m}/\text{m}$ or 10^{-6} m/m).

3.1.1.1 *mean coefficient of linear thermal expansion (CTE), n*—The linear thermal expansion per change in temperature; the mean coefficient of linear thermal expansion is represented by:

$$\bar{\alpha}_{T_1} = \frac{\Delta L/L_0}{\Delta T} = \frac{1}{L_0} \cdot \frac{\Delta L}{\Delta T} = \frac{1}{L_0} \frac{L_1 - L_0}{T_1 - T_0} \quad (1)$$

The coefficient of thermal expansion is expressed in parts per million per degree Kelvin (such as $\mu\text{m}/\text{mK}$ or 10^{-6} m/mK).

3.1.1.1 *Discussion*—This has to be accompanied by the values of the two temperatures to be meaningful; the reference temperature (T_0) is 20 °C, and the notation may then only contain a single number, such as $\bar{\alpha}_{200}$, meaning the mean coefficient of linear thermal expansion between 20 °C and 200 °C.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *reference specimen, n*—a particularly identified or pedigreed material sample, with well-characterized behavior and independently documented performance.

3.2.2 *specimen, n*—a representative piece of a larger body (anode, cathode, and so forth) that is considered to be fairly typical of a portion or of the entire piece.

3.2.3 *vitreous silica dilatometer, n*—a device used to determine linear thermal expansion, by measuring the difference in linear thermal expansion between a test specimen and the vitreous silica parts of the dilatometer.

*A Summary of Changes section appears at the end of this standard