



Standard Test Method of Measuring Thermal Expansion and Creep of Refractories Under Load¹

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1. Scope

1.1 This test method covers the procedure for measuring the linear change of refractory specimens that are subjected to compressive stress while being heated and while being held at elevated temperatures.

1.2 This test method does not apply to materials whose strength depends on pitch or carbonaceous bonds unless appropriate atmospheric control is used (see 7.3).

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *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.*

2. Referenced Documents

2.1 ASTM Standards:²

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

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *maximum dilation*—the percent expansion where the thermal-expansion rate equals the creep-deformation rate. It can be used in estimating thermal-expansion relief when used in conjunction with the temperature at maximum dilation.

3.1.2 *temperature at maximum dilation*—in addition to estimating thermal-expansion relief, it can be used to rank products in terms of relative refractoriness. In general, the

higher the temperature at maximum dilation, the more refractory the product and the better it is able to resist deformation at elevated temperatures.

3.1.3 *20 to 50 h creep*—the percent deformation between the 20 and 50 h can be used to rank products in terms of relative load bearing capacity at a particular temperature. Relative rankings of various products may differ at different temperatures.

4. Summary of Test Method

4.1 Test specimens sawed from samples of refractory brick or from prefabricated samples of monolithic refractories are placed in a furnace and subjected to a prescribed compressive stress. Sensors are positioned for continuously measuring the linear change of the specimens parallel to the direction of the compressive stress. The temperature and linear change of the specimens are continuously recorded while heating the furnace at a controlled rate for thermal expansion under load testing. The time and linear change of the specimens are also continuously recorded while at soak temperature for 20 to 50 h of creep testing.

4.2 The user should be aware that other mechanisms, besides those related to creep, may be activated. This is especially true as temperatures approach 1650°C. When other material responses are activated, such as corrosion, oxidation, sintering, etc., strong caution should be exercised when interpreting and identifying creep mechanisms.

4.3 Since materials tend to exhibit faster creep rates during the initial stage of deformation, the user should be cautioned when extrapolating measured creep rates beyond the normal 50 h test time. The material must be in the secondary creep stage in order to extrapolate to longer times.

5. Significance and Use

5.1 The thermal expansion under load and the 20 to 50 h creep properties of a refractory are useful in characterizing the load bearing capacity of a refractory that is uniformly heated. Directly applicable examples are blast furnace stoves and glass furnace checkers.

¹ This test method is under the jurisdiction of ASTM Committee C08 on Refractories and is the direct responsibility of Subcommittee C08.01 on Strength.

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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.