INTERNATIONAL

Designation: C1099 – 07 (Reapproved 2019)

Standard Test Method for Modulus of Rupture of Carbon-Containing Refractory Materials at Elevated Temperatures[1]

This standard is issued under the fixed designation C1099; 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.

1. Scope

1.1 This test method covers the determination of the modulus of rupture of carbon-containing refractories at elevated temperatures in air.

1.2 The values stated in inch-pound units and degrees Fahrenheit are to be regarded as standard. The values given in parentheses are for information only.

1.3 *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.* For specific hazard statements, see Section 5.

1.4 *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]

C583 Test Method for Modulus of Rupture of Refractory Materials at Elevated Temperatures

E220 Test Method for Calibration of Thermocouples By Comparison Techniques

2.2 *ISO Standard:*[3]

ISO Recommendation 5013 Determination of the Hot Modulus of Rupture of Shaped and Unshaped Dense and Insulating Refractory Products

3. Significance and Use

3.1 The modulus of rupture of carbon-containing refractories at elevated temperatures has become accepted as a useful measurement in quality control testing and in research and development. These measurements are also used to determine the suitability of particular products for various applications and to develop specifications. The sample may undergo some oxidation during the test.

3.2 In 1988, ruggedness testing was conducted on this test procedure. The following variables were studied:

3.2.1 Testing temperature (2525 (1385) versus 2575 °F (1413 °C)),

3.2.2 Air atmosphere versus argon atmosphere in the furnace,

3.2.3 Hold time prior to breaking the sample (12 versus 18 min), and

3.2.4 Loading rate on the sample (175 (778) versus 350 lb-/min (1556 N/min)).

3.3 Resin-bonded magnesia-carbon brick containing approximately 17 % carbon after coking were tested in two separate ruggedness tests. Metal-free brick were tested in the first ruggedness test, while aluminum-containing brick were tested in the second. Results were analyzed at a 95 % confidence level.

3.4 For the metal-free brick, the presence of an argon atmosphere and hold time had statistically significant effects on the modulus of rupture at 2550 °F (1400 °C). The argon atmosphere yielded a lower modulus of rupture. The samples tested in air had a well-sintered decarburized zone on the exterior surfaces, possibly explaining the higher moduli of rupture. The longer hold time caused a lower result for the metal-free brick.

3.5 For the aluminum-containing brick, testing temperature, the presence of an argon atmosphere, and loading rate had statistically significant effects on the modulus of rupture at 2550 °F (1400 °C). The higher testing temperature increased the measured result, the presence of an argon atmosphere lowered the result, and the higher loading rate increased the result.

[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.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.