



Standard Test Method for Dynamic Young's Modulus, Shear Modulus, and Poisson's Ratio of Refractory Materials by Impulse Excitation of Vibration¹

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1. Scope

1.1 This test method covers the measurement of the fundamental resonant frequencies for the purpose of calculating the dynamic Young's modulus, the dynamic shear modulus (also known as the modulus of rigidity), and the dynamic Poisson's ratio of refractory materials at ambient temperatures. Specimens of these materials possess specific mechanical resonant frequencies, which are determined by the elastic modulus, mass, and geometry of the test specimen. Therefore, the dynamic elastic properties can be computed if the geometry, mass, and mechanical resonant frequencies of a suitable specimen can be measured. The dynamic Young's modulus is determined using the resonant frequency in the flexural mode of vibration and the dynamic shear modulus is determined using the resonant frequency in the torsional mode of vibration. Poisson's ratio is computed from the dynamic Young's modulus and the dynamic shear modulus.

1.2 Although not specifically described herein, this method can also be performed at high temperatures with suitable equipment modifications and appropriate modifications to the calculations to compensate for thermal expansion.

1.3 The values are stated in SI units and are to be regarded as the standard.

1.4 *This standard may involve hazardous materials, operations, and equipment. 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 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. Referenced Documents

2.1 *ASTM Standards:*²

C71 Terminology Relating to Refractories

C215 Test Method for Fundamental Transverse, Longitudinal, and Torsional Resonant Frequencies of Concrete Specimens

C885 Test Method for Young's Modulus of Refractory Shapes by Sonic Resonance

C1259 Test Method for Dynamic Young's Modulus, Shear Modulus, and Poisson's Ratio for Advanced Ceramics by Impulse Excitation of Vibration

3. Summary of Test Method

3.1 The fundamental resonant frequencies are determined by measuring the resonant frequency of specimens struck once mechanically with an impacting tool. Frequencies are measured with a transducer held lightly against the specimen using a signal analyzer circuit. Impulse and transducer locations are selected to induce and measure one of two different modes of vibration. The appropriate resonant frequencies, dimensions, and mass of each specimen may be used to calculate dynamic Young's modulus, dynamic shear modulus, and dynamic Poisson's ratio.

4. Significance and Use

4.1 This test method is non-destructive and is commonly used for material characterization and development, design data generation, and quality control purposes. The test assumes that the properties of the specimen are perfectly isotropic, which may not be true for some refractory materials. The test also assumes that the specimen is homogeneous and elastic. Specimens that are micro-cracked are difficult to test since they do not yield consistent results. Specimens with low densities

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.