Designation: C 769 – 98 (Reapproved 2005)

An American National Standard

Standard Test Method for Sonic Velocity in Manufactured Carbon and Graphite Materials for Use in Obtaining an Approximate Young's Modulus[1]

This standard is issued under the fixed designation C 769; 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 a procedure for measuring the sonic velocity in manufactured carbon and graphite materials having a grain size less than 0.80 mm (1⁄32 in.). The sonic velocity can be used to obtain an approximate value for Young's modulus.

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

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

2. Referenced Documents

2.1 *ASTM Standards:* [2]

C 559 Test Method for Bulk Density by Physical Measurement of Manufactured Carbon and Graphite Articles

C 747 Test Method for Moduli of Elasticity and Fundamental Frequencies of Carbon and Graphite Materials by Sonic Resonance

IEEE/ASTM SI 10 Standard for Use of the International System of Units (SI) (the Modern Metric System)

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *longitudinal sonic pulse*—a sonic pulse in which the displacements are in the direction of propagation of the pulse.

3.1.2 *pulse travel time, (T_t)*—the total time, measured in seconds, required for the sonic pulse to traverse the specimen being tested, and for the associated electronic signals to traverse the circuits of the pulse-propagation circuitry.

3.1.3 *zero time, (T_o)*—the travel time (correction factor), measured in seconds, associated with the electronic circuits in the pulse-propagation system.

4. Summary of Test Method

4.1 The velocity of sound waves passing through the test specimen is determined by measuring the distance through the specimen and dividing by the time lapse, between the transmitted pulse and the received pulse.[3,4] An approximate value for Young's modulus can then be obtained as follows:

$$E = \rho v^2 \quad (1)$$

where:

E = Young's modulus of elasticity, Pa,
ρ = density, kg/m^3, and
v = signal velocity, m/s.

Strictly speaking, the elastic constant given by this measurement is not E but C_{33}, provided the sonic pulse is longitudinal and the direction of propagation is along the axis of symmetry.[3,4]

5. Significance and Use

5.1 Sonic velocity measurements are useful for comparing materials.

5.2 A value for Young's modulus can be obtained for many applications, which will generally be within 10 % of the value obtained by other methods, such as in Test Method C 747.

6. Apparatus

6.1 *Driving Circuit*, which consists of an ultrasonic pulse generator capable of producing pulses in a frequency range from 0. 5 to 2.6 MHz.

6.2 *Transducer*, input.

6.3 *Transducer*, output.

6.4 *Oscilloscope, dual trace* with a preamplifier and time-delay circuitry.

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.F0 on Manufactured Carbon and Graphite Products.

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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] Schreiber, Anderson, and Soga, *Elastic Constants and Their Measurement,* McGraw-Hill Book Co., 1221 Avenue of the Americas, New York, NY 10020, 1973.

[4] *American Institute of Physics Handbook*, 3rd ed., McGraw-Hill Book Co., 1221 Avenue of the Americas, New York 10020, 1972, pp. 3–98ff.