



Standard Test Method for Measuring Ultrasonic Velocity in Advanced Ceramics with Broadband Pulse-Echo Cross-Correlation Method¹

This standard is issued under the fixed designation C 1331; 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 describes a procedure for measurement of ultrasonic velocity in structural engineering solids such as monolithic ceramics, toughened ceramics, and ceramic matrix composites.

1.2 This test method is based on the broadband pulse-echo contact ultrasonic method. The procedure involves a computer-implemented, frequency-domain method for precise measurement of time delays between pairs of echoes returned by the back surface of a test sample or part.

1.3 This test method describes a procedure for using a digital cross-correlation algorithm for velocity measurement. The cross-correlation function yields a time delay between any two echo waveforms (1).²

2. Referenced Documents

2.1 ASTM Standards:³

B 311 Test Method for Density Determination for Powder Metallurgy (P/M) Materials Containing Less Than Two Percent Porosity

C 373 Test Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products

E 494 Practice for Measuring Ultrasonic Velocity in Materials

E 1316 Terminology for Nondestructive Examinations

2.2 ASNT Document:

Recommended Practice SNT-TC-1A for Nondestructive Testing Personnel Qualification and Certification⁴

2.3 Military Standard:

MIL-STD-410 Nondestructive Testing Personnel Qualification and Certification⁵

2.4 Additional references are cited in the text and at end of this document.

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *back surface*—the surface of a test sample which is opposite to the front surface and from which back surface echoes are returned at normal incidence directly to the transducer.

3.1.2 *bandwidth*—the frequency range of an ultrasonic probe, defined by convention as the difference between the lower and upper frequencies at which the signal amplitude is 6 dB down from the frequency at which maximum signal amplitude occurs.

3.1.3 *broadband transducer*—an ultrasonic transducer capable of sending and receiving undistorted signals over a broad bandwidth, consisting of a thin damped piezocrystal in a buffered probe (search unit).

3.1.4 *buffered probe*—an ultrasonic search unit as defined in Terminology E 1316 but containing a delay line, or buffer rod, to which the piezocrystal is affixed within the search unit housing and which separates the piezocrystal from the test sample (Fig. 1).

3.1.5 *buffer rod*—an integral part of a buffered probe, usually a quartz or fused silica cylinder that provides a time delay between the excitation pulse from the piezocrystal and echoes returning from a sample coupled to the free end of the buffer rod.

3.1.6 *cross-correlation function*—the cross-correlation function, implemented by a digital algorithm, yields a time delay between any two (ultrasonic) echo waveforms. This time is used to determine velocity (1).

3.1.7 *dispersion*—variation of ultrasonic velocity as a function of wavelength, that is, frequency dependence of velocity.

¹ This test method is under the jurisdiction of ASTM Committee C28 on Advanced Ceramics and is the direct responsibility of Subcommittee C28.03 on Physical Properties and Performance.

Current edition approved May 10, 2001. Published July 2001. Originally published as C 1331–96. Last previous edition C 1331–96.

² The boldface numbers in parentheses refer to the list of references at the end of this test method.

³ 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.

⁴ Available from the American Society for Nondestructive Testing, 1711 Arlington Ln., Columbus, OH 43228.

⁵ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

