



Standard Test Method for Measuring the P-Wave Speed and the Thickness of Concrete Plates Using the Impact-Echo Method¹

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1. Scope*

1.1 This test method covers procedures for determining the thickness of concrete slabs, pavements, bridge decks, walls, or other plate-like structure using the impact-echo method.

1.2 The following two procedures are covered in this test method:

1.2.1 *Procedure A: P-Wave Speed Measurement*—This procedure measures the time it takes for the P-wave generated by a short-duration, point impact to travel between two transducers positioned a known distance apart along the surface of a structure. The P-wave speed is calculated by dividing the distance between the two transducers by the travel time.

1.2.2 *Procedure B: Impact-Echo Test*—This procedure measures the frequency at which the P-wave generated by a short-duration, point impact is reflected between the parallel (opposite) surfaces of a plate. The thickness is calculated from this measured frequency and the P-wave speed obtained from Procedure A.

1.2.3 Unless specified otherwise, both Procedure A and Procedure B must be performed at each point where a thickness determination is made.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 The text of this standard references notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.5 *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 C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.64 on Nondestructive and In-Place Testing.

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2. Referenced Documents

2.1 ASTM Standards:²

C125 Terminology Relating to Concrete and Concrete Aggregates

C597 Test Method for Pulse Velocity Through Concrete

E1316 Terminology for Nondestructive Examinations

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this test method, refer to Terminology C125 and Terminology E1316.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *acoustic impedance, n* —the product of P-wave speed and density that is used in computations of characteristics of stress wave reflection at boundaries.

3.2.2 *P-wave, n* —the dilatational (longitudinal or primary) stress wave that causes particle displacement parallel to the direction of wave propagation: this wave produces normal stresses (tensile or compressive) as it propagates.

3.2.3 *P-wave speed, n* —the speed with which the P-wave propagates through a semi-infinite solid.

3.2.3.1 *Discussion*—The P-wave speed is the same as the compressional pulse velocity measured according to Test Method C597.

3.2.4 *apparent P-wave speed in a plate^{3,4}, n* —a wave speed that is equal to 0.96 of the P-wave speed:

$$C_{p, \text{plate}} = 0.96 C_p \quad (1)$$

where:

$C_{p, \text{plate}}$ = the apparent P-wave speed in a plate, m/s, and
 C_p = the P-wave speed in concrete that is obtained from Procedure A, m/s.

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 Sansalone, M. and Streett, W.B., *Impact-Echo: Nondestructive Evaluation of Concrete and Masonry*, Bullbrier Press, Ithaca, NY and Jersey Shore, PA, 1997.

⁴ Sansalone, M., Lin, J. M., and Streett, W. B., "A Procedure for Determining P-wave Speed in Concrete for Use in Impact-Echo Testing Using P-wave Speed Measurement Technique," *ACI Journal*, Vol. 94, No. 6, November–December 1997, pp. 531–539.