



Standard Test Method for Pulse Velocity Through Concrete¹

This standard is issued under the fixed designation C597; 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 reappraisal. A superscript epsilon (ε) indicates an editorial change since the last revision or reappraisal.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This test method covers the determination of the propagation velocity of longitudinal stress wave pulses through concrete. This test method does not apply to the propagation of other types of stress waves through concrete.

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

C125 Terminology Relating to Concrete and Concrete Aggregates

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

C823 Practice for Examination and Sampling of Hardened Concrete in Constructions

E1316 Terminology for Nondestructive Examinations

3. Terminology

3.1 *Definitions*—Refer to Terminology **C125** and the section related to ultrasonic examination in Terminology **E1316** for definitions of terms used in this test method.

4. Summary of Test Method

4.1 Pulses of longitudinal stress waves are generated by an electro-acoustical transducer that is held in contact with one

surface of the concrete under test. After traversing through the concrete, the pulses are received and converted into electrical energy by a second transducer located a distance L from the transmitting transducer. The transit time T is measured electronically. The pulse velocity V is calculated by dividing L by T .

5. Significance and Use

5.1 The pulse velocity, V , of longitudinal stress waves in a concrete mass is related to its elastic properties and density according to the following relationship:

$$V = \sqrt{\frac{E(1-\mu)}{\rho(1+\mu)(1-2\mu)}} \quad (1)$$

where:

E = dynamic modulus of elasticity,

μ = dynamic Poisson's ratio, and

ρ = density.

5.2 This test method is applicable to assess the uniformity and relative quality of concrete, to indicate the presence of voids and cracks, and to evaluate the effectiveness of crack repairs. It is also applicable to indicate changes in the properties of concrete, and in the survey of structures, to estimate the severity of deterioration or cracking. If used to monitor changes in condition over time, test locations are to be marked on the structure to ensure that tests are repeated at the same positions.

5.3 The degree of saturation of the concrete affects the pulse velocity, and this factor must be considered when evaluating test results (**Note 1**). In addition, the pulse velocity in saturated concrete is less sensitive to changes in its relative quality.

NOTE 1—The pulse velocity in saturated concrete may be up to 5 % higher than in dry concrete.³

5.4 The pulse velocity is independent of the dimensions of the test object provided reflected waves from boundaries do not complicate the determination of the arrival time of the directly transmitted pulse. The least dimension of the test object must exceed the wavelength of the ultrasonic vibrations (**Note 2**).

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 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 Bungey, J. H., Millard, S. G., and Grantham, M.G., 2006 *Testing of Concrete in Structures*, 4th ed., Taylor & Francis, 339 pp.