Designation: E494 – 10

# Standard Practice for Measuring Ultrasonic Velocity in Materials[1]

This standard is issued under the fixed designation E494; 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.

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

## 1. Scope*

1.1 This practice covers a test procedure for measuring ultrasonic velocities in materials with conventional ultrasonic pulse echo flaw detection equipment in which results are displayed in an A-scan display. This practice describes a method whereby unknown ultrasonic velocities in a material sample are determined by comparative measurements using a reference material whose ultrasonic velocities are accurately known.

1.2 This procedure is intended for solid materials 5 mm (0.2 in.) thick or greater. The surfaces normal to the direction of energy propagation shall be parallel to at least ±3°. Surface finish for velocity measurements shall be 3.2 µm (125 µin.) rms or smoother.

NOTE 1—Sound wave velocities are cited in this practice using the fundamental units of metres per second, with inches per second supplied for reference in many cases. For some calculations, it is convenient to think of velocities in units of millimetres per microsecond. While these units work nicely in the calculations, the more natural units were chosen for use in the tables in this practice. The values can be simply converted from m/s to mm/µs by moving the decimal point three places to the left, that is, 3500 m/s becomes 3.5 mm/µs.

1.3 Ultrasonic velocity measurements are useful for determining several important material properties. Young's modulus of elasticity, Poisson's ratio, acoustic impedance, and several other useful properties and coefficients can be calculated for solid materials with the ultrasonic velocities if the density is known (see Appendix X1).

1.4 More accurate results can be obtained with more specialized ultrasonic equipment, auxiliary equipment, and specialized techniques. Some of the supplemental techniques are described in Appendix X2. (Material contained in Appendix X2 is for informational purposes only.)

NOTE 2—Factors including techniques, equipment, types of material, and operator variables will result in variations in absolute velocity readings, sometimes by as much as 5 %. Relative results with a single combination of the above factors can be expected to be much more accurate (probably within a 1 % tolerance).

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

1.6 *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]

C597 Test Method for Pulse Velocity Through Concrete

E317 Practice for Evaluating Performance Characteristics of Ultrasonic Pulse-Echo Testing Instruments and Systems without the Use of Electronic Measurement Instruments

E543 Specification for Agencies Performing Nondestructive Testing

E797 Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method

E1316 Terminology for Nondestructive Examinations

2.2 *ASNT Documents:*[3]

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

ASNI/ASNT-CP-189 Standard for Qualification and Certification of Nondestructive Testing Personnel

2.3 *AIA Document:*[4]

NAS-410 Certification and Qualification of Nondestructive Testing Personnel

## 3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, see Terminology E1316.

[1] This practice is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.06 on Ultrasonic Method.

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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] Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518, http://www.asnt.org.

[4] Available from Aerospace Industries Association of America, Inc. (AIA), 1250 Eye St., NW, Washington, DC 20005.

***A Summary of Changes section appears at the end of this standard**

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