



Standard Practice for Measuring Ultrasonic Velocity in Materials¹

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This specification has been approved for use by agencies of the 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 $\pm 3^\circ$. Surface finish for velocity measurements shall be 3.2 μm (125 $\mu\text{in.}$) rms or smoother.

NOTE 1—Sound wave velocities are cited in this practice using the fundamental units of meters 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 millimeters 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/sec to mm/ μsec by moving the decimal point three places to the left, that is, 3500 m/s becomes 3.5 mm/ μsec .

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 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:

C 597 Test Method for Pulse Velocity Through Concrete²

E 317 Practice for Evaluating Performance Characteristics of Ultrasonic Pulse-Echo Examination Instruments and Systems Without the Use of Electronic Measurement Instruments³

E 797 Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method³

E 1316 Terminology for Nondestructive Examinations³

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, see Terminology E 1316.

4. Summary of Practice

4.1 Several possible modes of vibration can propagate in solids. This procedure is concerned with two velocities of propagation, namely those associated with longitudinal (v_l) and transverse (v_t) waves. The longitudinal velocity is independent of sample geometry when the dimensions at right angles to the beam are very large compared with beam area and wave length. The transverse velocity is little affected by physical dimensions of the sample. The procedure described in Section 6 is, as noted in the scope, for use with conventional pulse echo flaw detection equipment only.

5. Apparatus

5.1 The ultrasonic testing system to be used in this practice shall include the following:

5.1.1 *Test Instrument*—Any ultrasonic instrument comprising a time base, transmitter (pulser), receiver (echo amplifier),

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 *Annual Book of ASTM Standards*, Vol 04.02.

³ *Annual Book of ASTM Standards*, Vol 03.03.