



Standard Practice for Ultrasonic Angle-Beam Contact Testing¹

This standard is issued under the fixed designation E587; 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 practice covers ultrasonic examination of materials by the pulse-echo technique, using continuous coupling of angular incident ultrasonic vibrations.

1.2 This practice shall be applicable to development of an examination procedure agreed upon by the users of the practice.

1.3 The values stated in inch-pound units are regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *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

E114 Practice for Ultrasonic Pulse-Echo Straight-Beam Contact Testing

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

E1316 Terminology for Nondestructive Examinations

2.2 ASNT Documents:³

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

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

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.

Current edition approved June 1, 2010. Published July 2010. Originally approved in 1976. Last previous edition approved in 2005 as E587 - 00(2005). DOI: 10.1520/E0587-10.

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 Arlington Ln., Columbus, OH 43228-0518, <http://www.asnt.org>.

2.3 Military Standards:⁴

MIL-STD-410 Nondestructive Testing Personnel Qualification and Certification

2.4 Aerospace Industries Association Document:⁵

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.

4. Significance and Use

4.1 An electrical pulse is applied to a piezoelectric transducer which converts electrical to mechanical energy. In the angle-beam search unit, the piezoelectric element is generally a thickness expander which creates compressions and rarefactions. This longitudinal (compressional) wave travels through a wedge (generally a plastic). The angle between transducer face and the examination face of the wedge is equal to the angle between the normal (perpendicular) to the examination surface and the incident beam. Fig. 1 shows the incident angle ϕ_i , and the refracted angle ϕ_r , of the ultrasonic beam.

4.2 When the examination face of the angle-beam search unit is coupled to a material, ultrasonic waves may travel in the material. As shown in Fig. 2, the angle in the material (measured from the normal to the examination surface) and mode of vibration are dependent on the wedge angle, the ultrasonic velocity in the wedge, and the velocity of the wave in the examined material. When the material is thicker than a few wavelengths, the waves traveling in the material may be longitudinal and shear, shear alone, shear and Rayleigh, or Rayleigh alone. Total reflection may occur at the interface. (Refer to Fig. 3.) In thin materials (up to a few wavelengths thick), the waves from the angle-beam search unit traveling in the material may propagate in different Lamb wave modes.

4.3 All ultrasonic modes of vibration may be used for angle-beam examination of material. The material forms and

⁴ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>.

⁵ Available from Aerospace Industries Association of America, Inc. (AIA), 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209-3928, <http://www.aia-aerospace.org>.