Designation: E 587 – 00

Standard Practice for Ultrasonic Angle-Beam Examination by the Contact Method[1]

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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 The values stated in inch-pound units are regarded as standard. The SI equivalents are in parentheses and may be approximate.

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:*

E 114 Practice for Ultrasonic Pulse-Echo Straight-Beam Examination by the Contact Method[2]

E 317 Practice for Evaluating Performance Characteristics of Ultrasonic Pulse-Echo Testing Systems Without the Use of Electronic Measurement Instruments[2]

E 543 Practice for Agencies Performing Nondestructive Testing[2]

E 1316 Terminology for Nondestructive Examinations[2]

2.2 *ASNT Documents:*

SNT-TC-1A Recommended Practice for Nondestructive Testing Personnel Qualification and Certification[3]

ANSI/ASNT CP-189 Standard for Qualification and Certification of Nondestructive Testing Personnel[3]

2.3 *Military Standards:*

MIL-STD-410 Nondestructive Testing Personnel Qualification and Certification[4]

2.4 *Aerospace Industries Association Document:*

NAS 410 Certification and Qualification of Nondestructive Testing Personnel[5]

3. Terminology

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

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 the probable flaw locations and orientations determine selection of beam directions and modes of vibration. The use of angle beams and the selection of the proper wave mode presuppose a knowledge of the geometry of the object; the probable location, size, orientation, and reflectivity of the expected flaws; and the laws of physics governing the propagation of ultrasonic waves. Characteristics of the examination system used and the ultrasonic properties of the material being

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[2] *Annual Book of ASTM Standards*, Vol 03.03.

[3] Available from American Society for Nondestructive Testing, Inc., 1711 Arlingate Lane, Columbus, OH 43228.

[4] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

[5] Available from Aerospace Industries Association of America, Inc., 1250 Eye St. NW, Washington D.C. 20005.

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