



Designation: E1001 – 21

Standard Practice for Detection and Evaluation of Discontinuities by the Immersed Pulse-Echo Ultrasonic Method Using Longitudinal Waves¹

This standard is issued under the fixed designation E1001; 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 describes procedures for the ultrasonic examination of bulk materials or parts by transmitting pulsed, longitudinal waves through a liquid couplant into the material and observing the indications of reflected waves (see Fig. 1). It covers only examinations in which one search unit is used as both transmitter and receiver (pulse-echo) and in which the part or material being examined is coupled to the part by a liquid column or is totally submerged in the couplant (either method is considered to be immersion testing). This practice includes general requirements and procedures which may be used for detecting discontinuities and for making a relative or approximate evaluation of the size of discontinuities.

1.2 This practice replaces Practice E214 and provides more detailed procedures for the selection, standardization, and operation of an examination system and for evaluation of the indications obtained.

1.3 *Units*—The values stated in inch-pound units are to be 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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. Referenced Documents

2.1 ASTM Standards:²

C1212 Practice for Fabricating Ceramic Reference Specimens Containing Seeded Voids (Withdrawn 2018)³

C1336 Practice for Fabricating Non-Oxide Ceramic Reference Specimens Containing Seeded Inclusions (Withdrawn 2018)³

E127 Practice for Fabrication and Control of Flat Bottomed Hole Ultrasonic Standard Reference Blocks

E214 Practice for Immersed Ultrasonic Testing by the Reflection Method Using Pulsed Longitudinal Waves (Withdrawn 2007)³

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:⁴

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

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

2.3 AIA Document:⁵

NAS-410 Certification and Qualification of Nondestructive Testing Personnel

NOTE 1—For DoD contracts, unless otherwise specified, the issues of the documents, which are DoD adopted, are those listed in the issue of the DoDISS (Department of Defense Index of Specifications Standards) cited in the solicitation.

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 The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlington Ln., Columbus, OH 43228-0518, <http://www.asnt.org>.

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

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

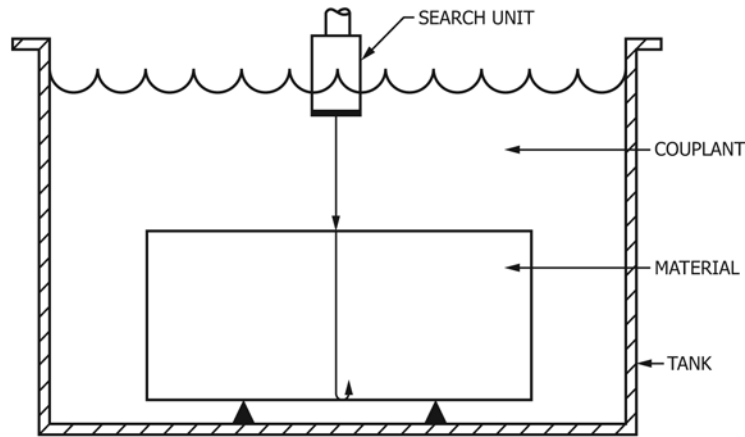


FIG. 1 Basic Immersion Setup

2.4 ISO Document:⁶

ISO 9712 Non-destructive Testing—Qualification and Certification for NDT Personnel

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *effective beam diameter, n* —that distance through which a search unit can be traversed across a reference reflector so that the corresponding echo amplitude is at least one half (–6 dB) of the maximum amplitude. The effective beam diameter is not a characteristic of the search unit alone, but is dependent on propagating medium, distance to the discontinuity, reflector geometry, etc.

3.2.2 *scan index, n* —the length of the step created by indexing the scan of the search unit over the part, that is continuously scanning in one direction, then stepping in the direction perpendicular to the scan or making a linear advance per rotation (pitch) for rotary scan of cylindrical parts. The allowable scan index should be correlated with the search unit effective beam diameter to ensure full coverage of the part as described in 8.2 below.

3.2.3 *transfer, n* —a change in scanning gain to compensate for differences in attenuation of the reference standard and the part or material being examined.

4. Summary of Practice

4.1 This practice describes a means for obtaining an evaluation of discontinuities in materials by immersed examination with longitudinal ultrasonic waves. Equipment, reference standards, examination and evaluation procedures, and documentation are described in detail.

5. Basis of Application

5.1 The following items are subject to contractual agreement between the parties using or referencing this practice.

5.2 *Personnel Qualification:*

5.2.1 If specified in the contractual agreement, personnel performing examinations to this practice shall be qualified in accordance with a nationally or internationally recognized NDT personnel qualification practice or standard such as ANSI/ASNT-CP-189, SNT-TC-1A, NAS-410, ISO 9712, or a similar document and certified by the employer or certifying agency, as applicable. The practice or standard used and its applicable revision shall be identified in the contractual agreement between the using parties.

5.3 *Qualification of Nondestructive Agencies*—If specified in the contractual agreement, NDT agencies shall be qualified and evaluated as described in Specification E543. The applicable edition of Specification E543 shall be specified in the contractual agreement.

5.4 *Procedures and Techniques*—The procedures and techniques to be utilized shall be as specified in the contractual agreement.

5.5 *Surface Preparation*—The pre-examination surface preparation criteria shall be in accordance with 8.1 unless otherwise specified.

5.6 *Extent of Examination*—The extent of examination shall be in accordance with 12.3, unless otherwise specified.

5.7 *Reporting Criteria/Acceptance Criteria*—Reporting criteria and acceptance criteria for the examination results shall be in accordance with 12.3, unless otherwise specified.

5.8 *Reexamination of Repaired/Reworked Items*—Reexamination of repaired/reworked items is not addressed in this practice and if required shall be specified in the contractual agreement.

6. Significance and Use

6.1 This practice provides guidelines for the application of immersed longitudinal wave examination to the detection and quantitative evaluation of discontinuities in materials.

6.2 Although not all requirements of this practice can be applied universally to all examination situations and materials, it does provide a basis for establishing contractual criteria between suppliers and purchasers of materials for performing

⁶ Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.