



Designation: **E664/E664M – 10 E664/E664M – 15**

Standard Practice for the Measurement of the Apparent Attenuation of Longitudinal Ultrasonic Waves by Immersion Method¹

This standard is issued under the fixed designation E664/E664M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope—Scope*

1.1 This practice describes a procedure for measuring the apparent attenuation of ultrasound in materials or components with flat, parallel surfaces using conventional pulse-echo ultrasonic flaw detection equipment in which reflected indications are displayed in an A-scan presentation.

1.2 The measurement procedure is readily adaptable for the determination of relative attenuation between materials. For absolute (true) attenuation measurements, indicative of the intrinsic nature of the material, it is necessary to correct for specimen geometry, sound beam divergence, instrumentation, and procedural effects. These results can be obtained with more specialized ultrasonic equipment and techniques.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the 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

[E214 Practice for Immersed Ultrasonic Testing by the Reflection Method Using Pulsed Longitudinal Waves \(Withdrawn 2007\)](#)³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 Other Documents:

[SNT-TC-1A Recommended for Personnel Qualification and Certification of Nondestructive Testing Personnel](#)³

[ANSI/ASNT CP-189 ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel](#)²

[NAS-410 NAS Certification and Qualification of Nondestructive Personnel \(Quality Assurance Committee\)](#)⁴

[ISO 9712 Non-destructive Testing—Qualification and Certification of NDT Personnel](#)⁵

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, see Terminology [E1316](#).

4. Summary of Practice

4.1 This practice describes a procedure for determining apparent attenuation by measuring the decay of multiple back reflections of longitudinal ultrasonic waves introduced into specimens with flat, parallel surfaces by the immersion technique.

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; June 1, 2015. Published July 2010; June 2015. Originally approved in 1978. Last previous edition approved in 2005 as E664 – 03E664 – 10. (2005). DOI: 10.1520/E0664 – E0664M-10; 10.1520/E0664 – E0664M-15.

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

⁴ Available from Aerospace Industries Association of America, Inc., 1250 Eye St., NW, Washington, DC 20005.

⁵ Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, http://www.iso.org.

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

5. Significance and Use

5.1 The measurement of apparent attenuation in materials is useful in applications such as the comparison of heat treatments of different lots of material or the assessment of the degradation of materials due to environment.

5.2 Several different modes of wave vibration can be propagated in solids. This practice is concerned with the attenuation associated with longitudinal waves introduced into the specimen by the immersion method.

5.3 This practice allows for the comparison of the apparent attenuations of geometrically similar specimens.

5.4 For the determination of apparent attenuation, the procedures described herein are valid only for measurements in the far field of the ultrasonic beam.

6. Basis of Application

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

6.2 Personnel Qualification

6.2.1 If specified in the contract agreement, personnel performing examinations to this standard 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 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.

6.3 *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.

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

6.5 *Timing of Examination*—The timing of examination shall be identified in the contractual agreement between the using parties.

6.6 *Extent of Examination*—The extent of the examination shall be identified in the contractual agreement between the using parties.

6.7 *Reporting Criteria/Acceptance Criteria*—Reporting criteria for the examination results shall be in accordance with Section 10 unless otherwise specified. Since acceptance criteria are not specified in this standard, they shall be specified in the contractual agreement.

6.8 *Re-examination of Repair/Reworked Items*—Re-examination of repaired/reworked items is not addressed in this standard and if required shall be specified in the contractual agreement.

7. Apparatus

7.1 *Ultrasonic Flaw Detection System*— A system capable of generating, receiving, and displaying electrical pulses ultrasonic energy at the frequency of interest. Display shall be an A-scan presentation.

7.1.1 *Performance Characteristics*—The vertical linearity limits shall be determined as specified in Practice E317. All measurements shall be made only within the linear ranges of the system.

7.2 *Search Unit*—The size and frequency should be determined to suit the application, and only non-focused search units may be used.

7.3 *Couplant*—Normally water. See Practice Terminology E214/E1316 for alternatives.

7.4 *Reference Block*—The use of a reference block is suggested to evaluate the stability of the measurement system if measurements will be made over a period of time. The reference block should have acoustic properties similar to those of the examined material in the frequency range of interest.

8. Specimen

8.1 *Geometric Similarity*—When comparing the apparent attenuations of two or more materials or components, the specimens used must be geometrically similar. They must be flat and parallel within 0.008 in. [0.20 mm]/in. [25.4 mm] of diameter or cross section and differ in thickness by no more than a factor of 2. The cross section of each specimen must meet the requirements of 7.28.2.

8.2 *Minimum Dimensions*—The thickness of the specimen (parallel to the ultrasonic beam) shall be of a dimension so that at least two back surface reflections can be resolved at the frequency of interest. The dimensions normal to the ultrasonic beam shall be much greater than the beam width and wavelength (at least three times the transducer dimension) so that side wall echoes do not interfere with the measurements.

NOTE 1—For the determination of true attenuation, careful consideration must be made of parameters such as front surface and back surface parallelism, surface finish, etc. However, useful apparent attenuation information can be obtained if the requirements of 7.18.1 and 7.28.2 are satisfied.