Designation: E 664 – 93 (Reapproved 2000)

Standard Practice for the Measurement of the Apparent Attenuation of Longitudinal Ultrasonic Waves by Immersion Method[1]

This standard is issued under the fixed designation E 664; 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 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 inch-pound units are to be regarded as 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:*

E 214 Practice for Immersed Ultrasonic Examination by the Reflection Method Using Pulsed Longitudinal Waves[2]

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

E 1316 Terminology for Nondestructive Examinations[2]

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this practice, see Terminology E 1316.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *apparent attenuation*—the *observed* ultrasound energy loss. In addition to the true loss, the apparent attenuation may also include losses attributable to instrumentation, specimen configuration, beam divergence, interface reflections, and measurement procedure.

3.2.2 *attenuation*—a factor that describes the decrease in ultrasound intensity with distance. Normally expressed in decibels per unit length.

NOTE 1—The attenuation parameter is sometimes expressed in nepers (Np) per unit length. The value in decibels (dB) is 8.68 times the value in nepers. If the loss over a path is 1 Np, then the amplitude has fallen to 1/e of its initial value (e = 2.7183. . .).

3.2.3 *decibel (dB)*—twenty times the logarithmic expression of the ratio of two amplitudes.

$$dB = 20 \log_{10} (\text{amplitude ratio})$$

3.2.4 *true attenuation*—that portion of the observed ultrasound energy loss which is intrinsic to the medium through which the ultrasound propagates. True attenuation losses may be attributed to the basic mechanisms of absorption and scattering.

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.

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.

[1] This practice is under the jurisdiction of ASTM Committee E-7 on Nondestructive Testing, and is the direct responsibility of Subcommittee E 07.06 on Ultrasonic Method.

Current edition approved Sept. 15, 1993. Published November 1993. Originally published as E 664 – 78. Last previous edition E 664 – 78 (1989)$^{\epsilon 1}$.

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