



Standard Practice for Ultrasonic Testing of Geomembranes¹

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1. Scope

1.1 This practice provides a summary of equipment and procedures for ultrasonic testing of geomembranes using the pulse echo method.

1.2 Ultrasonic wave propagation in solid materials is correlated to physical and mechanical properties and condition of the materials. In ultrasonic testing, two wave propagation characteristics are commonly determined: velocity (based on wave travel time measurements) and attenuation (based on wave amplitude measurements). Velocity of wave propagation is used to determine thickness, density, and elastic properties of materials. Attenuation of waves in solid materials is used to determine microstructural properties of the materials. In addition, frequency characteristics of waves are analyzed to investigate the properties of a test material. Travel time, amplitude, and frequency distribution measurements are used to assess the condition of materials to identify damage and defects in solid materials. Ultrasonic measurements are used to determine the nature of materials/media in contact with a test specimen as well. Measurements are conducted in the time-domain (time versus amplitude) or frequency-domain (frequency versus amplitude).

1.3 Measurements of one or more ultrasonic wave transmission characteristics are made based on the requirements of the specific testing program.

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:

D 4437 Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes

D 4545 Practice for Determining the Integrity of Factory Seams Used in Joining Manufactured Flexible Sheet Geomembranes

D 4883 Test Method for Density of Polyethylene by the

Ultrasound Technique

E 1316 Terminology for Nondestructive Examinations

3. Terminology

3.1 Definitions:

3.1.1 *geomembrane, n*—an essentially impermeable geosynthetic composed of one or more synthetic sheets.

3.1.2 *atmosphere for testing geomembranes, n*—air maintained at a relative humidity of 50 to 70 % and a temperature of $21 \pm 1^\circ\text{C}$.

3.1.3 For definitions of terms related to ultrasonic testing, refer to Terminology E 1316.

4. Summary of Practice

4.1 Mechanical waves are introduced to a geomembrane from a surface of the material using an ultrasonic transducer. Transmission characteristics of the waves in the geomembrane are determined. The measured characteristics are used to evaluate certain properties and condition of geomembranes.

5. Significance and Use

5.1 This practice covers test arrangements, measurement techniques, sampling methods, and calculations to be used for nondestructive evaluation of geomembranes using ultrasonic testing.

5.2 Wave velocity may be established for particular geomembranes (for specific polymer type, specific formulation, specific density). Relationships may be established between velocity and both density and tensile properties of geomembranes. An example of the use of ultrasound for determining density of polyethylene is presented in Test Method D 4883. Velocity measurements may be used to determine thickness of geomembranes **(1, 2)**.² Travel time and amplitude of transmitted waves may be used to assess the condition of geomembranes and to identify defects in geomembranes including surface defects (for example, scratches, cuts), inner defects (for example, discontinuities within geomembranes), and defects that penetrate the entire thickness of geomembranes (for example, pinholes) **(3, 4)**. Bonding between geomembrane sheets can be evaluated using travel time, velocity, or impedance measurements for seam assessment

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.