



Standard Test Method for High-Strain Dynamic Testing of Piles¹

This standard is issued under the fixed designation D 4945; 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 test method covers the procedure for testing vertical or batter piles individually to determine the force and velocity response of the pile to an impact force applied axially by a pile driving hammer or similar device that will cause a large strain impact to the top of the pile. This test method is applicable to deep foundation units that function in a manner similar to foundation piles, regardless of their method of installation provided that they are receptive to high strain impact testing.

1.2 *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.* For a specific precautionary statement, see Note 5.

NOTE 1—High-strain dynamic testing requires a strain at impact which is representative of a force in the pile having the same order of magnitude, or greater, than the ultimate capacity of the pile.

NOTE 2—This standard method may be applied for high-strain dynamic testing of piles with the use of only force or strain transducers and/or acceleration, velocity or displacement transducers as long as the test results clearly state how the testing deviates from the standard.

NOTE 3—A suitable follower may be required for testing cast-in-place concrete piles. This follower should have an impedance between 80 and 150 % of that of the pile. However, additional caution and analysis may be required if the impedance is not within 10 %. For mandrel-driven piles, the mandrel may be instrumented in a similar way to a driven pile provided that the mandrel is constructed of a single member with no joints.

2. Referenced Documents

2.1 ASTM Standards:

- C 469 Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression²
- D 198 Methods of Static Tests of Timbers in Structural Sizes³
- D 653 Terminology Relating to Soil, Rock, and Contained Fluids⁴

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² Annual Book of ASTM Standards, Vol 04.02.

³ Annual Book of ASTM Standards, Vol 04.10.

⁴ Annual Book of ASTM Standards, Vol 04.08.

D 1143 Test Method for Piles Under Static Axial Compressive Load⁴

3. Terminology

3.1 Except as defined in 3.2, the terminology used in this test method conforms with Terminology D 653.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *capblock*—the material inserted between the hammer striker plate and the drive cap on top of the pile (also called hammer cushion).

3.2.2 *cushion*—the material inserted between the drive cap on top of the pile and the pile (also called pile cushion).

3.2.3 *impact event*—the period of time during which the pile is moving in a positive and/or negative direction of penetration due to the impact force application. See Fig. 1.

3.2.4 *moment of impact*—the first moment of time after the start of the impact event when the acceleration is zero. See Fig. 1.

3.2.5 *pile impedance*—indicates the resistance a pile has to a sudden impact change in velocity.

3.2.5.1 *Discussion*—It can be calculated by multiplying the cross-sectional area by Young's Modulus of Elasticity and dividing the product by the strain wave speed. Alternatively, the impedance can be calculated by multiplying the unit specific density by the wave speed and cross-sectional area.

$$Z = AE/c = \rho CA \quad (1)$$

where:

Z = Impedance,

A = Cross-sectional area,

E = Young's Modulus of Elasticity,

C = Wave speed of pile, and

ρ = Unit specific density.

3.2.6 *strain wave speed (or wave speed)*—the speed with which a strain wave propagates through a pile; it is a property of the pile composition.

3.2.7 *particle velocity*—the instantaneous velocity of a particle in the pile as a strain wave passes by.

3.2.8 *restriking*—the redriving of a previously driven pile after a waiting period of from 15 min to 30 days or more.

3.2.8.1 *Discussion*—The length of the waiting period is dependent upon the type of pile and the soil conditions along the shaft and at the toe of the pile.