Designation: D6951/D6951M – 18 (Reapproved 2023)

Standard Test Method for Use of the Dynamic Cone Penetrometer in Shallow Pavement Applications[1]

This standard is issued under the fixed designation D6951/D6951M; 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 measurement of the penetration rate of the dynamic cone penetrometer with an 8 kg [17.6 lb] hammer (8 kg [17.6 lb] DCP) through undisturbed soil or compacted materials, or both. The penetration rate may be related to *in situ* strength such as an estimated *in situ* CBR (California Bearing Ratio). A soil density may be estimated (Note 1) if the soil type and moisture content are known. The DCP described in this test method is typically used for pavement applications.

1.2 The test method provides for an optional 4.6 kg [10.1 lb] sliding hammer when the use of the 8 kg [17.6 lb] sliding mass produces excessive penetration in soft ground conditions.

1.3 *Units*—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 nonconformance 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, 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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D7380/D7380M Test Method for Soil Compaction Determination at Shallow Depths Using 2.3-kg [5-lbm] Dynamic Cone Penetrometer

3. Terminology

3.1 *Definitions:*

3.1.1 *8 kg [17.6 lb] DCP dynamic cone penetrometer, n*—a device with an 8 kg [17.6 lb] hammer used to assess the *in situ* strength of undisturbed soil or compacted materials, or both, by dropping the hammer from a set height and measuring the depth of penetration and counting hammer drops (blows). (See Fig. 1.)

3.1.2 *sliding attachment, n*—an optional device used in reading the distance the DCP tip has penetrated. It may be fastened to the anvil or lower rod to hold/slide along a separate measuring rod, or it may be fastened to the separate rod and slide along a graduated drive rod. (See Fig. 1.)

4. Summary of Test Method

4.1 The operator drives the DCP tip into soil by lifting the sliding hammer to the handle and then releasing it. The total penetration for a given number of blows is measured and recorded in mm/blow, which is then used to describe stiffness, estimate an *in situ* CBR strength from an appropriate correlation chart, or other material characteristics.

5. Significance and Use

5.1 This test method is used to assess *in situ* strength of undisturbed soil and compacted materials (or both). The penetration rate of the 8 kg [17.6 lb] DCP can be used to

[1] This test method is under the jurisdiction of ASTM Committee E17 on Vehicle - Pavement Systems and is the direct responsibility of Subcommittee E17.41 on Pavement Testing and Evaluation.

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[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.

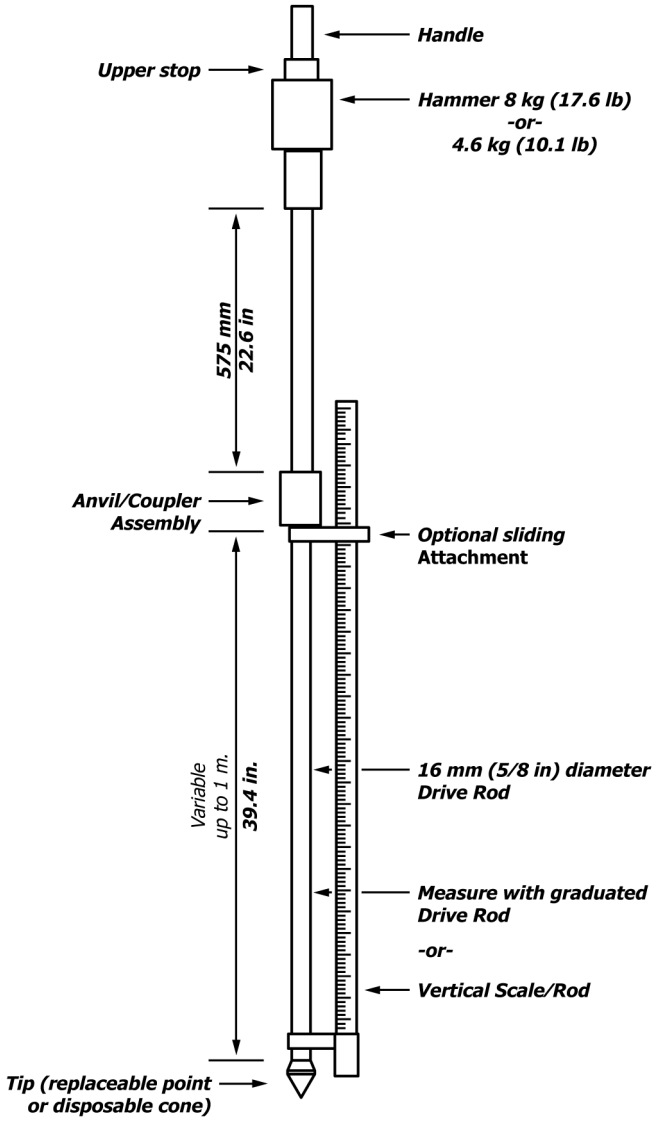

FIG. 1 Schematic of DCP Device

estimate *in situ* CBR (California Bearing Ratio), to identify strata thickness, shear strength of strata, and other material characteristics.

5.1.1 Other test methods exist for DCPs with different hammer weights and cone tip sizes, which have correlations that are unique to the instrument, such as Test Method D7380/D7380M.

5.2 The 8 kg [17.6 lb] DCP is held vertically, and therefore is typically used in horizontal construction applications, such as pavements and floor slabs.

5.3 This instrument is typically used to assess material properties down to a depth of 1000 mm [39 in.] below the surface. The penetration depth can be increased using drive rod extensions. However, if drive rod extensions are used, care should be taken when using correlations to estimate other parameters, since these correlations are only appropriate for specific DCP configurations. The mass and inertia of the device will change and skin friction along drive rod extensions will occur.

5.4 The 8 kg [17.6 lb] DCP can be used to estimate the strength characteristics of fine and coarse-grained soils, granular construction materials, and weak stabilized or modified materials. The 8 kg [17.6 lb] DCP cannot be used in highly stabilized or cemented materials or for granular materials containing a large percentage of aggregates greater than 50 mm [2 in.].

5.5 The 8 kg [17.6 lb] DCP can be used to estimate the strength of *in situ* materials underlying a bound or highly stabilized layer by first drilling or coring an access hole.

NOTE 1—The DCP may be used to assess the density of a fairly uniform material by relating density to penetration rate on the same material. In this way, undercompacted or "soft" spots can be identified, even though the DCP does not measure density directly.[3]

5.6 A field DCP measurement results in a field or *in situ* CBR and will not normally correlate with the laboratory or soaked CBR of the same material. The test is thus intended to evaluate the *in situ* strength of a material under existing field conditions.

6. Apparatus

6.1 The 8 kg [17.6 lb] DCP is shown schematically in Fig. 1. It consists of the following components: a 16 mm [⅝ in.] diameter steel drive rod with a replaceable point or disposable cone tip, an 8 kg [17.6 lb] hammer which is dropped from a fixed height of 575 mm [22.6 in.], a coupler assembly, and a handle. The tip has an included angle of 60° and a diameter at the base of 20 mm [0.79 in.]. (See Fig. 2.)

6.1.1 The apparatus is typically constructed of stainless steel, with the exception of the replacement point tip, which may be constructed from hardened tool steel or a similar material resistant to wear.

6.2 The following tolerances are required:

6.2.1 Hammer weight measurement of 8.0 kg [17.6 lb]; tolerance is 0.01 kg [0.02 lb],

[3] "METHOD ST6: Measurement of the In Situ Strength of Soils by the Dynamic Cone Penetrometer (DCP), Special Methods for Testing Roads," Draft TMH6, Technical Methods for Highways (TMH), Pretoria, South Africa, ISBN 0 7988 2289 9, 1984, p. 20.

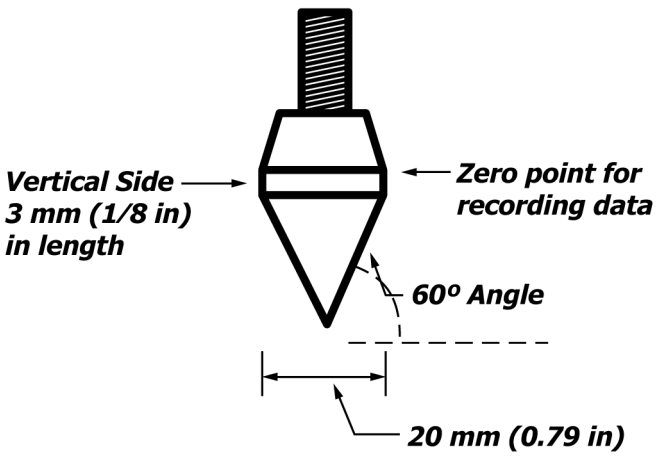

FIG. 2 Replaceable Point Tip