



Designation: D8121/D8121M – 19

# Standard Test Method for Approximating the Shear Strength of Cohesive Soils by the Handheld Vane Shear Device<sup>1</sup>

This standard is issued under the fixed designation D8121/D8121M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

## 1. Scope

1.1 This test method describes approximating the shear strength of cohesive soils using a handheld (pocket) vane shear device.

1.2 The device allows for a simple and portable method for measuring the approximate undrained shear strength of saturated, fine-grained, cohesive soils. The test method can be used in the field or in the laboratory, on the ends of sample tubes, on the surface of block samples or excavations, or on the surface of other test specimens with rigid confinement.

1.3 *Units*—The values stated in either inch-pound units or SI units [given in brackets] 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. Tables of critical dimensions and tolerances of the described vanes are provided in separate units of inches and mm.

NOTE 1—The original shear vane device was developed when shear strength was often reported in tons per square foot (TSF) or kilograms per square centimeter ( $\text{kg}/\text{cm}^2$ ) which are approximately equivalent. These units have prevailed within the industry and are adopted herein.

1.4 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice [D6026](#), unless superseded by this test method.

1.4.1 The procedures used to specify how data are collected, recorded, and calculated in this standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives, and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee [D18](#) on Soil and Rock and is the direct responsibility of Subcommittee [D18.05](#) on Strength and Compressibility of Soils.

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of this test method to consider significant digits used in analysis methods for engineering design.

1.5 *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.*

1.6 *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*:<sup>2</sup>

[D653 Terminology Relating to Soil, Rock, and Contained Fluids](#)

[D2216 Test Methods for Laboratory Determination of Water \(Moisture\) Content of Soil and Rock by Mass](#)

[D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction](#)

[D4648 Test Methods for Laboratory Miniature Vane Shear Test for Saturated Fine-Grained Clayey Soil](#)

[D6026 Practice for Using Significant Digits in Geotechnical Data](#)

## 3. Terminology

3.1 *Definitions*:

3.1.1 For common definitions of technical terms used in this test method, refer to Terminology [D653](#).

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *vane multiplier (VM), n*—a multiplier to correct the vane's dial reading based on the standard (mid-size) vane to the larger or smaller vane ([4.2](#)).

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.2.2 *calibration factor (CF), n*—correction to the vane’s dial reading based upon the physical calibration of the torsional shear device in accordance with **Annex A1**.

#### 4. Summary of Test Method

4.1 The handheld vane shear device is comprised of a calibrated torque spring, post, measuring scale, and one of three vanes. A flat surface is prepared on a specimen of cohesive soil, usually confined by a sampling tube or specimen ring; the side walls of a test pit; or exposed footing. The vane is pressed into the soil surface and the device is rotated at a specified rate until the soil shears. The failure surface is prescribed by the face of the vane and the depth of the blades. A pointer retains the maximum value on the measuring scale, ranging from 0 to 1 TSF [0 to 100 kPa], with major divisions of 0.05 TSF [5 kPa] when a standard (mid-size) shear vane is used.

4.2 Typically, three vane sizes are provided with the device. The standard (mid-sized) vane has a multiplier of 1. The smaller vane is used for stiffer soils and typically has a multiplier of 2.5. The larger vane is used for softer soils and typically has a multiplier of 0.2. The reading on the scale is multiplied by the factor for the specific vane to obtain the correct measure of strength.

#### 5. Significance and Use

5.1 The handheld shear vane method provides a rapid method of measuring the approximate undrained shear strength of a fine-grained, cohesive soil either in the field or laboratory. This standard does not supplement or replace **D4648**.

5.2 The device is intended for use in saturated cohesive soils for determining their approximate undrained shear strength. Cohesive soils with appreciable amounts of silt or fine sand

may experience some degree of drainage during shear and adversely affect the results.

NOTE 2—The user will probably not know at the time of testing if the material is saturated. However, that would not preclude using the device for less than saturated conditions based on the knowledge and experience of the user.

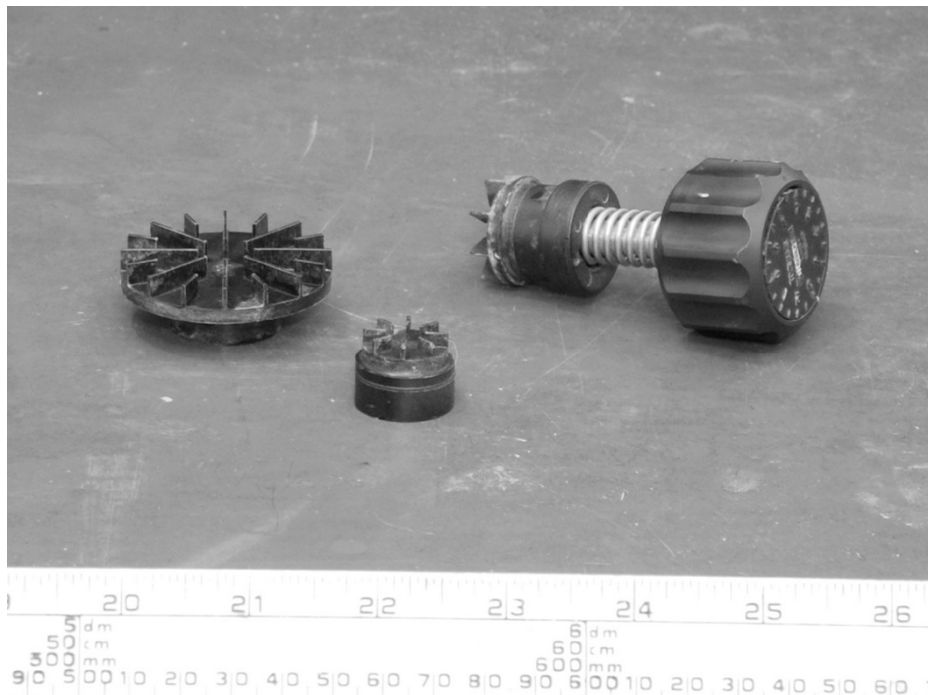
5.3 The presence of coarse materials or heterogeneous soils within the testing volume will adversely affect the results and may preclude the use of this test method.

5.4 The handheld shear vane test is not used to duplicate any particular field conditions but supplements the overall investigative program. However, consistent physical parameters are used in the test such that correlations of shear strength data can be made to evaluate variability of a deposit, assess sample quality, assist in planning of laboratory testing programs, and to classify the consistency.

NOTE 3—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice **D3740** are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice **D3740** does not in itself assure reliable results. Reliable results depend on many factors; Practice **D3740** provides a means of evaluating some of those factors.

#### 6. Apparatus

6.1 *Torsional Shear Device*—A mechanical device consisting of a calibrated torque spring attached to a measuring scale and outfitted with one or multiple interchangeable vanes. **Fig. 1** shows an example of a typical torsional shear device with standard (mid-size) vane attached, along with a smaller and a larger sized vane. **Fig. 2** is a schematic of the torsional shear device.



**FIG. 1** Example of a Typical Torsional Shear Device with Standard (mid-size) Vane Attached, Along with Smaller and Larger Sized Vanes

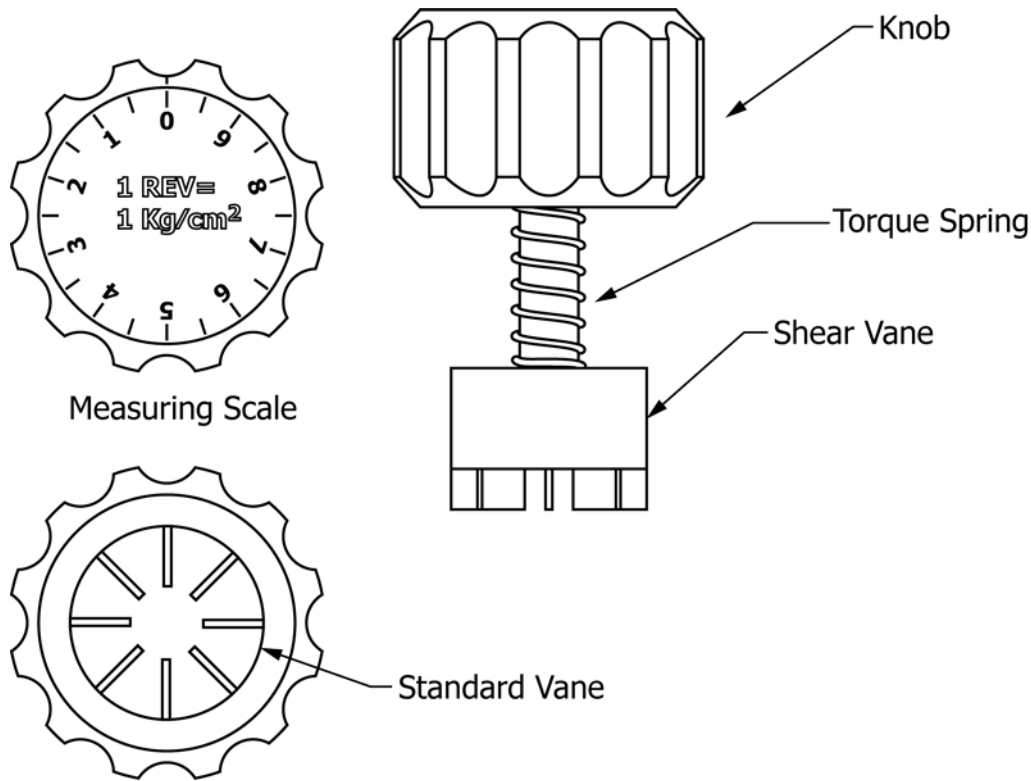


FIG. 2 Schematic of Torsional Shear Device

6.1.1 *Torque Spring*—The torque spring shall be calibrated for the appropriate measuring scale. This is typically performed by the manufacturer at the time of assembly.

6.1.2 *Measuring Scale*—The measuring scale shall measure from 0 to 1 TSF [0 to 100 kPa], with major divisions of 0.05 TSF [5 kPa], allowing interpolation to the nearest half division 0.025 TSF [2.5kPa] when the standard (mid-size) shear vane is attached. The measuring scale shall be outfitted with a pointer that retains the maximum value.

NOTE 4—The scale of some handheld shear vanes is provided in kilograms per square centimeter ( $\text{kg}/\text{cm}^2$ ) which are generally regarded as equivalent in value to tons per square foot (TSF) for this test method.

6.1.3 *Knob*—The device shall have a knob that allows for gripping and rotating of the device without impacting the measured value on the scale.

6.2 *Vane(s)*—Vaness are constructed of stiff material such as machined steel or aluminum, or plastic either injected molded or 3D printed. At least one vane of known multiplier is required. Each vane shall have blades along the face of the vane. Each blade shall extend from the face of the vane. The depth of the blade affects the multiplier for the vane. The multiplier for the vane is provided by the manufacturer and generally 1 by the standard 1 in. [25.4 mm] vane; 2.5 for the high capacity  $\frac{3}{4}$ -in. [19.0 mm] vane and 0.2 for the sensitive  $1\frac{7}{8}$ -in. [47.6 mm] vane. Fig. 3 illustrates the configuration of the vanes.

6.2.1 Table 1 provides the critical dimensions and tolerances in inches for the three vane sizes. Table 2 provides similar information as Table 1, but in mm. Table 3 provides thickness in in. and mm for vanes of machined stainless steel or

aluminum, and injected plastic. See Appendix X1 for the equations used to determine the multiplier for a vane, given its dimensions.

6.2.2 *Calibration Masses*—Calibration masses causing approximately 30 percent, 60 percent, and 90 percent of the full-scale reading. See Annex A1 for calibration procedures.

6.3 *Straight Edge*—Steel straight edge at least 6 in. [150 mm] in length with one beveled edge or a flat edged paint scraper.

6.4 *Measuring Device*—The device to measure the vane dimensions shall be capable of measuring to the nearest 0.001 in. [0.01 mm] or better.

6.5 If the user elects to determine water contents of the test sample, that apparatus required to perform D2216 will be required.

## 7. Specimen Preparation

7.1 Using a straight edge, create a flat surface on the end of a confinement ring or test area. The surface should be prepared with minimal disturbance. If disturbance does occur the user should prepare an alternate surface if feasible or document the observed disturbance in the data record.

## 8. Preparation of Apparatus

8.1 Select the vane size appropriate for the estimated shear strength. Several trials may be required to determine which vane will cause an acceptable measurement as described in 9.8.