Designation: D6026 – 06

StandardPractice for Using Significant Digits in Geotechnical Data[1]

This standard is issued under the fixed designation D6026; 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 is intended to promote uniformity in recording significant digits for measured and calculated values involving geotechnical data. The guidelines presented are industry standard, and are representative of the significant digits that should generally be retained. The guidelines 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 of this practice to consider significant digits used in analysis methods for engineering design..

1.1.1 Using significant digits in geotechnical data involves the processes of collecting, calculating, and recording either measured values or calculated values (results), or both.

1.2 This practice accepts a variation of the traditional rounding method that recognizes the algorithm common to most hand-held calculators, see 5.2.3. The traditional rounding method (see 5.2) is in accordance with Practice E29 or IEEE/ASTM SI 10.

1.3 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D2905 Practice for Statements on Number of Specimens for Textiles (Withdrawn 2008)[3]

D4356 Practice for Establishing Consistent Test Method Tolerances (Withdrawn 2007)[3]

D6913 Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E344 Terminology Relating to Thermometry and Hydrometry

E456 Terminology Relating to Quality and Statistics

E833 Terminology of Building Economics

IEEE/ASTM SI 10 Standard for Use of the International System of Units (SI): *The Modern Metric System*

3. Terminology

3.1 *Definitions:*

3.1.1 For common definitions of soil and rock terms in this standard, refer to Terminology D653.

3.1.2 *accuracy, n*—the degree of agreement of an individual measurement or average of measurements with an accepted reference value, or level. See Terminology E344 - 97

3.1.3 *calculated value, n*—the resulting value determined by processing measured value(s) using an equation. See Practice D4356 - 84(Reapproved 1996).

3.1.3.1 *Discussion*—In many cases the calculated value(s) is considered a determination value(s).

[1] This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rockand is the direct responsibility of Subcommittee D18.91 on Standards Development and Review.

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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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

*A Summary of Changes section appears at the end of this standard

3.1.4 *determination value, n*—the numerical quantity calculated by means of the test method equation from the measurement values obtained as directed in a test method. See Practice D4356 - 84(Reapproved 1996).

3.1.5 *measurement value, n*—the resulting value determined by measuring a dimension, quantity, or property.

3.1.5.1 *Discussion*—In many cases the term "measured value(s)" is also referred to as "measurement value(s)". See Practice D4356 - 84(Reapproved 1996).

3.1.6 *precision, n*—the closeness of agreement between independent test results obtained under stipulated conditions. See Terminology E456 - 96.

3.1.6.1 *Discussion*—Precision depends on random errors and does not relate to the true or specified value.

3.1.6.2 *Discussion*—The measure of precision usually is expressed in terms of imprecision and computed as a standard deviation of the test results. Less precision is reflected by a larger standard deviation.

3.1.6.3 *Discussion*—"Independent test results" means results obtained in a manner not influenced by any previous result on the same or similar test object. Quantitative measures of precision depend critically on the stipulated conditions. Repeatability and reproducibility conditions are particular sets of extreme conditions.

3.1.7 *rounding, n*—the process of reducing the number of digits in a number according to rules relating to the required accuracy of the value.

3.1.8 *significant digit*—any of the integers one through nine and zeros except leading zeros and some trailing zeros.

3.1.8.1 Zero is a significant digit if it comes between two non-zero integers.

3.1.8.2 Zeros leading the first nonzero digit of a number indicate the order of magnitude only and are not significant digits. For example, the number 0.0034 has two significant digits.

3.1.8.3 Zeros trailing the last nonzero digit for numbers represented with a decimal point are significant digits. For example, 4.00 and 4.01 have three significant digits.

3.1.8.4 The significance of trailing zeros for numbers represented without use of a decimal point can only be identified from knowledge of the source of the value.

3.1.9 *test result, n*—the value obtained by applying a given test method, expressed as a single determination or a specified combination of a number of determinations. See Practice D2905 - 91.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *sensitivity analysis, n*—a test of the outcome of an analysis by altering one or more parameters from an initially assumed value(s). See Terminology E833 - 97b.

3.2.1.1 *Discussion*—Sensitivity analyses are often related to the design process, but not exactly applied in that design process. A sensitivity analysis might include how measured shear strength or hydraulic conductivity varies with molding water content and percent compaction.

3.2.2 *variability analysis, n*—the determination of the variation in values within a given boundary condition(s)

3.2.2.1 *Discussion*—A variability analysis might include how a given property varies with depth.

4. Significance and Use

4.1 The guidelines presented in this practice for retaining significant digits and rounding numbers may be adopted by the using agency or user. Generally, their adoption should be used for calculating and recording data when specified requirements are not included in a standard.

4.2 The guidelines presented herein should not be interpreted as absolute rules but as guides to calculate and report observed or test data without exaggerating or degrading the accuracy of the values.

4.2.1 The guidelines presented emphasize recording data to enough significant digits or number of decimal places to allow sensitivity and variability analyses to be performed, see 3.2.

5. Guidelines for Rounding Numbers in Calculating and Recording Data

5.1 *General Discussion*—Rounding data avoids the misleading impression of precision while preventing the loss of information due to coarse resolution. Any approach to retention of significant digits of necessity involves some loss of information; therefore, the level of rounding should be selected carefully considering both planned and potential uses for the data. See Practice E29.

5.2 *Rounding Numbers*—When a numerical value is to be rounded to fewer digits than the total number available, use the following procedure which is in accordance with Practice E29 or IEEE/ASTM SI 10:

When the first digit beyond the last place to be retained is:	The digit in the last place retained is:	Examples
<5	unchanged	2.445 to 2.4
>5	increased by 1	2.464 to 2.5
Exactly 5	increased by 1 if it is odd unchanged if it is even	2.55 to 2.6 or 2.45 to 2.4
5 followed only by zeros	same as above for exactly 5	2.5500 to 2.6 or 2.4500 to 2.4

5.2.1 The rounded value should be obtained in one step by direct rounding of the most precise value available and not in two or more successive rounding steps. For example, 89 490 rounded to the nearest 1000 is at once 89 000. It would be incorrect to round first to the nearest 100, giving 89 500 and then to the nearest 1000, giving 90 000.

5.2.2 The same rule applies when rounding a number with many digits to a number with a few digits as occurs when using a computer or calculator that displays the answer to a computation as ten or more digits and the answer is to be recorded to a few digits. For example, the number 2.34567 rounded to two significant digits would be 2.3.

5.2.3 Calculators and computers, in general, do not follow all the rules given in 5.2, (that is, only rounding up odd digits followed by a five, while even digits stay the same (2.55 to 2.6 or 2.45 to 2.4)) and generally always round up. Recognizing the widespread use of calculators and computers that always round up, their use shall not be regarded as nonconforming with this practice.