



Designation: D8438/D8438M – 23

Standard Test Methods for Use of Hyperspectral Sensors for Soil Nutrient Analysis of Ground Based Samples¹

This standard is issued under the fixed designation D8438/D8438M; 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 (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This test method describes procedures for sampling and testing of soils obtained from ground-based samples using diffuse reflectance spectrometry using handheld portable spectrometers measuring spectra in visible and near infrared (vis-NR) and mid-infrared (MIR) range. The sensor can measure moisture content, PH, organic matter, Cation Exchange Capacity (CEC) as well as macro and micro elemental nutrients in parts per million (PPM) or percentage, including but not limited to nitrogen, phosphorous, potassium, zinc, iron, boron, sulfur, calcium, magnesium, and manganese.

1.2 There are two methods that can be used to perform the test.

1.2.1 *Method A*—The analysis is performed in the laboratory on the sample after the sample has been oven dried and sieved.

1.2.2 *Method B*—The analysis is performed in the field on a moist sample after homogenization. After post-processing of multiple reflectance site data using methods A and B, the moisture content can be measured, and the spectral signature is normalized for moisture content.

1.3 The limitation of this method is that the results of an individual test for elemental analysis would not be the same as exacting reference values from traditional wet chemical lab analysis used by soil scientists. Results of wet chemistry tests or tests from soil science libraries may be used to calibrate a specific site model comprised of many individual tests. Spectral data for organics has shown to be as accurate as conventional methods such as Test Methods D2974.

1.4 For soil nutrient analysis the sample is not finely ground as in typical qualitative spectral analysis as outlined in standard Practice E1252. The spectrometer is checked periodically during testing using procedures in accordance with Guide E1866 performance testing.

¹ This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.01 on Surface and Subsurface Investigation.

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1.5 Moisture content is a preferred term in agricultural applications. For this standard, gravimetric water content may be measured in accordance with Test Methods D2216 when drying samples and used to calibrate the site model, but the overall results of spectral analysis are more qualitative, and the term Moisture Content is used in this standard.

1.6 *Units*—The values stated in either SI units or inch-pound units [given in brackets] are to be regarded separately as standard. Wavelengths are stated only in nanometers, nm. 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.

1.7 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026. The procedures used to specify how data is collected, recorded or 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 of this standard to consider significant digits used in analysis methods for engineering design.

1.7.1 Spectral data is acquired by electrical data acquisition systems and therefore numeric data is carried through recording and into databases without rounding of numeric data.

1.8 *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.*

1.9 *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.*