THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURE, AND ENVIRONMENTAL SCIENCES

Standard Operating Procedure
pH and Electrical Conductivity in Soil and Soil-like Media
Soil Water Environmental Laboratory (SWEL)
Version 11

1.0 SCOPE

1.1 This method utilizes one sample preparation procedure for determination of pH (Thomas, 1996) and electrical conductivity in soil and soil like media. pH is an operationally defined measure of the H^+ ions that are active in soil solution, and EC provides an operationally defined measurement of a soil's salinity (Rhoades, 1996).

2.0 DEFINITIONS

2.1 $pH = -log[H^+]$

2.2 Electrical Conductivity is a measurement of a solution's ability to conduct electricity with units reported in decisiemens ($dS\ m^{-1}$)

2.3 Laboratory Control Sample: The laboratory control sample is an intralaboratory developed sample whose true value is approximated by the average of repeated measures.

2.4 Duplicate Samples: A duplicate test involves splitting a sample into two sub-samples and processing each through the same sample preparation procedure in order to determine the precision of the method.

3.0 EQUIPMENT AND SUPPLIES

3.1 pH meter and probe

3.2 Conductivity meter and probe

3.3 pH 4, 7, and 10 buffer solutions

3.4 1.399 $dS\ m^{-1}$ (1.399 millimho ($m\mho\ cm^{-1}$)) conductivity standard

3.5 Deionized water (DI) water ≥18 megaΩ

3.6 Reciprocating shaker

3.7 20 mL bottletop dispenser

4.0 PROCEDURE

4.1 Weigh 10g soil and add 20mL DI to 50mL disposable centrifuge tubes to make a 1:2 soil:deionized water solution.

4.1.1 4.1a Record bottletop dispenser calibration in Appendix (20ml ± 0.4mL).

4.2 Place on reciprocating shaker for 30 minutes, remove, swirl, uncap, and let stand for 10 minutes.

4.3 Calibrate pH meter using pH 4, 7, and 10 buffer solutions according to manufacturer recommendations and record % slope on the analysis sheet.

4.4 Insert the electrode directly into the soil suspension but not touching the bottom of the tube, allow meter to stabilize and read pH.

4.5 Rinse electrode with deionized water in between each sample.

4.6 Note: if measuring pH and EC on multiple batches, the conclusion of pH measurement for a given batch (i.e., before measuring EC on that batch) provides an opportune time to put the next batch on shaker.

4.7 Calibrate the EC meter by adjusting the temperature correction until the measured EC for the standard solution matches the known value, e.g., 1.399 m℧ cm^{-1} (appropriate when standard solution and soil extract are the same temperature).

4.7.1 Turn bottom left knob into upright position, and bottom right knob to the 2m setting.
4.7.2 Pour 6 mL of EC standard into 15 mL falcon tube.
4.7.3 Rinse EC probe with DI and gently shake off excess water. Insert EC probe into EC standard so that bottom of probe is in contact with bottom of falcon tube.
4.7.4 Adjust temperature coefficient knob until reading matches value on bottle of EC std.
4.7.5 Note: calibration must use fresh EC standard. Do not attempt to rinse probe and re-measure the standard. Doing so will dilute the standard. Standard adjustment should therefore be performed just once prior to making measurements on the samples undergoing analysis, and the 6 mL of standard should then be discarded.

4.8 Rinse EC probe, gently shake off excess water, and insert the probe into the soil suspension so that the bottom of probe is in contact with the bottom of the centrifuge tube. In this position, the black bands on the probe should be fully covered / in contact with the soil solution. Report the EC reading in units of (m℧ cm^{-1}). If EC is very low, bottom right knob may need to be set to u℧, and units reported accordingly.

4.9 Thoroughly rinse probe with DI and gently shake off excess DI between samples.

5.0 QUALITY CONTROL

5.1 Laboratory Control Sample: The laboratory control sample must fall within ± 20% of the known value.

5.2 Sample Duplicates: The % relative standard deviation (%RSD) must be no more than 20%.

$$RPD = 100 \times \frac{|S - D|}{Avg. (S,D)}$$

6.0 CALCULATIONS

6.1 Unit conversions:

6.1.1 1000 micromho ($\mu ℧\ cm^{-1}$) **=** 1 millimho ($m℧\ cm^{-1}$)

6.1.2 1 millimho ($m℧\ cm^{-1}$) **=** 1 deciSiemens ($dS\ m^{-1}$)

7.0 INTERPRETATION

7.1 Soil pH is important when considering human and plant health. The solubility of metals in soil is influenced by soil pH. Growing plants in contaminated soil can result in seemingly healthy plants that have levels of metals toxic to humans (Kabata-Pendias, 1992). Soil pH affects plant growth primarily through nutrient availability. Plant essential nutrients tend to be most available to the plant at a neutral pH. A soil pH range of 5.5 to 8 is ideal for most plants (Brady and Weil, 1996).

8.0 REFERENCES

8.1 Brady, N.C. and R.R. Weil. 1996. The Nature and Property of Soils. Prentice-Hall Inc. Upper Saddle River, NJ.

8.2 Kabata-Pendias, A. 1992. Trace Elements in Soils and Plants. 2nd ed. CRC Press, Boston, MA, USA.

8.3 Rhoades, J.D. 1996. Salinity, electrical conductivity, and total dissolved solids. p. 417-435. *In* D.L. Sparks (ed.) Methods of Soil Analysis. Part 3. SSSA Book Ser. 5. SSSA, Madison, WI.

8.4 Thomas, G.W. 1996. Soil pH and soil acidity. p. 475-490. *In* D.L. Sparks (ed.) Methods of Soil Analysis. Part 3. SSSA Book Ser. 5. SSSA, Madison, WI

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Bottletop Dispenser
Calibration
Verification

Volume	g DI	g DI	g DI	g DI	g DI	date	initials

Volume	g DI	g DI	g DI	g DI	g DI	date	initials

Volume	g DI	g DI	g DI	g DI	g DI	date	initials