



Parameter

Automated Soil pH (ROSS Ultra Triode™ Gel-Filled)

Introduction

Soil pH indicates its alkalinity or acidity. This property influences soil chemistry and crop production. A low maintenance ROSS Ultra Triode™ guarantees accurate measurement of soil pH. It allows not only simultaneous measurements of pH and temperature, but automatic temperature compensation. Analysis can be automated to process large number of samples on the Orion Star Plus Meter with the AutoTration™ Autosampler.

Reference

1. Communication with the lead soil scientist from the Auburn University Soil Testing Laboratory on January 22 of 2009.
2. Recommended Chemical Soil Test Procedures for the North Central Region. North Central Regional Research Publication No. 221 (Revised), 1998.
(<http://extension.missouri.edu/explorepdf/specialb/sb1001.pdf>)

Recommended Equipment

Star Plus Benchtop Meter with 48-position AutoTration-500 Autosampler (Orion 1119000SPA or 1112000SPA, or 1115000SPA, or 1117000SPA); Orion Gel ROSS Ultra Triode™ (Orion 8107BNUMD); 12 – 16 mL Soil Scoop (see an example in the Chapter 2 of the reference 2); U.S. Standard testing sieve No. 10; OSTER 12 speed blender MDL6641 or equivalent.

Required Solutions

pH 4.01, 7.00, and 10.01 Buffer (Orion 910104, 910107 and 910110); deionized water (DI); ROSS storage solution (810001) or pH electrode storage solution (Orion 910001).

Meter and Autosampler Setup and Interface

Connect the Com 1 RS232 port on the Autosampler (A/S) to the RS232 port on the meter using the A/S to meter interface cable. Connect the Com 2 RS232 port on the Autosampler to the serial port on PC. Connect both plugs of the triode and a stirrer to the Star Plus meter. Turn on the power to the meter and A/S; start a computer program to record data.

In Setup mode on the meter, review and change the parameters to prepare it for use with the Autosampler (see the Star Plus [Meter and Autosampler Interface guide for details](#)); turn the A/S function on, select the 48 beaker tray, enter 4 for the number of rinse beakers, enter 10 seconds for the electrode rinse time, enter 3 for the number of pH calibration points, enter 0 for the number of conductivity calibration points, enter the total number of sample beakers to be measured (not including rinse and calibration beakers); set the baud rate to 1200; set read type to auto; set stirrer speed to 4, log delete to no (to allow overwrite of the oldest data points); turn data log on; turn off the meter auto-shutoff feature. Set the following pH settings: resolution to 0.01 and buffer set to USA. If all steps were followed correctly the meter display will show a number with two decimal places in the top line and "pH" to the right of the top line. The temperature

will also be displayed in the top left of the screen.

Electrode Setup

See the electrode manual for preparation of the electrode.

Electrode Performance Check

These checks must be done before working with A/S. Check slope by testing two buffers. Drift may be checked by comparing a 1-minute to 2-minute reading of pH 7 buffer. Results should agree with desired criteria. See troubleshooting section of manual if slope and/or drift are not acceptable.

Electrode Storage, Soaking, and Rinsing

Store electrode in small bottle with electrode storage solution when transporting probe and for long term storage.

Sample Preservation

None required.

Preparation of samples and tray (the sample rack)

Sample preparation: dry the soil sample(s) at 60°C in the oven overnight until dry. Cool sample, then grind using a blender, and sieve through a 2-mm (10 mesh) sieve. Scoop 12-16 mL of soil sample and place in the beaker, add equal mL DI water in the beaker, mix manually, and leave for 30 minutes.

Sample tray preparation: fill the first 4 beakers (rinse) with 40 mL DI water; fill next three beakers (5, 6, and 7) with pH 4.01, 7.00, and 10.01 calibration buffers. Fill the 8 – 48 positions with the pH buffers and prepared samples. It is recommended to verify calibration by periodically analyzing the pH buffers during a run – typically, after the calibration, every ten samples, and at the end of the run.

Calibration and analysis

Press the MEASURE key to initiate the Autosampler. The A/S will move the triode and the stirrer to the rinse beakers. Once the triode and stirrer have been rinsed, they are then sent to the beaker with pH 4.01 calibration buffer; after the calibration in the first buffer, the Autosampler will again move the triode and the stirrer to the rinse beakers; this sequence will be repeated for each calibration buffer. Meter is calibrated automatically. After the calibration, the meter will start sample measurement. The actual measurements will be shown on the display. The stirrer probe will automatically begin stirring when the measurement starts and end stirring when the pH reading is stable. When a stable reading is achieved, the pH result will be saved in the datalog and sent to a computer. The Autosampler will move the triode and the stirrer to the rinse beakers for the time specified in the setup menu and then to the next sample beaker. Note: to stop the Autosampler during the analysis, press the SETUP key on the meter and turn off the Autosampler as described in the Star Plus Meter and Autosampler Interface guide.

Quality Control (QC)

Recommended QC procedures include: calibration, calibration verification, sample duplicates, slope, drift, and QC sample.



Soil pH with Gel Ross Triode & Orion 5 Star Plus Meter with Autosampler

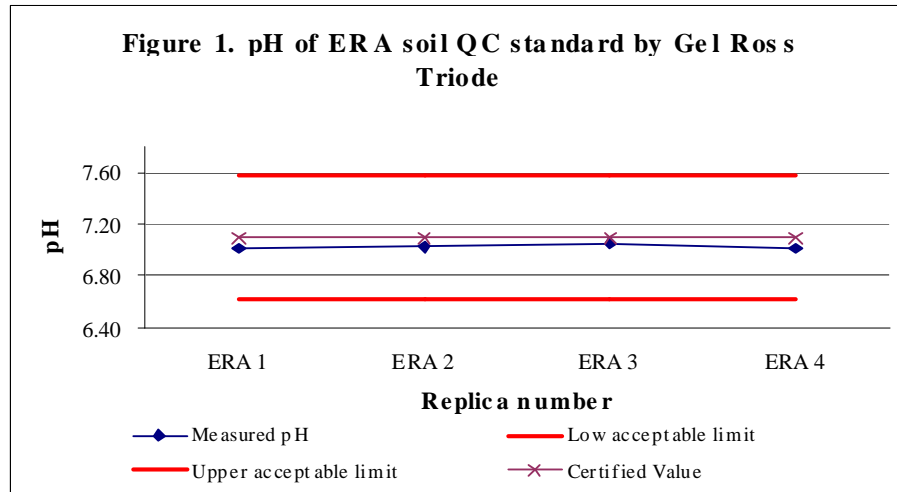


Figure 1

The QC sample (ERA Cat. No. 914) has a certified pH value of 7.10 and Acceptance Limits of 6.62 - 7.59 (0.97 pH units). The results of four replicates were very reproducible (STDEV=0.02pH) and accurate (well within the acceptable limits).

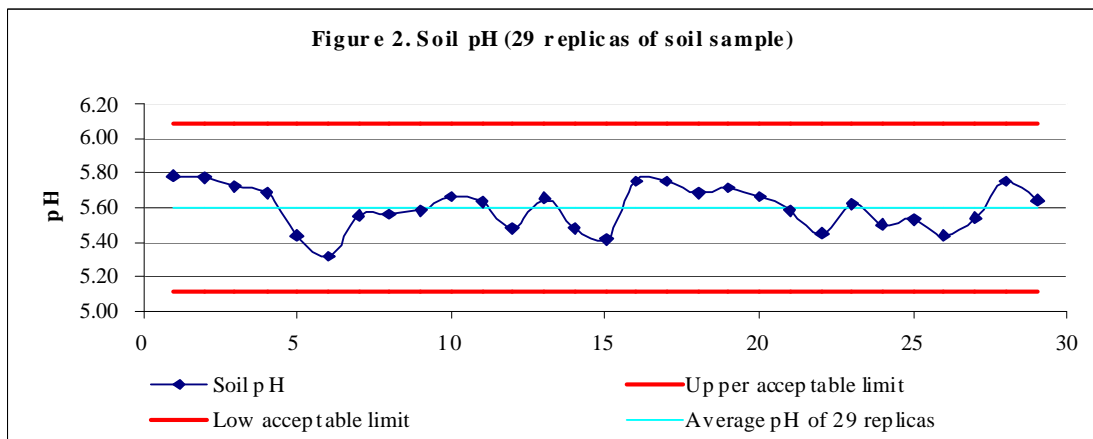


Figure 2

pH of 29 replicas of soil sample are measured on the Star Plus Meter with the Autosampler using the Ross Gel Triode . All the results are within acceptable limits (based on commercially available soil pH QC sample). The mean pH value is 5.60 and STDEV=0.12.

Table 1. Calibration verification

Buffer pH	pH reading	Sample T, °C	Expected pH	Delta from expected pH
pH 4 (after cal.)	4.02	20.4	4.01	-0.01
pH 7 (after cal.)	7.01	20.3	7.01	0.00
pH 10 (after cal.)	10.06	20.3	10.06	0.00
pH 7 (after sample #7)	7.03	19.9	7.01	-0.02
pH 7 (after sample #17)	7.04	20.1	7.01	-0.03
pH 7 (after sample #27)	7.04	19.9	7.01	-0.03
pH 4 (at the end of run)	4.06	19.6	4.00	-0.06
pH 7 (at the end of run)	7.04	19.5	7.02	-0.02
pH 10 (at the end of run)	10.08	19.4	10.07	-0.01