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Smart Water Application Technologies/SWAT Calibration Report

Testing Agency: Center for Irrigation Technology http://cati.csufresno.edu/cit/

Testing Period: December 2005 to September 2006

Product Type: Soil Moisture Sensor

Product Make and Model: Delta-T SM200 Moisture Sensor

Product Description: Sensor measures soil volumetric water content

SWAT Protocol*: Turf and Landscape Irrigation Equipment - SOIL MOISTURE SENSORS
Phase 1: Indoor Lab Screening Tests - 4th Draft Testing Protocol

The concept of soil moisture sensors has an extensive history of scientific study and documentation. The objective of Phase 1 lab tests is to determine sensor calibration curves over a range of conditions that affect soil moisture, including soil type, temperature and salinity. Phase 1 testing determines sensor response over manufacturer specified test ranges to continue into Phase 2. At that time the soil sensor will be integrated with an irrigation controller to measure irrigation adequacy and efficiency in a virtual landscape using the current performance criteria of 0.40 inches of rainfall and 2.50 inches of ETo.

Phase 1 Soil Moisture Sensor testing does not test the efficacy of a sensor over the entire range of soil moisture conditions possible and do not measure the integration of a soil sensor with a controller to manage irrigation.

Sensor performance curves were developed to determine the relationship between sensor readings and soil moisture content for a soil filled container. Relationships are determined for a range of soil textures, ambient temperatures and water conductivity values.

***All SWAT protocols may be viewed at www.irrigation.org**

Phase 1 SWAT Calibration Summary: Delta-T SM200 Moisture Sensor

Measures are between field capacity (i.e. practical soil water holding capacity) and a selected drying range specified by the manufacturer over which the sensor was tested.	**Equation (Linear)**
Test of Soil Moisture Sensor	**Response Function Developed[1]**
Response in Fine-Textured Soil	Linear (y = 0.815x + 0.0773)
Response in Medium-Textured Soil	Linear (y = 0.918x + 0.0199)
Response in Coarse-Textured Soil	Linear (y = 1.026x + 0.0178)
Response in Soil at 20 °C (68 °F)	Linear (y = 0.836x + 0.0634)
Response in Soil at 30 °C (86 °F)	Linear (y = 0.894x - 0.0165)
Response in Soil Susceptible to Freezing	Linear (y = 0.650x + 0.0868)
Response in Fine-Textured Soil to Irrigation with 1.5 dS/m salinity water	Linear (y = 0.781x + 0.1043)
Response in Medium-Textured Soil to Irrigation with 1.5 dS/m salinity water	Linear (y = 0.808x + 0.0572)
Response in Medium-Textured Soil to Irrigation with 3.0 dS/m salinity water	Linear (y = 0.916x+ 0.0427)
Response in Coarse-Textured Soil to Irrigation with 1.5 dS/m salinity water	Linear (y = 0.973x + 0.0324)

[1]Regression equations of the data gathered vs. moisture content as measured by gravimetric sampling, or the measured weight of water in the soil samples. The dynamics of variable manufacture selected calibration endpoints preclude the applicability of correlation coefficients for inter-test or inter-sensor comparisons. A Nonlinear designation means a regression equation other than a straight line was used to best describe the relationship.

Product Detail Supplied by Manufacturer

Delta-T SM200 Moisture Sensor **www.dynamax.com**

Operation	Features	Additional Hardware
Frequency domain reflectometry (FDR) dielectric sensor	❑ Measures volumetric soil moisture through dielectric soil properties from 0-60% SMV ❑ All sensors provided with factory calibrations for mineral and organic soils ❑ Very consistent results with salinity up to 5 dS/m and across normal temperature ranges ❑ No post installation adjustments needed ❑ Durable sensor with stainless steel electrodes can be buried indefinitely	**Closed-loop automatic moisture control equipment** ❑ Dynamax Moisture Click (IL200-MC) and Moisture Switch (IL200-MS) add-on controllers ❑ Delta T-GP1 moisture controller/logger ❑ Provides common interrupt and sensor input function for irrigation timers. ❑ Rated for 24 V ac and 12-120 V ac/dc (IL200-MS only) ❑ Sealed enclosures outdoor rated