

Standard Operating Procedure: Shortwave
Near-Infrared (SWIR) Optical Moisture Spectrometer

Field Servicing, Radiometric Dark-Current Zeroing, and Liquid Water Absorption Calibration

Document Title:	SWIR Spectrometer Calibration SOP	Doc ID / Ref:	SOP-SWIR-001
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1. Purpose & Technical Scope

Shortwave Near-Infrared (SWIR) spectrometers operate in the 1.3 μm to 2.5 μm spectral region (specifically targeting water absorption peaks at 1.45 μm and 1.94 μm). These non-contact optical sensors measure liquid water content in plant tissue and topsoil surfaces. This SOP defines thermal stabilization, dark-current baseline subtraction, Spectralon reference panel calibration, and water index (NDWI / MSI) extraction procedures [1].

2. Required Calibration Standards & Equipment

- **SWIR Field Spectrometer:** 1.0–2.5 μm InGaAs/Extended-InGaAs array spectrometer.
- **99% Diffuse Reflectance Panel:** NIST-traceable Labsphere Spectralon target.
- **Illumination Source:** Calibrated 50W Halogen halogen light source or solar zenith alignment rig.
- **Black Optical Shutter Cap:** Light-tight anodized aluminum dark cap.
- **Cleaning Supplies:** Spectratech lens wipes and anhydrous isopropyl alcohol.

3. Step-by-Step Calibration & Operating Procedure

1. **Detector Thermal Stabilization:** Power on the thermoelectric cooler (TEC) and allow the detector array to stabilize at -15.0°C (±0.2°C) for at least 15 minutes before collecting spectra.
2. **Dark Current Capture (DC):** Attach the light-tight black cap to the optical fore-optics. Initiate 50 averaged dark frame sweeps and store the dark spectrum (\$DC_λ\$) in non-volatile memory.
3. **White Reference Baseline (\$WR_λ\$):** Position the clean 99% Spectralon panel perpendicular to the lens at a fixed distance (30 cm). Ensure no shadows or ambient reflection sources contaminate the target. Record 50 integration sweeps to establish raw baseline intensity.
4. **Reflectance Conversion (\$R_λ\$):** Verify that sample target reflectance is automatically calculated as:
\$R_λ = \frac{S_λ - DC_λ}{WR_λ - DC_λ} \times 100\%\$
5. **Water Absorption Index Calculation:** Calculate the Moisture Stress Index (MSI = \$R_{1600} / R_{820}\$) and Normalized Difference Water Index (NDWI = \$(R_{860} - R_{1240}) / (R_{860} + R_{1240})\$). Confirm signal-to-noise ratio (\$SNR > 500:1\$) across the 1.45 μm and 1.94 μm water absorption bands.

FIELD VERIFICATION & APPROVAL SIGN-OFF	
Prepared & Approved By:	Kadeem Manning (Lead Field Specialist)
Technician Signature:	Kadeem Manning
Verification Date:	September 16, 2026
Calibration Status:	[X] PASSED & VERIFIED [] REJECTED