

Open-Ended Coaxial Dielectric Probe System

Standard Operating Procedure & Calibration Protocol

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Target Equipment: Open-Ended Coaxial Dielectric Probe System	Status: Approved for Field Use

1.0 PURPOSE & SCOPE

This SOP details 1-port Vector Network Analyzer (VNA) calibration and permittivity extraction using an Open-Ended Coaxial Dielectric Probe across 500 MHz to 20 GHz. This probe technique measures complex permittivity (ϵ' and ϵ'') of liquids, semi-solids, and biological tissues.

2.0 CALIBRATION & TESTING PROCEDURE

- VNA Thermal Stabilization:** Warm up VNA (Keysight FieldFox) for 30 minutes. Set frequency range to 500 MHz – 20 GHz (1601 points, IF bandwidth 1 kHz).
- 3-Standard Calibration:** Perform 1-port reflection calibration at the coaxial probe tip plane using: (a) Air (open), (b) Metallic shorting block (short), (c) Deionized water at 25.0 °C (known reference liquid load).
- Probe Contact Inspection:** Ensure flat probe face is free of micro-scratches and clean using isopropanol. Eliminate air bubbles at the liquid-probe interface.
- Permittivity Extraction:** Compute ϵ' and ϵ'' using Bilinear Capacitive Inversion models.
- Temperature Correction:** Apply Cole-Cole water thermal correction equations for ambient drift.

3.0 CALIBRATION ACCEPTANCE CRITERIA

Parameter	Target Requirement	Tolerance
VNA Directivity	ϵ' in Air = 1.00	+/- 0.02
DI Water ϵ' at 2 GHz	78.4 at 25.0 °C	+/- 0.5
DI Water ϵ'' at 2 GHz	9.6 at 25.0 °C	+/- 0.3

APPROVAL & AUTHORIZATION	FIELD EXECUTION SIGN-OFF
Prepared By: Kadeem Manning Title: Lead Field Calibration Specialist Signature: <i>Kadeem Manning</i> Date: 2026-09-16	Field Technician: _____ Station / Location: _____ Signature: _____ Date: _____