

## Calibration Procedure

# DeFelsko PosiTector Dew Point Meter Logger (DPML) Probe

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# 1 Introduction and UUC Performance Requirements

1.1 This procedure describes the calibration of the DeFelsko PosiTector Dew Point Meter Logger (DPML) probe with the following specifications:

Table 1-1 Measurement Ranges

Function	Measurement Range	Resolution
Air Temperature	-10 to 60 °C (14 to 140 °F)	0.1°C (0.1°F)
Relative Humidity	0 to 100% RH	0.1%
Surface Temperature	-10 to 100 °C (14 to 212 °F)	0.1°C (0.1°F)

1.2 The unit being calibrated will be referred to as the UUC (Unit-Under-Calibration).

# 2 Measurement Standards and Support Equipment Performance Requirements

2.1 The UUC accuracy requirements are based upon the published UUC performance specifications.

2.2 The test uncertainty ratio applied in this calibration procedure is 4:1 unless otherwise stated. The surface temperature uncertainty ratio for the range -10 to 80 °C is 2.9:1.

2.3 Minimum-Use-Specifications are the minimum test equipment specifications required to meet all the UUC accuracy requirements and the test uncertainty ratio applied.

Table 2-1 UUC Accuracy Requirements and Description

UUC Function	Range	Accuracy	Test Method
Air Temperature Relative Humidity	-10 to 60°C (14 to 140°F) 0 to 100% RH	± 0.5°C (1.0°F) ± 3.0 %	Humidity Generator
Surface Temperature	-10 to 80°C (14 to 176°F) 80 to 100°C (176 to 212°F)	± 0.5°C (1.0°F) ± 1.5°C (3.0°F)	Temperature Calibrator

Table 2-2 Minimum Use Specifications

Function	Range	Accuracy
Air temperature	-10 to 60°C (14 to 140°F)	± 0.125°C (0.25°F)
Relative Humidity	0 to 100% RH	± 0.75%
Surface Temperature	-10 to 80°C (14 to 176°F)	± 0.125°C (0.25°F)
	80 to 100°C (176 to 212°F)	± 0.375°C (0.75°F)

Table 2-3 Actual Air Temperature & Relative Humidity Equipment Specifications

	Actual Equipment
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Manufacturer/Model #'s Applicable	Specifications	
	Range	Accuracy
Thunder Scientific Model 1200 Humidity Generator	10 to 60 °C (50 to 140 °F)	± 0.05 °C (± 0.09 °F)
	10 to 95% RH	± 0.5%

Table 2-4 Actual Surface Temperature Test Equipment Specifications

Equipment Name Manufacturer/Model #'s Applicable	Actual Equipment Specifications	
	Range	Accuracy
1. Type K Thermocouple	-200 – 1250 °C (-328 – 2282 °F)	0.138°C
2. Distilled Water Ice Bath	N/A	0.05 °C
3. Keithley 2000 Multimeter	Up to 100 mV	0.090 °C
4. EDL STS-SC2 Calibrator	40 °C	0.016 °C
	100 °C	0.25°C

Keithley 2000 Multimeter calculation

Use ITS-90 (International Temperature Standard) Table for Type K Thermocouple

Temperatures at 40°C (1.612 mV) and 100 °C (4.096mV)

Scale Range → 100 mV with 1 year accuracy = 50 ppm of reading + 35 ppm of range

Accuracy @ 40°C = (50 ppm x 1.612 mV) + (35 ppm x 100 mV)  
= 3.580 uV

(40°C / 1.612mv) \* 0.003580mv = .089°C

Accuracy @ 100°C = (50 ppm x 4.096 mV) + (35 ppm x 100 mV)  
= 3.704 uV

(100°C / 4.096mv) \* 0.003704mv = 0.090 °C

Surface Temperature Combined Accuracy @ 40°C = (Thermocouple<sup>2</sup> + Bath<sup>2</sup> + Keithley<sup>2</sup> + Surface plate<sup>2</sup>)<sup>0.5</sup>  
= (0.138<sup>2</sup> + 0.05<sup>2</sup> + 0.090<sup>2</sup> + 0.016<sup>2</sup>)<sup>0.5</sup>  
= 0.17 °C

Surface Temperature Combined Accuracy @ 100°C = (Thermocouple<sup>2</sup> + Bath<sup>2</sup> + Keithley<sup>2</sup> + Surface plate<sup>2</sup>)<sup>0.5</sup>  
= (0.138<sup>2</sup> + 0.05<sup>2</sup> + 0.090<sup>2</sup> + 0.25<sup>2</sup>)<sup>0.5</sup>  
= 0.30 °C

Surface Temperature Uncertainty Ratio (-40 to 80 °C): = 2.9:1 (0.5 °C / 0.17 °C)

**Caution:** The instructions in this Calibration Procedure relate specifically to the equipment and conditions listed in this section. If other equipment is substituted, the information and instructions must be interpreted accordingly.

Table 2-5 Calibration Environment and Warm-Up Requirements

Measurement Standards & Support Equipment Environmental Requirements:	Temperature: $23 \pm 5^{\circ}$ C. Relative Humidity: Less than 95% Barometric Pressure $30 \pm 1.5$ in Hg ( $1016 \pm 50$ mbar)
Measurement Standards & Support Equipment Warm-up and Stabilization Requirements:	Thunder Scientific Humidity Generator: 60 minutes  EDL STS-SC2 surface temperature calibrator: 15 minutes

### 3 Preliminary Operations

*Note:* Review the entire document before starting the calibration process.

#### 3.1 Visual Inspection

3.1.1 Damage or excess wear must be repaired prior to beginning the calibration process.

3.1.2 Visually inspect the UUC for:

- Wear or damage to the probe body or tip
- Missing parts
- Proper identification

3.2 Remove the battery cap, insert a battery and replace the cap.

3.3 Using a smart device, launch the PosiTector SmartLink app and verify the device detects the probe. Also verify the probe has at least 25% battery.

### 4 Humidity and Air Temperature Calibration Process

Refer to UUC and equipment instruction manual(s) for menu navigation instructions, details on features and operating instructions.

*Note:* Whenever a test requirement is not met as indicated in table 6-1, verify the results of the test and take corrective action before proceeding.

4.1 Place the probe(s) in the humidity chamber. Multiple probes can be calibrated in the chamber simultaneously but the area with the sensor filter cannot be blocked. Record the probe serial number(s) and the Barometric pressure (mbars).

4.2 Adjust the set point of the humidity chamber to 35 % RH and allow to stabilize for at least 2 hours. After the stabilization time record the chamber relative humidity and air temperature readings. Use a smart device to access the UUC as describe in section 3.3. Record the UUC relative humidity and air temperature.

Note: When turning on the gage do not perform a full reset.

- 4.3 Adjust the set point of the humidity chamber to 65 % RH and allow to stabilize for at least 2 hours. After the stabilization time record the chamber relative humidity reading. Use a smart device to access the UUC as describe in section 3.3. Record the UUC relative humidity.
- 4.4 Remove the probe(s) from the chamber and proceed to the surface temperature calibration.

## 5 Surface Temperature Calibration

- 5.1 Prepare an ice bath using distilled water per ASTM E563-11. Connect the thermocouple to TC1 of the surface temperature calibrator, the ice bath and the Keithley 2000 Multimeter.
- 5.2 Set the surface temperature calibrator to 40 °C and allow to stabilize for at least 15 minutes.
- 5.3 Place the DPML Probe on the center of the top surface of the surface temperature calibrator until the probe and meter readings stabilize then record the readings for the probe per 3.3 and the Keithley 2000 Multimeter\*.

**\*Note:** The multimeter readings must be adjusted by the surface temperature offsets as indicated on the surface temperature calibrator calibration certificate.

- 5.4 Repeat steps 5.2 & 5.3 for 100 °C.

## 6 Performance Requirements

**Note:** The technician will collect the data needed to complete columns D and E. The technician shall then calculate the values for Column F and record all information as shown in table 6-1. Do not write in this procedure.

Table 6-1 Requirements and Calibration Data for DeFelsko PosiTector DPML Probes

Reference (A)	Units (B)	Set Point (C)	Test Equipment Reading (D)	Gage Reading (E)	Probe Measurement Accuracy (F)	Allowable Tolerance (G)
Relative Humidity	%RH	35				± 3.0
Ambient Temperature	°C	N/A				± 0.5
Relative Humidity	%RH	65				± 3.0
Surface Temperature Low	°C	40				± 0.5
Surface Temperature High	°C	100				± 1.5

Note: To convert from °C to °F →  $T_{°F} = 1.8 * T_{°C} + 32$

