

## Calibration Procedure

# DeFelsko PosiTector Dew Point Meter with Anemometer (DPMA)

## Table of Contents

1.	Introduction and UUC Performance Requirements.....	1
	Table 1-1 Measurement Ranges .....	2
2.	Measurement Standards and Support Equipment Performance Requirements .....	2
	Table 2-1 UUC Accuracy Requirements and Description.....	2
	Table 2-2 Minimum Use Specifications .....	2
	Table 2-3 Actual Air Temperature & Relative Humidity Equipment Specifications .....	2
	Table 2-4 Actual Wind Speed Equipment Specifications .....	3
	Table 2-5 Actual Surface Temperature Test Equipment Specifications.....	3
	Table 2-6 Calibration Environment and Warm-Up Requirements .....	4
3.	Preliminary Operations .....	4
4.	Humidity and Temperature Calibration Process.....	4
5.	Anemometer Calibration.....	6
6.	Performance Requirements .....	6
	Table 6-1 Requirements and Data for DeFelsko PosiTector DPMA Probe .....	7
	Management Procedure Change Notice .....	8

## 1. Introduction and UUC Performance Requirements

- 1.1 This procedure describes the calibration of the DeFelsko PosiTector Dew Point Meter with Anemometer (DPMA) with the following specifications:

Table 1-1 Measurement Ranges

Function	Measurement Range	Resolution
Air Temperature	-40 to 80 °C (-40 to 175 °F)	0.1°C (0.1°F)
Surface Temperature	-40 to 190 °C (-40 to 375 °F)	0.1°C (0.1°F)
Relative Humidity	0 to 100% RH	0.1%
Wind Speed	0 to 20 m/s	0.1m/s

- 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 -40 to 80 °C is 2.2:1. The wind speed uncertainty ratio at 20 m/s is 3.3:1.
- 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	-40 to 80 °C (-40 to 175 °F)	± 0.5 °C (1.0 °F)	Humidity Generator
Relative Humidity	0 to 100% RH	± 3.0 %	
Surface Temperature	-40 to 80 °C (-40 to 175 °F) >80 to 190 °C (175 to 375 °F)	± 0.5 °C (1.0 °F) ± 1.5 °C (3.0 °F)	Temperature Calibrator
Wind Speed	0 to 20 m/s	± 0.7 m/s	Wind Tunnel and Vane Anemometer

Table 2-2 Minimum Use Specifications

Function	Range	Accuracy
Air temperature	-40 to 80 °C (-40 to 175 °F)	± 0.125 °C (0.25 °F)
Relative Humidity	0 to 100% RH	± 0.75%
Surface Temperature	-40 to 80 °C (-40 to 175 °F)	± 0.125 °C (0.25 °F)
	>80 to 190 °C (175 to 375 °F)	± 0.375 °C (0.75 °F)
Wind Speed	0 to 20 m/s	± 0.21 m/s

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

Manufacturer/Model #'s	Actual Equipment Specifications	
	Range	Accuracy

Applicable		
Thunder Scientific Model 2500 Humidity Generator	0 to 70 °C (32 to 158 °F)	$\pm 0.06$ °C ( $\pm 0.11$ °F)
	10 to 95% RH	$\pm 0.5\%$

Table 2-4 Actual Wind Speed Equipment Specifications

Manufacturer/Model #'s Applicable	Actual Equipment Specifications	
	Range	Accuracy
Kanomax 6815	0.2 – 40 m/s	$\pm 1\%$ of reading $\pm 1$ digit

Accuracy @ 20.00 m/s =  $(20.00 \text{ m/s} \times 0.01) + 0.01 \text{ m/s}$   
 = 0.21 m/s  
 Uncertainty ratio @ 20m/s =  $(0.7/0.21) = 3.3:1$

Table 2-5 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	0.16 °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 =  $(50 \text{ ppm} \times 1.612 \text{ mV}) + (35 \text{ ppm} \times 100 \text{ mV})$   
 = 3.580 uV  
 $(40^\circ\text{C} / 1.612\text{mv}) * 0.003580\text{mv} = 0.089^\circ\text{C}$

Accuracy @ 100°C =  $(50 \text{ ppm} \times 4.096 \text{ mV}) + (35 \text{ ppm} \times 100 \text{ mV})$   
 = 3.704 uV  
 $(100^\circ\text{C} / 4.096\text{mv}) * 0.003704\text{mv} = 0.090^\circ\text{C}$

Surface Temperature Combined Accuracy @ 40°C =  $(\text{Thermocouple}^2 + \text{Bath}^2 + \text{Keithley}^2 + \text{Surface plate}^2)^{0.5}$   
 =  $(0.138^2 + 0.05^2 + 0.089^2 + 0.16^2)^{0.5}$   
 = 0.23 °C

Surface Temperature Uncertainty Ratio (-40 to 80 °C): =  $(0.5^\circ\text{C} / 0.23^\circ\text{C}) = 2.2:1$

Surface Temperature Combined Accuracy @ 100°C =  $(\text{Thermocouple}^2 + \text{Bath}^2 + \text{Keithley}^2 + \text{Surface plate}^2)^{0.5}$   
 =  $(0.138^2 + 0.05^2 + 0.090^2 + 0.25^2)^{0.5}$   
 = 0.30 °C

Surface Temperature Uncertainty Ratio (80 to 190 °C): =  $(1.5^\circ\text{C} / 0.3^\circ\text{C}) = 5:1$

**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 2-6 Calibration Environment and Warm-Up Requirements

Measurement Standards & Support Equipment Environmental Requirements:	Temperature: $23 \pm 5^{\circ} \text{C}$ . Relative Humidity: Less than 95% Barometric Pressure $30 \pm 1.5 \text{ in Hg}$ ( $1016 \pm 50 \text{ mbar}$ )
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 Visually inspect the UUC for:

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

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

### 4. Humidity and Temperature Calibration Process

#### 4.1 Set-up

##### 4.1.1 Verify that the Minicomputer and Characterization gage are on (Figure 4-1b).

##### 4.1.2 **Turning** on the Thunder Scientific 2500 Humidity Generator; the power switch is located at the lower left rear of the console just above the power cord (Figure 4-1a).

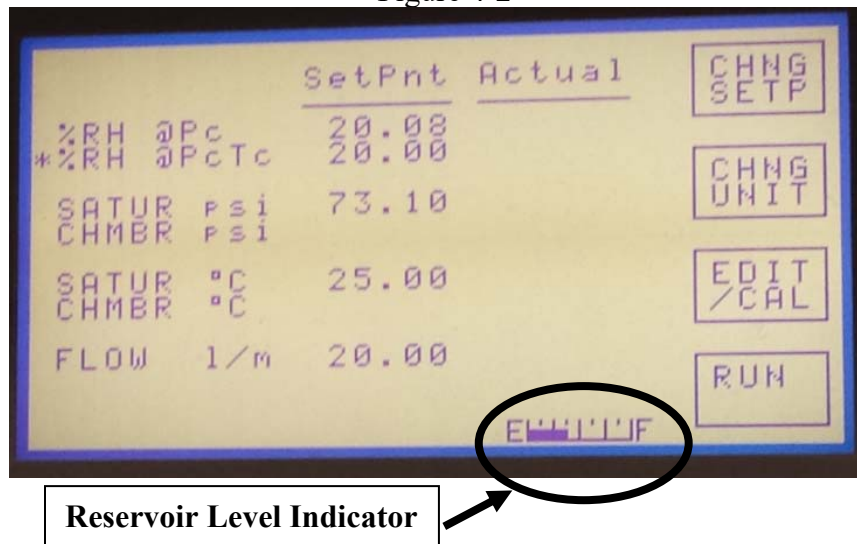
Figure 4-1a

Figure 4-1b



- 4.1.3 At the end of the power-up sequence, the following control screen will appear. Ensure that the **reservoir is not empty** or close to empty before testing, if so, fill reservoir before testing. NOTE: Only distilled water is to be used. Error Code “8” – Reservoir Needs Water.

Figure 4-2



## 4.2 Test

- 4.2.1 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.

- 4.2.2 If the probe has a protective cap, remove it before proceeding.

- 4.2.3 With an extension cable connected to the UUC and the PosiTector Gage body, place the UUC in the chamber and the gage on the outside of the chamber.

**Note:** If an extension cable is not available, the UUC/Gage combination can be placed in the chamber. The gage would need to be set in Auto Log Mode to obtain the readings. Refer to the gage user manual on how to set Auto Log Mode.

- 4.2.4 Adjust the set point of the humidity chamber to 35 %RH and allow to stabilize for at least 60 minutes. After the stabilization time turn on the gage(s) wait about one minute to verify the reading is stable, and record the gage and the chamber relative humidity readings on the calibration certificate. Record the gage and the chamber air temperature readings on the calibration certificate.
- 4.2.5 Adjust the set point of the humidity chamber to 65 %RH and allow to stabilize for at least 60 minutes. After the stabilization time turn on the gage(s) wait about one minute to verify the reading is stable and record the gage and the chamber relative humidity readings on the calibration certificate. Disconnect the probe(s) from the connectors in the chamber.
- 4.2.6 Adjust the surface temperature calibrator set point to 40 °C and allow to stabilize for at least 15 minutes.
- 4.2.7 Connect the probe to a gage body and place the DPM surface probe on the center of the top surface of the surface temperature calibrator until the temperature stabilizes and record the highest reading for calibrator and the gage.
- 4.2.8 Repeat steps 4.2.6 - 4.2.7 for 100°C.

## 5. Anemometer Calibration

- 5.1 Ensure the wind tunnel and Kanomax Anemometer operate properly.
- 5.2 Attach the UUC to a gage and insert the probe into the wind tunnel. Make sure the sliding cover stays fully open.
- 5.3 Set the wind tunnel to 5 m/s and allow tunnel to stabilize. Record the UUC and Kanomax velocities on the calibration certificate.
- 5.4 Repeat step 5.3 for 10, 15 and 20 m/s.

## 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 Data for DeFelsko PosiTector DPMA Probe

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				$\pm 3.0$
Ambient Temperature	°C	N/A				$\pm 0.5$
Relative Humidity	%RH	65				$\pm 3.0$
Surface Temperature Low	°C	40				$\pm 0.5$
Surface Temperature High	°C	100				$\pm 1.5$
Wind Speed	m/s	5				$\pm 0.7$
Wind Speed	m/s	10				$\pm 0.7$
Wind Speed	m/s	15				$\pm 0.7$
Wind Speed	m/s	20				$\pm 0.7$

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

## Management Procedure Change Notice

Procedure Number: MP 2562

Revision Level: B

Date of Change: May 26, 2023

Title: Calibration Procedure, DeFelsko PosiTector Dew Point Meter with  
Anemometer (DPMA)

### Reason for Change:

- Thunder Scientific Model 1200 is no longer used
- Updated Tables

### Description of Change:

- Removed Thunder Scientific Model 1200 figures from procedure
- In Table 2-1 and 2-2 - Added the greater than (>) symbol to Surface Temperature ranges
- In Table 2-3 - Changed Thunder Scientific Model 1200 to Thunder Scientific Model 2500
- In Table 2-5 - Changed EDL STS-SC2 Calibrator 40 °C accuracy of 0.016 °C to 0.16 °C  
(+ associated accuracy formula)

I confirm I have read and understand the procedure and the change described above.

Printed Name	Signature	Date

Management Form 0010.02-05/1998