DeFelsko®

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Calibration Procedure

# DeFelsko PosiTector Dew Point Meter with Anemometer (DPMA)

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# 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 2.9:1. 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) | ± 0.5 °C (1.0 °F) | Temperature Calibrator |
| | 80 to 190 °C (175 to 375 °F) | ± 1.5 °C (3.0 °F) | |
| 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 Applicable | Actual Equipment Specifications | |
|---|---|---|
| | Range | Accuracy |
| Thunder Scientific Model 1200 Humidity Generator | 10 to 60 °C (60 to 140 °F) | ± 0.05 °C (± 0.09 °F) |
| | 10 to 95% RH | ± 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 | ± 1% of reading ± 1 digit |

Accuracy @ 20.00 m/s = (20.00 m/s x 0.01) + 0.01m/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<br>100 °C | 0.016 °C<br>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 = $(\text{Thermocouple}^2 + \text{Bath}^2 + \text{Keithley}^2 + \text{Surface plate}^2)^{0.5}$
$= (0.138^2 + 0.05^2 + 0.090^2 + 0.016^2)^{0.5}$
= 0.17 °C
Surface Temperature Uncertainty Ratio (-40 to 80 °C): = (0.5 °C / 0.17 °C) = 2.9:1

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 °C / 0.3 °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 ± 5° C.<br>Relative Humidity: Less than 95%<br>Barometric Pressure 30 ± 1.5 in Hg<br>(1016 ± 50mbar) |
| Measurement Standards & Support Equipment Warm-up and Stabilization Requirements: | Thunder Scientific Humidity Generator:<br>60 minutes<br><br>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

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

4.2 Attach the probe(s) to the connectors in the humidity chamber. Multiple probes can be calibrated in the chamber simultaneously. Make note of what probe is attached to which body. Record the probe serial number(s) and Barometric Pressure (mbars) on the calibration certificate.

Figure 4-1



4.3 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.

4.4 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.

4.5 Adjust the surface temperature calibrator set point to 40 °C and allow to stabilize for at least 15 minutes.

4.6 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.

4.7 Repeat steps 4.5 - 4.6 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 | | | | ± 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 |
| Wind Speed | m/s | 5 | | | | ± 0.7 |
| Wind Speed | m/s | 10 | | | | ± 0.7 |
| Wind Speed | m/s | 15 | | | | ± 0.7 |
| Wind Speed | m/s | 20 | | | | ± 0.7 |

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

# Management Procedure Change Notice

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

| |
|---|
| Reason for Change:<br><br>• New procedure |
| Description of Change:<br><br>• New product |

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

| Printed Name | Signature | Date |
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