

Thunder Scientific Corporation  
623 Wyoming Blvd. SE • Albuquerque, NM 87123 • 505-265-8701

## *Certificate of Conformance*

Customer: MESA LABORATORIES, INC  
12100 W. 6th Avenue, Lakewood, CO 80228  
Purchase Order: PO-025403  
Item: Thunder Scientific 2500 Humidity Generator  
ID Number: TE10294  
Serial Number: 0501476  
Quality Manual: CL-1000, Rev 2, 14 Aug 19  
Work Instruction: CL-4012, Rev 2, 29 May 19  
Calibration Date: 13 Feb 20  
Cert. Number: 18017

This certifies the above product was calibrated in compliance with ISO/IEC 17025:2017 and ANSI/NCSL Z540-1-1994; Part 1 using applicable Thunder Scientific procedures.

At planned intervals, Thunder Scientific measurement and generation standards are calibrated by comparison to or measurement against national standards, natural physical constants, consensus standards, or by ratio type measurements using self-calibrating techniques.


This calibration is traceable to the International System of Units (SI) through NIST-maintained standards.

The environment in which this instrument was calibrated is maintained within the operating specifications of the instrument and the standards.

This calibration order conforms to all procurement document requirements.

Manufacturer and/or user specifications are noted in the calibration report. Measured values greater than those specification are identified; no conformance decision is made or implied.

Supporting documentation relative to traceability is on file and is available for examination upon request. This report contains flow data that is not covered by the NVLAP accreditation.

  
Thunder Scientific Corporation

THUNDER SCIENTIFIC CORPORATION  
623 Wyoming Blvd SE, Albq, NM 87123



REPORT OF  
HUMIDITY COMPARISON

Customer: MESA LABORATORIES, INC  
12100 W. 6th Avenue, Lakewood, CO 80228  
Purchase Order Number: PO-025403

Item: Thunder Scientific 2500 Humidity Generator s/n 0501476 ID# TE10294  
Comparison Required: As Rcvd/As Left at 10, 20, 50 & 80 %RH at 25 °C.

Cert. Number: 18017  
Quality Manual: CL-1000, Rev 2, 14 Aug 19  
Work Instruction: CL-4012, Rev 2, 29 May 19  
Comparison Date: 13 Feb 20  
Ambient Conditions: 24 °C (±4 °C) & 40 %RH (±20 %RH)  
Generator Flow Rate: 20 slpm  
Test Gas: Air

Stds Used: MBW DP-30 EN0040 exp 05 Sep 20  
0.08 °C FP/DP uncertainty, k=2  
Hart 1504/5665 EN0095 exp 13 May 20  
0.03 °C uncertainty, k=2  
Heise DXD EN0138 exp 15 May 20  
0.01 psiA uncertainty (0 to 50 psiA), k=2

The Model 2500 produces an atmosphere of known humidity based on the "two-pressure" principle. The accuracy was verified using a reference chilled mirror hygrometer. "Ref %RH" was calculated using "Ref DP", "Ref Temp" and "Ref Pressure" measurements. This comparison is traceable to the International System of Units (SI) through NIST-maintained standards. Supporting documentation relative to traceability is available for review by appointment.

**U<sub>Comparison</sub>** (Measurement Comparison Uncertainty) is the RSS (root sum square) of the UUT's standard deviation of ten readings at each test point, the UUT resolution and the uncertainty of the standards, with a coverage factor of k=2 at a 95 percent confidence level.

**As Rcvd Data:**

| Ref DP °C | 2500 DP °C | Ref Temp °C | Ref Pressure psiA | 2500 Saturator psiA | 2500 Saturator °C | 2500 Chamber psiA | 2500 Chamber °C | Ref %RH | 2500 %RH | Difference %RH | U <sub>Comparison</sub> %RH |
|-----------|------------|-------------|-------------------|---------------------|-------------------|-------------------|-----------------|---------|----------|----------------|-----------------------------|
| -8.75     | -8.75      | 24.96       | 11.891            | 121.9               | 25.00             | 11.90             | 25.02           | 9.99    | 10.00    | 0.01           | 0.07                        |
| 0.50      | 0.51       | 24.98       | 11.871            | 59.94               | 25.00             | 11.88             | 25.03           | 20.01   | 20.00    | -0.01          | 0.16                        |
| 13.88     | 13.90      | 24.99       | 11.864            | 23.75               | 25.00             | 11.87             | 25.04           | 50.07   | 50.00    | -0.07          | 0.28                        |
| 21.36     | 21.35      | 25.00       | 11.860            | 14.80               | 25.00             | 11.87             | 25.05           | 80.24   | 80.00    | -0.24          | 0.42                        |

**As Left Data:**

| Ref DP °C | 2500 DP °C | Ref Temp °C | Ref Pressure psiA | 2500 Saturator psiA | 2500 Saturator °C | 2500 Chamber psiA | 2500 Chamber °C | Ref %RH | 2500 %RH | Difference %RH | U <sub>Comparison</sub> %RH |
|-----------|------------|-------------|-------------------|---------------------|-------------------|-------------------|-----------------|---------|----------|----------------|-----------------------------|
| -8.78     | -8.75      | 24.96       | 12.047            | 123.9               | 25.00             | 12.08             | 25.00           | 9.97    | 10.00    | 0.03           | 0.07                        |
| 0.44      | 0.49       | 24.96       | 12.044            | 61.03               | 25.00             | 12.08             | 25.01           | 19.95   | 20.00    | 0.05           | 0.12                        |
| 13.83     | 13.87      | 24.97       | 12.115            | 24.35               | 25.00             | 12.15             | 25.00           | 49.96   | 50.00    | 0.04           | 0.28                        |
| 21.32     | 21.32      | 24.98       | 12.118            | 15.19               | 25.00             | 12.15             | 25.01           | 80.14   | 80.01    | -0.13          | 0.42                        |

Measured values resulting in an error greater than the manufacturer's specification limits are indicated by 'MV>Spec'. No conformance decision is made or implied.

Adjustments: System verification before and after all adjustments.

Thunder Scientific 2500 uncertainty is 0.5 %RH. This uncertainty includes the long term stability, reproducibility, repeatability and resolution of the 2500 for a period of up to one year, as long as the unit is maintained per Thunder Scientific's recommendations.

As Rcvd: Operational Failure: NONE  
Physical Damage: NONE

As Left: Calibration Seals: 0

Lemuel Padin, Cal Tech

Jarred Crouse, Lab Manager

This report shall not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government. Results relate only to the items tested or calibrated. This report shall not be reproduced except in full, without the written approval of Thunder Scientific Corporation.

**THUNDER SCIENTIFIC CORPORATION**  
623 Wyoming Blvd SE, Albq, NM 87123

**REPORT OF  
PRESSURE CALIBRATION**



Customer: MESA LABORATORIES, INC  
12100 W. 6th Avenue, Lakewood, CO 80228  
Purchase Order Number: PO-025403

Item: Thunder Scientific 2500 Humidity Generator s/n 0501476 ID# TE10294  
Low Range Pressure Transducer s/n: 1008027  
High Range Pressure Transducer s/n: 995503

Low Pressure Calibration Required: As Rcvd/As Left at 12.5, 20, 30, 40 & 50 psiA.  
High Pressure Calibration Required: As Rcvd/As Left at 50, 75, 100, 125 & 150 psiA.

Cert. Number: 18017  
Quality Manual: CL-1000, Rev 2, 14 Aug 19  
Work Instruction: CL-4012, Rev 2, 29 May 19  
Calibration Date: 05 Feb 20  
Ambient Conditions: 24 °C (±4 °C) & 40 %RH (±20 %RH)  
Test Gas: Nitrogen

Std Used: Ruska 7520i EN0118 exp 17 May 20  
0.02 psiA uncertainty (0 to <100 psiA), k=2  
0.05 psiA uncertainty (100 to <250 psiA), k=2

Reference pressures were generated for each transducer and curve fit coefficients were verified, or calculated and stored to memory. This calibration is traceable to the International System of Units (SI) through NIST-maintained standards. Supporting documentation relative to traceability is available for review by appointment.

**U** (Measurement Uncertainty) is the RSS (root sum square) of the standard deviation of the UUT's error over the test range, the UUT resolution and the uncertainty of the standard, with a coverage factor of k=2 at a 95 percent confidence level.

**As Rcvd/As Left Data:**

**As Rcvd/As Left Data:**

Low Pressure Transducer:

High Pressure Transducer:

| Ref<br>psiA | 2500<br>psiA | Error<br>psiA | <b>U</b><br>psiA | Ref<br>psiA | 2500<br>psiA | Error<br>psiA | <b>U</b><br>psiA |
|-------------|--------------|---------------|------------------|-------------|--------------|---------------|------------------|
| 12.500      | 12.49        | -0.01         | 0.02             | 50.000      | 50.00        | 0.00          | 0.10             |
| 20.000      | 19.99        | -0.01         | 0.02             | 75.000      | 74.99        | -0.01         | 0.10             |
| 30.000      | 29.99        | -0.01         | 0.02             | 100.000     | 99.98        | -0.02         | 0.10             |
| 40.000      | 39.99        | -0.01         | 0.02             | 125.000     | 124.9        | -0.10         | 0.13             |
| 50.000      | 49.98        | -0.02         | 0.02             | 150.000     | 149.9        | -0.10         | 0.13             |

Measured values resulting in an error greater than the manufacturer's specification limits are indicated by 'MV>Spec'. No conformance decision is made or implied.

Adjustments: NONE

Manufacturer's specifications: ±0.15% of full scale.

As Rcvd: Operational Failure: NONE  
Physical Damage: NONE

Lemuel Padin, Cal Tech

Jarred Crouse, Lab Manager

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THUNDER SCIENTIFIC CORPORATION  
623 Wyoming Blvd SE, Albu, NM 87123



REPORT OF  
TEMPERATURE CALIBRATION

Customer: MESA LABORATORIES, INC  
12100 W. 6th Avenue, Lakewood, CO 80228  
Purchase Order Number: PO-025403

Item: Thunder Scientific 2500 Humidity Generator s/n 0501476 ID# TE10294  
Temperature Calibration Required: As Rcvd at 0, 20, 35, 50 & 70 °C.

Cert. Number: 18017  
Quality Manual: CL-1000, Rev 2, 14 Aug 19  
Work Instruction: CL-4012, Rev 2, 29 May 19  
Calibration Date: 05 Feb 20  
Ambient Conditions: 24 °C (±4 °C) & 40 %RH (±20 %RH)  
Test Medium: FC-77 Fluorinert™

Std Used: Hart 1504/5665 EN0029 exp 18 Nov 20  
0.03 °C uncertainty, k=2

The 2500's four RTD's were compared to the standard thermometer in a temperature bath containing FC-77 Fluorinert™. Reference temperatures were generated and curve fit coefficients were verified, or calculated and stored to memory. This calibration is traceable to the International System of Units (SI) through NIST-maintained standards. Supporting documentation relative to traceability is available for review by appointment.

**U** (Measurement Uncertainty) is the RSS (root sum square) of the standard deviation of the UUT's error over the test range, the UUT resolution and the uncertainty of the standard, with a coverage factor of k=2 at a 95 percent confidence level.

**As Rcvd Data:**

| Ref °C | Saturator °C | Error °C | U °C |  | Ref °C | Chamber °C | Error °C | U °C |
|--------|--------------|----------|------|--|--------|------------|----------|------|
| 70.024 | 70.02        | 0.00     | 0.04 |  | 70.024 | 70.02      | 0.00     | 0.04 |
| 49.970 | 49.99        | 0.02     | 0.04 |  | 49.970 | 49.98      | 0.01     | 0.04 |
| 35.017 | 35.01        | -0.01    | 0.04 |  | 35.017 | 35.03      | 0.01     | 0.04 |
| 20.012 | 20.00        | -0.01    | 0.04 |  | 20.012 | 20.03      | 0.02     | 0.04 |
| 0.036  | 0.03         | -0.01    | 0.04 |  | 0.036  | 0.04       | 0.00     | 0.04 |

| Ref °C | Presat °C | Error °C | U °C |         | Ref °C | Exp Valve °C | Error °C | U °C |
|--------|-----------|----------|------|---------|--------|--------------|----------|------|
| 70.024 | 70.09     | 0.07     | 0.04 | MV>Spec | 70.024 | 70.01        | -0.01    | 0.04 |
| 49.970 | 50.03     | 0.06     | 0.04 |         | 49.970 | 49.98        | 0.01     | 0.04 |
| 35.017 | 35.02     | 0.00     | 0.04 |         | 35.017 | 35.01        | -0.01    | 0.04 |
| 20.012 | 19.99     | -0.02    | 0.04 |         | 20.012 | 20.01        | 0.00     | 0.04 |
| 0.036  | 0.04      | 0.00     | 0.04 |         | 0.036  | 0.03         | -0.01    | 0.04 |

Measured values resulting in an error greater than the manufacturer's specification limits are indicated by 'MV>Spec'. No conformance decision is made or implied.

Manufacturer's specifications: ±0.06 °C

As Rcvd: Operational Failure: NONE  
Physical Damage: NONE

Lemuel Padin, Cal Tech

Jarred Crouse, Lab Manager

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**THUNDER SCIENTIFIC CORPORATION**  
623 Wyoming Blvd SE, Albq, NM 87123



**REPORT OF  
TEMPERATURE CALIBRATION**

Customer: MESA LABORATORIES, INC  
12100 W. 6th Avenue, Lakewood, CO 80228  
Purchase Order Number: PO-025403

Item: Thunder Scientific 2500 Humidity Generator s/n 0501476 ID# TE10294  
Temperature Calibration Required: As Left at 0, 20, 35, 50 & 70 °C.

Cert. Number: 18017  
Quality Manual: CL-1000, Rev 2, 14 Aug 19  
Work Instruction: CL-4012, Rev 2, 29 May 19  
Calibration Date: 05 Feb 20  
Ambient Conditions: 24 °C (±4 °C) & 40 %RH (±20 %RH)  
Test Medium: FC-77 Fluorinert™

Std Used: Hart 1504/5665 EN0029 exp 18 Nov 20  
0.03 °C uncertainty, k=2

The 2500's four RTD's were compared to the standard thermometer in a temperature bath containing FC-77 Fluorinert™. Reference temperatures were generated and curve fit coefficients were verified, or calculated and stored to memory. This calibration is traceable to the International System of Units (SI) through NIST-maintained standards. Supporting documentation relative to traceability is available for review by appointment.

*U* (Measurement Uncertainty) is the RSS (root sum square) of the standard deviation of the UUT's error over the test range, the UUT resolution and the uncertainty of the standard, with a coverage factor of k=2 at a 95 percent confidence level.

**As Left Data:**

| Ref<br>°C | Saturator<br>°C | Error<br>°C | Chamber<br>°C | Error<br>°C | Presat<br>°C | Error<br>°C | Exp Valve<br>°C | Error<br>°C | <i>U</i><br>°C |
|-----------|-----------------|-------------|---------------|-------------|--------------|-------------|-----------------|-------------|----------------|
| 70.003    | 70.00           | 0.00        | 69.99         | -0.01       | 70.00        | 0.00        | 70.00           | 0.00        | 0.03           |
| 49.992    | 50.01           | 0.02        | 50.01         | 0.02        | 50.00        | 0.01        | 50.01           | 0.02        | 0.03           |
| 34.981    | 34.99           | 0.01        | 34.99         | 0.01        | 34.97        | -0.01       | 34.99           | 0.01        | 0.03           |
| 19.999    | 20.01           | 0.01        | 20.00         | 0.00        | 19.98        | -0.02       | 20.00           | 0.00        | 0.03           |
| 0.019     | 0.02            | 0.00        | 0.02          | 0.00        | 0.01         | -0.01       | 0.01            | -0.01       | 0.03           |

Measured values resulting in an error greater than the manufacturer's specification limits are indicated by 'MV>Spec'. No conformance decision is made or implied.

Adjustments: Calibration coefficients were calculated and saved to memory.

Manufacturer's specifications: ±0.06 °C

Lemuel Padin, Cal Tech

Jarred Crouse, Lab Manager

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**THUNDER SCIENTIFIC CORPORATION**

623 Wyoming Blvd SE, Albq, NM 87123

**REPORT OF  
FLOW CALIBRATION**

Customer: MESA LABORATORIES, INC  
12100 W. 6th Avenue, Lakewood, CO 80228  
Purchase Order Number: PO-025403

Item: Thunder Scientific 2500 Humidity Generator s/n 0501476 ID# TE10294  
Mass Flow Meter s/n: 79266

Mass Flow Calibration Required: As Rcvd/As Left at approximately 0, 10 & 20 slpm

Cert. Number: 18017  
Quality Manual: CL-1000, Rev 2, 14 Aug 19  
Work Instruction: CL-4012, Rev 2, 29 May 19  
Calibration Date: 12 Feb 20  
Ambient Conditions: 24 °C (±4 °C) & 40 %RH (±20 %RH)  
Test Medium: Air

Std Used: BIOS DC-2 EN0003 exp 12 Dec 20  
1.4% of reading uncertainty, k=2

Flow output of the 2500 was monitored by a BIOS DC-2 flow meter. Reference flows were generated and curve fit coefficients were verified, or calculated and stored to memory. This calibration is traceable to the International System of Units (SI) through NIST-maintained standards. Supporting documentation relative to traceability is available for review by appointment.

**U** (Measurement Uncertainty) is the RSS (root sum square) of the UUT's historical repeatability value, the UUT resolution and the uncertainty of the standard, with a coverage factor of k=2 at a 95 percent confidence level.

**As Rcvd/As Left Data:**

| Ref<br>slpm | 2500<br>slpm | Error<br>slpm | <b>U</b><br>slpm |
|-------------|--------------|---------------|------------------|
| -----       | -----        | -----         | -----            |
| 20.06       | 20.19        | 0.13          | 0.29             |
| 9.95        | 9.88         | -0.07         | 0.15             |
| 0.00        | 0.00         | 0.00          | 0.06             |

Measured values resulting in an error greater than the manufacturer's specification limits are indicated by 'MV>Spec'. No conformance decision is made or implied.

Adjustments: NONE

Manufacturer's specifications: ±0.8 slpm

As Rcvd: Operational Failure: NONE  
Physical Damage: NONE

  
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Lemuel Padin, Cal Tech

  
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Jarred Crouse, Lab Manager

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