



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-014498
Item: Thunder Scientific 2500 Humidity Generator
ID Number: TE10706
Serial Number: 1106851
Quality Manual: CL-QM-01, Issue 8, 08 Jan 15
Procedure: CL-SOP-0013, Issue 8, 10 May 18
Calibration Date: 18 Jun 18
Cert. Number: 16166

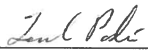
This certifies the above product was calibrated in compliance with ISO/IEC 17025:2005 and ANSI/NCSL Z540-1-1994; Part 1 using applicable Thunder Scientific procedures.

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.

At the time of shipment, this instrument did meet published operating/user specifications at the required test points and did conform to the procurement document requirements. Refer to calibration report.

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

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REPORT OF
HUMIDITY COMPARISON

Customer: MESA LABORATORIES, INC.
12100 W. 6th Avenue, Lakewood, CO 80228
Purchase Order Number: PO-014498

Item: Thunder Scientific 2500 Humidity Generator s/n 1106851 ID# TE10706
Comparison Required: As Rcvd/As Left at 10, 20, 50 & 80 %RH at 25 °C.

Cert. Number: 16166
Quality Manual: CL-QM-01, Issue 8, 08 Jan 15
Procedure: CL-SOP-0013, Issue 8, 10 May 18
Comparison Date: 18 Jun 18
Ambient Conditions: 24 °C (±4 °C) & 40 %RH (±20 %RH)
Generator Flow Rate: 20 slpm
Test Gas: Air

Std's Used: MBW DP-30 EN0040 exp 08 Sep 18
0.08 °C FP/DP uncertainty, k=2
Hart 1504/5665 EN0124 exp 26 Jul 18
0.03 °C uncertainty, k=2
Heise DXD EN0138 exp 24 May 19
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_{Comparison} (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 _{Comparison} %RH
-8.77	-8.74	24.95	12.094	124.1	25.00	12.11	25.02	9.98	10.00	0.02	0.07
0.49	0.51	24.97	12.092	61.19	25.00	12.12	25.02	20.01	20.00	-0.01	0.12
13.87	13.88	24.98	12.093	24.28	25.00	12.12	25.02	50.06	50.00	-0.06	0.28
21.33	21.34	24.98	12.092	15.14	25.00	12.13	25.03	80.19	80.01	-0.18	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 _{Comparison} %RH
-8.78	-8.75	24.97	12.126	124.6	25.00	12.15	25.00	9.96	10.00	0.04	0.07
0.47	0.49	24.97	12.119	61.40	25.00	12.15	25.01	19.98	20.00	0.02	0.13
13.87	13.88	24.97	12.116	24.34	25.00	12.15	25.01	50.09	50.02	-0.07	0.29
21.33	21.32	24.99	12.114	15.19	25.00	12.15	25.01	80.14	80.01	-0.13	0.42

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: Within Tolerance: YES
Operational Failure: NONE
Physical Damage: NONE

As Left: Within Tolerance: YES
Limited Range: NONE
Calibration Seals: 0


Lemuel Padin, Cal Tech


Jarred Crouse, Lab Manager

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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-014498

Item: Thunder Scientific 2500 Humidity Generator s/n 1106851 ID# TE10706
Low Range Pressure Transducer s/n: 1323558
High Range Pressure Transducer s/n: 1299038

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: 16166
Quality Manual: CL-QM-01, Issue 8, 08 Jan 15
Procedure: CL-SOP-0013, Issue 8, 10 May 18
Calibration Date: 01 Jun 18
Ambient Conditions: 24 °C (±4 °C) & 40 %RH (±20 %RH)
Test Gas: Nitrogen

Std Used: Mensor PCS400 EN0037 exp 17 May 19
0.02 psiA uncertainty (0 to 100 psiA), k=2
0.04 psiA uncertainty (100 to 300 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:

Low Pressure Transducer:				High Pressure Transducer:			
Ref psiA	2500 psiA	Error psiA	U psiA	Ref psiA	2500 psiA	Error psiA	U psiA
12.500	12.50	0.00	0.02	50.000	50.00	0.00	0.02
20.000	20.00	0.00	0.02	75.000	75.00	0.00	0.02
30.000	30.00	0.00	0.02	100.00	100.0	0.00	0.07
40.000	40.00	0.00	0.02	125.00	125.0	0.00	0.07
50.000	50.00	0.00	0.02	150.00	150.0	0.00	0.07

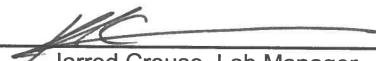
Adjustments: NONE

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

As Rcvd: Within Tolerance: YES
Operational Failure: NONE
Physical Damage: NONE

As Left: Within Tolerance: YES
Limited Range: 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-014498

Item: Thunder Scientific 2500 Humidity Generator s/n 1106851 ID# TE10706
Temperature Calibration Required: As Rcvd/As Left at 0, 20, 35, 50 & 70 °C.

Cert. Number: 16166
Quality Manual: CL-QM-01, Issue 8, 08 Jan 15
Procedure: CL-SOP-0013, Issue 8, 10 May 18
Calibration Date: 01 Jun 18
Ambient Conditions: 24 °C (±4 °C) & 40 %RH (±20 %RH)
Test Medium: FC-77 Fluorinert™

Std Used: Hart 1504/5665 EN0029 exp 29 Nov 18
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	Chamber °C	Error °C	Presat °C	Error °C	Exp Valve °C	Error °C	U °C
69.988	69.99	0.00	70.00	0.01	70.05	0.06	69.99	0.00	0.03
50.010	50.02	0.01	50.03	0.02	50.03	0.02	50.02	0.01	0.03
34.997	34.99	-0.01	35.01	0.01	35.01	0.01	34.99	-0.01	0.03
19.980	19.99	0.01	20.00	0.02	20.00	0.02	19.99	0.01	0.03
0.026	0.02	-0.01	0.02	-0.01	0.03	0.00	0.02	-0.01	0.03

As Left Data:

Ref °C	Saturator °C	Error °C	Chamber °C	Error °C	Presat °C	Error °C	Exp Valve °C	Error °C	U °C
69.989	69.98	-0.01	69.98	-0.01	69.98	-0.01	69.98	-0.01	0.03
50.006	50.01	0.00	50.00	-0.01	49.99	-0.02	50.01	0.00	0.03
34.987	34.98	-0.01	34.99	0.00	34.99	0.00	34.98	-0.01	0.03
20.016	20.02	0.00	20.02	0.00	20.02	0.00	20.02	0.00	0.03
0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03

Adjustments: New calibration coefficients were calculated and saved to memory.

Manufacturer's specifications: ±0.06 °C

As Rcvd: Within Tolerance: YES
Operational Failure: NONE
Physical Damage: NONE

As Left: Within Tolerance: YES
Limited Range: NONE


Lemuel Padin, Cal Tech


Jarred Crouse, Lab Manager

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**REPORT OF
FLOW CALIBRATION**

Customer: MESA LABORATORIES, INC.
12100 W. 6th Avenue, Lakewood, CO 80228
Purchase Order Number: PO-014498

Item: Thunder Scientific 2500 Humidity Generator s/n 1106851 ID# TE10706
Mass Flow Meter s/n: 141168

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

Cert. Number: 16166
Quality Manual: CL-QM-01, Issue 8, 08 Jan 15
Procedure: CL-SOP-0013, Issue 8, 10 May 18
Calibration Date: 18 Jun 18
Ambient Conditions: 24 °C (±4 °C) & 40 %RH (±20 %RH)
Test Medium: Air

Std Used: BIOS DC-2 EN0003 exp 18 Dec 18
uncertainty 1.4% of reading, k=2

Flow output of the 2500 was monitored by a BIOS DC-2 primary 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 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:

Ref slpm	2500 slpm	Error slpm	<i>U</i> slpm
19.60	19.97	0.37	0.28
10.49	10.71	0.22	0.16
0.00	0.02	0.02	0.06

Adjustments: NONE


Manufacturer's specifications: ±0.8 slpm

As Rcvd: Within Tolerance: YES
Operational Failure: NONE
Physical Damage: NONE

As Left: Within Tolerance: YES
Limited Range: NONE



Lemuel Padin, Cal Tech



Jarred Crouse, Lab Manager

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