Thunder Scientific Corporation

# Certificate of Calibration

Customer:	SOUTHWEST RESEARCH INSTITUTE
	6220 Culebra Rd., San Antonio, TX 78238
Purchase Order:	359043K
Item:	Model 2500 Humidity Generator
Serial Number:	0210373
Date Tested:	18 Feb 03
Procedure:	CL-SOP-0013
Cert. Number:	3222

This certifies that the above product was calibrated in compliance with ISO/IEC 17025 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.

National standards are administered by the National Institute of Standards and Technology (NIST) or other recognized national standards laboratories.

On the date tested, your instrument met its published operating specifications.

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

Supporting documentation relative to traceability is on file and is available for examination upon request.

Thunder Scientific Corporation

Thunder Scientific Corporation • 623 Wyoming SE • Albuquerque, NM 87123 • 505-265-8701 Page 1 of 5

### REPORT OF HUMIDITY INTERCOMPARISON

#### Customer: SOUTHWEST RESEARCH INSTITUTE 6220 Culebra Rd., San Antonio, TX 78238 Purchase Order Number: 359043K

Item: Model 2500 Humidity Generator s/n 0210373 Comparison Required: As Left at 8.3, 10, 20, 50 & 80% R.H. at a test temperature of 25.0 °C.

Control Number: 3222 Procedure: CL-SOP-0013 Comparison Date: 18 Feb 03 Ambient Conditions: 24.4 °C & 39% RH Test Gas: Air Generator Flow Rate: 20 slpm Sample Flow Rate: 30 L/h Stds. Used: MBW DP-30 EN0040 expires 08 Aug 03  $\pm 0.1$  °C FP/DP uncertainty Hart 1504/5665 EN0017 exp 19 Apr 03  $\pm 0.01$  °C uncertainty Mensor PCS400 EN0037 exp 04 Jun 03  $\pm 0.01$  % FS uncertainty (100/500psiA)

Standards incorporated to establish this comparison are NIST traceable. The humidity standard (the 2500) produces an atmosphere of known humidity based on the "two-pressure" principle. The accuracy of the Model 2500 was tested using the MBW DP-30 chilled mirror hygrometer to read dewpoint and then the "MBW %RH" column was calculated using the "Hart Temp" column and "Mensor Pressure" column.

#### As Left Data:

MBW	Hart	Mensor	2500	2500	2500	2500	MBW	2500	Difference
Dew Point	Temp	Pressure	Saturation	Saturation	Chamber	Chamber	%RH	%RH	%RH
°C	°C	psiA	psiA	°C	psiA	°C			
-11.13	24.99	12.070	149.90	25.00	12.07	25.01	8.27	8.26	0.00
-8.76	24.99	12.072	123.72	25.00	12.07	25.01	9.97	10.00	0.03
0.51	24.99	12.069	60.86	25.00	12.07	25.01	20.01	20.05	0.04
13.85	24.99	12.069	24.19	25.00	12.07	25.01	49.97	50.01	0.04
21.30	24.99	12.065	15.08	25.01	12.07	25.01	79.99	80.02	0.03

Adjustments: None. System verification only.

Walter Elisbury, Cal Tech

Brad Bennewitz, Lab Manage

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.

Page 2 of 5

## **REPORT OF CALIBRATION**

#### Customer: SOUTHWEST RESEARCH INSTITUTE 6220 Culebra Rd., San Antonio, TX 78238 Purchase Order Number: 359043K

Item: Model 2500 Humidity Generator s/n 0210373

Low Range Pressure Transducer s/n 884090 High Range Pressure Transducer s/n 860426

Low Pressure Calibration Required: As Left at approximately 12.5, 30, & 50 psiA. High Pressure Calibration Required: As Left at approximately 50, 100, & 150 psiA.

Cert. Number: 3222 Procedure: CL-SOP-0013 Calibration Date: 17 Feb 03 Ambient Conditions: 24.4 °C & 39% RH Test Gas: Nitrogen

Stds Used: Mensor PCS400 EN0037 exp 04 Jun 03 ±0.01% FS uncertainty (100/500psiA)

Standards incorporated to establish this calibration are traceable to NIST thru Ruska Instrument Corp Cal # 01050916360. The Mensor PCS400 was used to calibrate the pressure transducers. Three reference pressures were generated for each transducer. The coefficients were then calculated and stored to memory.

Thunder Scientific certifies this calibration to be in compliance with ISO/IEC 17025.

#### As Left Data:

Low Pr	Low Pressure Transducer:		High Pressure Transducer:				
Test	2500	Error	Test	2500	Error		
psiA	psiA	psiA	psiA	psiA	psiA		
			******				
12.129	12.13	0.001	50.005	50.00	-0.005		
20.000	20.00	0.000	75.000	75.00	0.000		
30.000	30.00	0.000	100.005	100.0	-0.005		
40.000	40.00	0.000	125.000	125.0	0.000		
50.000	50.00	0.000	150.000	150.0	0.000		

Adjustments: Calibration coefficients were calculated and saved to memory.

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## **REPORT OF CALIBRATION**

Customer: SOUTHWEST RESEARCH INSTITUTE 6220 Culebra Rd., San Antonio, TX 78238 Purchase Order Number: 359043K

Item: Model 2500 Humidity Generator s/n 0210373

Temperature Calibration Required: As Left at approximately 0, 35, & 70 °C. Verified at 0, 20, 35, 50 & 70 °C.

Cert. Number: 3222 Procedure: CL-SOP-0013 Calibration Date: 17 Feb 03 Ambient Conditions: 24.6 °C & 33% RH Test Medium: FC-77 Fluorinert™ Stds Used: Hart 1504/5665 EN0029 exp 03 Jun 03 ±0.01 °C uncertainty

The 2500's four thermistors were compared to the Hart 1504/5665 reference thermometer in a temperature bath containing FC-77 Fluorinert<sup>™</sup>. Three known temperatures were generated. Coefficients were then calculated and stored to memory. This calibration is traceable to NIST thru Hart calibration report # A052546 and is in compliance with ISO/IEC 17025.

#### As Left Data:

Actual °C	Saturation °C	Error °C	Chamber °C	Error °C	Presatur °C	Error °C	Exp Valve °C	Error °C
70.064	70.06	-0.004	70.06	-0.004	70.05	-0.014	70.06	-0.004
49.967	49.98	0.013	49.97	0.003	49.97	0.003	49.98	0.013
35.021	35.03	0.009	35.02	-0.001	35.02	-0.001	35.02	-0.001
20.018	20.02	0.003	20.02	0.003	20.01	-0.007	20.02	0.003
0.152	0.149	-0.003	0.147	-0.006	0.148	-0.005	0.151	-0.001

Adjustments: Calibration coefficients were calculated and saved to memory.

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Walter Ellsbury, Cal Tech

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Brad Bennewitz, Lab Manager

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## **REPORT OF CALIBRATION**

Customer: SOUTHWEST RESEARCH INSTITUTE 6220 Culebra Rd., San Antonio, TX 78238 Purchase Order Number: 359043K

Item: Model 2500 Humidity Generator s/n 0210373

Mass Flow Transducer s/n 56953

Calibration Required: As Left at approximately 0, 10, & 20 slpm

Cert. Number: 3222 Procedure: CL-SOP-0013 Calibration Date: 18 Feb 03 Ambient Conditions: 24.8 °C & 46% RH Test Medium: Air

Stds Used: BIOS DC-2 EN0003 exp 09 Oct 03 uncertainty ±1.4% of reading

Flow output of the 2500 was monitored by a BIOS DC-2 primary flow meter. Three reference flows were generated and coefficients were calculated and stored to memory. Thunder Scientific certifies this calibration complies to ISO/IEC 17025 and is traceable to NIST through Bios International Corp. calibration report # 12629.

As Left Data:

Reference	2500	Error
sipm	sipm	slpm
		******
19.65	19.64	-0.01
10.14	10.30	0.16
0.000	0.013	0.01

Adjustments: Calibration coefficients were calculated and saved to memory.

Vate chat

alter Ellsbury, Cal Tech

Brad Bennewitz, Lab Manager

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.

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Calibration Report for TSC Model 2500 Humidity Generator

S/N 0210373 Date 02/18/03

Temperature	Zero	Span	Linearity	CalDate
Saturation Temperature PreSat Temperature Ex Valve Temperature Chamber Temperature Temp Reference Resistor	-1.39307E-01 1.04580E-01 1.91535E-01 -2.14089E-02 -2.50000E+01	9.95320E-03 9.94137E-03 9.94508E-03 9.94970E-03 1.00000E-02	6.32127E-09 7.74850E-09 7.03901E-09 7.48590E-09 0.00000E+00	02/17/03 02/17/03 02/17/03 02/17/03 02/17/03
Procesure	 2eno	Snen	Linearity	CalDate
FIEBBUIE	2610	opan	Linearry	Carbale
Low Range (0–50 psia) Hi Range (50–150 psia)	-3.36814E-02 -4.30560E-01	1.99524E-03 5.92706E-03	1.92048E-11 4.40052E-10	02/17/03 02/17/03
Flow	Zero	Span	Linearity	CalDate
Mass Flow Rate	0.00000E+00	1.60000E-03	0.00000E+00	02/18/03

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Certified by <u>Valla</u> clab Date <u>18 feb 03</u>

		6220 Culebra Institut Institute C Phone: 210-522	Road, P.O. Drawer 2851( e Quality Systems alibration Laboratory 2-5215 Fax 210-522-3692	ACCREDITED Certificate #
	R R	Certifica	te of Calibration	0972-01
	Submitted By: DI	V20	Work Order: 4	44054016
	Address: B5	7	Date Issued: J	un 10, 2003
	Contact: DA	ARRELL DUNN	Calibration Date: J	un 10, 2003
Manuf	Description: HI	IUNDER SCIENTIFIC 2500	**Calibration Due: J Calibration Location: B	un 10, 2004 Udg. 64
	Serial No: 02	10373	Environment: T	emp. 68.0°F Hum. 40 %RH
	Asset No: 01	0231	*As Found: L	IMITED CALIBRATION
	Procedure: CL	53, JUN/99	*As Left: L	IMITED CALIBRATION
onforms to I e reproduced nstrument de I. S. Governi	SO/IEC 17025, 1999 and d, except in full, without t scribed above. This certi ment	ANSI/NCSL 2540-1-1994 which are equiva the written approval of the Southwest Researc ficate shall not be used to claim product endo	lent to relevant requirements of the ISO 9000-1994 ser ch Institute Calibration Laboratory. The results of this present by the American Association for Laboratory.	ries of standards. This certificate may nucleon calibration relate only to the individual Accreditation (A2LA) or any agency of
ncertainty e presents an nan or equal	valuation includes the ite expanded uncertainty usi to 25% (4:1) of the test li	m under test and is calculated in accordance on $g$ a coverage factor of $k=2$ to approximate a mit unless otherwise stated in remarks or an $f$	with the ISO "Guide to the Expression of Uncertainty i 95% confidence level. The calibration process provid attachment	in Measurement" (GUM). The uncertain les a Test Uncertainty Ratio (TUR) of le
The client han the Test In the Internet the Test In tability of the	as sole responsibility for o strument (TI) reading(s) a e TI.	determination of in/out of tolerance or compli and limits as reported. The reported uncertain	ance/noncompliance. An in/out of tolerance opinion in the time of calibration in the results at the time of calibration is a state of calibration.	s provided for your convenience based or and does not imply any short or long ter
*Calibration	interval is determined by	the client and does not assure the instrument bration date.	t will remain within tolerance until this date. Any nur	iber of factors may cause the instrument
e out of toler Remarks: Standards	THE FLOW MEA IS NOT USED IN Used	ASUREMENT IS NOT CRITICAL 1 I THE HUMIDITY CALCULATION	FO THE ACCURACY OF THE GENERAT NS.	ED HUMIDITY AND
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e out of toler tandards Asser 009137 008920 003048 003049	THE FLOW MEA IS NOT USED IN Used Manufacturer HART SCIENTIFIC RUSKA RUSKA	ASUREMENT IS NOT CRITICAL 7 THE HUMIDITY CALCULATION Model C, INC 1575 C, INC 17660-A-120-6-W 2468-758 2465-729	TO THE ACCURACY OF THE GENERAT NS. Description THERMOMETER PLATINUM RTD PRESSURE CALIBRATOR PRESSURE CALIBRATOR	ED HUMIDITY AND Cal Due Jul 06, 03 Jul 06, 03 Mar 10, 05 Mar 10, 05
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e out of toler tandards Asser 009137 008920 003048 003049 002856 003216	THE FLOW MEA IS NOT USED IN Used Manufacturer HART SCIENTIFIC HART SCIENTIFIC RUSKA RUSKA RUSKA HASTINGS	ASUREMENT IS NOT CRITICAL 7 THE HUMIDITY CALCULATION Model C, INC 1575 C, INC 17660-A-120-6-W 2468-758 2465-729 2468-714-69900 VT-6B	TO THE ACCURACY OF THE GENERAT NS. Description THERMOMETER PLATINUM RTD PRESSURE CALIBRATOR PRESSURE CALIBRATOR WEIGHT SET, CLASS N/S VACUUM CONTROLLER & G.	ED HUMIDITY AND Cal Due Jul 06, 03 Jul 06, 03 Mar 10, 05 Mar 10, 05 Mar 10, 05 Mar 10, 05 Mar 10, 05 Mar 23, 03
e out of toler <b>Remarks:</b> <b>Standards</b> Asset 009137 008920 003048 003049 002856 003216 003949	THE FLOW MEA IS NOT USED IN Used Manufacturer HART SCIENTIFIC RUSKA RUSKA RUSKA RUSKA HASTINGS TROEMNER	Model   C, INC 1575   C, INC 17660-A-120-6-W   2468-758 2465-729   2468-714-69900 VT-6B   5MG-100G 5MG-100G	TO THE ACCURACY OF THE GENERAT NS. Description THERMOMETER PLATINUM RTD PRESSURE CALIBRATOR PRESSURE CALIBRATOR WEIGHT SET, CLASS N/S VACUUM CONTROLLER & G. WEIGHT SET, CLASS 1	ED HUMIDITY AND Cal Due Jul 06, 03 Jul 06, 03 Mar 10, 05 Mar 10, 05 Mar 10, 05 Mar 10, 05 AGE TUBE Oct 23, 03 Jan 20, 04
e out of toler tandards Asser 009137 008920 003048 003049 002856 003216 003949	THE FLOW MEA IS NOT USED IN Used Manufacturer HART SCIENTIFIC HART SCIENTIFIC RUSKA RUSKA RUSKA HASTINGS TROEMNER	ASUREMENT IS NOT CRITICAL 7 THE HUMIDITY CALCULATION Model C, INC 1575 C, INC 17660-A-120-6-W 2468-758 2465-729 2468-714-69900 VT-6B 5MG-100G	Description THERMOMETER PLATINUM RTD PRESSURE CALIBRATOR PRESSURE CALIBRATOR WEIGHT SET, CLASS N/S VACUUM CONTROLLER & G. WEIGHT SET, CLASS 1	ED HUMIDITY AND Cal Due Jul 06, 03 Jul 06, 03 Mar 10, 05 Mar 10, 05 Mar 10, 05 Mar 10, 05 Mar 20, 04
e out of toler tem arks: tandards Asser 009137 008920 003048 003049 002856 003216 003949 003949	Ander Gelofe the flex (vani THE FLOW MEA IS NOT USED IN Used Manufacturer HART SCIENTIFIC HART SCIENTIFIC RUSKA RUSKA RUSKA HASTINGS TROEMNER	ASUREMENT IS NOT CRITICAL 7 THE HUMIDITY CALCULATION Model C, INC 1575 C, INC 17660-A-120-6-W 2468-758 2465-729 2468-714-69900 VT-6B 5MG-100G	Description THERMOMETER PLATINUM RTD PRESSURE CALIBRATOR PRESSURE CALIBRATOR WEIGHT SET, CLASS N/S VACUUM CONTROLLER & G. WEIGHT SET, CLASS 1	ED HUMIDITY AND Cal Due Jul 06, 03 Jul 06, 03 Mar 10, 05 Mar 10, 05 Mar 10, 05 Mar 10, 05 Mar 10, 05 Mar 20, 04 Jul 06, 03 Jul 06, 03 Jul 06, 03 Jul 06, 03 Jul 06, 03 Jul 06, 03 Mar 10, 05 Mar 20, 04 V: Perry Carpenter

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Work Order Asset No.	444054016 010231	Mfr Model	Thunder Scienti 2500	fic	Technician	PWC
Serial No	210373	Туре	Pressure Indica	tor	Cal Date	10-Jun-03
Remarks:						
Function/Range	Test Point	TI Reading	Difference	+/-Limit	+/-Uncertainty	Found/Left
Pressure	PSIA	PSIA	PSIA	PSIA	PSIA	Result
	10.00	10.00	0.00	0.05	0.01	Pass
	30.00	30.00	0.00	0.05	0.01	Pass
	50.00	49.99	-0.01	0.05	0.01	Pass
	30.00	30.00	0.00	0.05	0.01	Pass

10.00 0.00 END OF REPORT

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Work Order Asset No.	444054016 010231	Mfr Model	Thunder Scientific 2500	0	Technician	PWC
Serial No	210373	Туре	Pressure Indicato	r	Cal Date	10-Jun-03
Remarks:						
Function/Range	Test Point	TI Reading	Difference	+/-Limit	+/-Uncertainty	Found/Left
Pressure	PSIA	PSIA	PSIA	PSIA	PSIA	Result
	50.00	49.98	-0.02	0.13	0.01	Pass
	100.00	99.98	-0.02	0.13	0.01	Pass
	150.00	149.90	-0.10	0.13	0.01	Pass
	100.00	99.98	-0.02	0.13	0.01	Pass
	50.00	49.98	-0.02	0.13	0.01	Pass

49.98 -0.02 END OF REPORT

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Work Order: Asset No. Serial No.	444054016 10231 210373	Mfr. Model Type	Thunder Scientific 2500 Temp/Humidity Chamber		Technician Cal Date	PWC 10-Jun-03
Remarks:						
Function/Range	Test Point	TI Reading	Difference	+/-Limit	+/-Uncertainty	

<b>y</b>						
Degree C	Degree C	Degree C	Degree C	Degree C	Degree C	
Sat Temp	0.127	0.126	-0.001	0.1	0.059	
	35.035	35.01	-0.02	0.1	0.059	
	69.994	69.99	0.00	0.1	0.059	
Pr Sat Temp	0.127	0.152	0.025	0.1	0.059	
	35.021	35.01	-0.01	0.1	0.059	
	74.988	69.98	-5.01	0.1	0.059	
Expn Temp	0.127	0.151	0.024	0.1	0.059	
	35.021	35.02	0.00	0.1	0.059	
	69.994	69.99	0.00	0.1	0.059	
Chmb temp	0.127	0.135	0.008	0.1	0.059	
	35.021	35.01	-0.01	0.1	0.059	
	69.994	69.98	-0.01	0.1	0.059	
		END C	F REPORT			

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Untitled Calibration Report for TSC Model 2500 Humidity Generator

S/N 0210373 Date 06/11/03

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Temperature	Zerc	Span	Linearity	CalDate
Saturation Temperature PreSat Temperature Ex Valve Temperature Chamber Temperature Temp Reference Resistor	-1.22580E-01 1.14534E-01 2.00052E-01 -8.70601E-03 -2.50000E+01	9.94940E-03 9.93959E-03 9.94199E-03 9.94704E-03 1.00000E-02	6.38748E-09 7.76810E-09 7.13789E-09 7.74808E-09 0.00000E+00	06/10/03 06/10/03 06/10/03 06/10/03 02/17/03
Pressure	Zerc	Span	Linearity	CalDate
Low Range (0-50 psia) Hi Range (50-150 psia)	-3.33968E-02 -4.23677E-01	1.99461E-03 5.92633E-03	5.96463E-11 6.50344E-10	06/09/03 06/09/03
Flow	Zerc	Span	Linearity	CalDate
Mass Flow Rate	0.00000E+00	1.60000E-03	0.00000E+00	02/18/03

Certified by <u>P.C.</u> Date <u>10 JON 03</u>

## Darrell Dunn

NICIIIO

From:	Perry Carpenter [Perry.Carpenter@swri.edu]
Sent:	Tuesday, June 10, 2003 12:00 PM
То:	darrell.dunn@swri.org
Cc:	Robert Trollinger; Walt Hill
Subject:	Limitation

# SOUTHWEST RESEARCH INSTITUTE®

To: Darrell Dunn, Div 20, Bld. 64

From: Institute Calibration Laboratory; Perry Carpenter

Date: June 10, 2003

Subject: Review of Work Request Number 444054016

The work you requested is held pending your review. Please review the information provided below and indicate "Approved" or provide other instructions to continue the work.

Unit Received: June 4, 2003 Work Requested: Calibration

Manufacturer: Thunder Scientific

Model: 2500

Description: Humidity Generator

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Serial Number: 0210373

Asset Number: 10231 User ID:

**Cause of Review:** The Calibration Lab Does not have the standards at the present time to calibrate flow on this instument. I am requesting a limitation stating "Flow Not Cald." The Flow measurement is not critical to the accuracy of the generator. The flow is not used for the humidity calculations.

Approved (

Disapproved return unit as is ()

Date:

Instructions () ~intended work λMU Authorized by Signature Print or

Return this review to the Institute Calibration Laboratory Bldg 64 or FAX to (210) 522-3692. If you have questions or require additional information please call 522-5215.

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Thank you for your timely response,

Walt Hill, Metrology Group Leader Institute calibration Laboratory

6/10/2003

S.R.R.		SOUTHWEST R 6220 Culet Institu Phone: 210	<b>ESEARCH INSTITUTE</b> <sup>TM</sup> bra Road, P.O. Drawer 2851( titute Quality Systems te Calibration Laboratory -522-5215 Fax 210-522-3692	ACCREDITED Certificate #
	R	Certi	ficate of Calibration	0972-01
	Submitted By: Address: Contact:	DIV20 B57 DARRELL DUNN	Work Order: 444059362 Date Issued: Jun 14, 2004 Calibration Date: Jun 14, 2004	
Manuf	acturer Model: Description:	THUNDER SCIENTIFIC 2500 HUMIDITY GENERATOR	<b>**Calibration Due:</b> Jun 14, 2005 <b>Calibration Location:</b> Bldg. 64	
	Serial No: Asset No:	0210373 010231	Environment: Temp. 68.0°F *As Found: LIMITED CA	Hum. 40 %RH
This certifica conforms to lose reproduce nstrument de J. S. Govern Juncertainty e epresents an number for c: The client h on the Test In stability of th *Calibration be out of tole	te documents traceab ISO/IEC 17025, 1999 d, except in full, with escribed above. This ment expanded uncertainty alibration data. as sole responsibility rstrument (TI) reading e TI. interval is determine rance before the next	obility to the National Institute of Standards an 2 and ANSI/NCSL Z540-1-1994 which are en- tout the written approval of the Southwest Re- certificate shall not be used to claim product the item under test and is calculated in accorda- y using a coverage factor of k=2 to approxim for determination of in/out of tolerance or co- g(s) and limits as reported. The reported unc- ed by the client and does not assure the instru- calibration date.	and Technology (NIST) and the International System of Units (SI). The Lab quivalent to relevant requirements of the ISO 9000-1994 series of standards esearch Institute Calibration Laboratory. The results of this calibration rela- endorsement by the American Association for Laboratory Accreditation ( ance with the ISO "Guide to the Expression of Uncertainty in Measuremen rate a 95% confidence level. See Remarks or attached Calibration Report of compliance/noncompliance. An in/out of tolerance opinion is provided for y pertainty relates only to the results at the time of calibration and does not in ument will remain within tolerance until this date. Any number of factors r	oratory quality system s. This certificate may not te only to the individual A2LA) or any agency of th t" (GUM). The uncertainty with the same Work Order your convenience based on uply any short or long term may cause the instrument to
Remarks: Standards	Used			
Asset 003949 003049 009137 002856 003048 003220	Manufacturer TROEMNER RUSKA HART SCIENT RUSKA RUSKA HASTINGS	Model 5MG-100G 2465-729 1575 2468-714-69900 2468-758 VT-6B	Description WEIGHT SET, CLASS 1 PRESSURE CALIBRATOR THERMOMETER WEIGHT SET, CLASS N/S PRESSURE CALIBRATOR VACUUM CONTROLLER WITH GAGE TUE	Cal Duc Feb 13, 05 May 17, 06 Sep 05, 04 Mar 10, 05 Mar 10, 05 BE Oct 22, 04
5	t	aug	Set Kisti	
		/		

#### Southwest Research Institute Calibration Laboratory Measurement Report

Work Order:	444059362	Mfr.	Thunder Scientific	Technician	SRK
Asset No.	10231	Model	2500		
Serial No.	210373	Туре	Temp/Humidity Chamber	Cal Date	14-Jun-04
Remarks:			······································		

Remarks:

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Calibration of all transducers was performed"in the system, as a system".

Calibration is performed on all of the transducers by solving for the coefficients A, B, and C of the formula:

 $Y=A+Bx+Cx^2$  (Y = The desired value for the transducer being calibrated. X = The new count of A/D while measuring a transducer.

 Function/Range	Test Point	TI Reading	Difference	+/-Uncertainty
 Degree C	Degree C	Degree C	Degree C	Degree C
Sat Temp	0.041	0.061	0.020	0.013
	35.053	35.03	-0.02	0.013
	64.982	64.97	-0.01	0.013
Pr Sat Temp	0.041	0.062	0.021	0.013
	35.053	35.03	-0.02	0.013
	64.982	64.96	-0.02	0.013
Expn Temp	0.041	0.065	0.024	0.013
	35.053	35.02	-0.03	0.013
	64.982	64.97	-0.01	0.013
Chmb temp	0.041	0.058	0.017	0.013
	35.053	35.00	-0.05	0.013
	64.982	64.91	-0.07	0.013
	END OF	- REPORT		

Work Order Asset No.	444059362 010231	Mfr Model	Thunder Scientific 2500 50 PSIA		Technician	SRK
Serial No.	210373	Туре	Pressure Tran	sducer	Cal Date	14-Jun-04
Remarks:						
Function/Range	Test Point	TI Reading	Difference	+/-Uncertainty		
Pressure	PSIA	PSIA	PSIA	PSIA		
	10.00193	9.99	-0.017	0.012		
	30.00193	29.99	-0.012	0.012		
	50.00193	49.99	-0.012	0.012		

END OF REPORT

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Work Order Asset No.	444059362 010231	Mfr Model	Thunder Scientific 2500 150 PSIA	Technician	SRK
Serial No.	210373	Туре	Pressure Transducer	Cal Date	14-Jun-04
Remarks:					
	**************************************	· ····································	·		
Function/Range	Test Point	TI Reading	Difference	+/-Uncertainty	_
Pressure	PSIA	PSIA	PSIA	PSIA	
	50.00193	49.99	-0.012	0.0117	
	100.00193	100.00	-0.002	0.0122	
	150.00193	149.90	-0.102	0.0130	

END OF REPORT

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R	SOU	THWESTRESE 6220 Culebra Road Institute Qu Institute Calib Phone: 210-522-52	<b>EARCH INSTITUT</b> d, P.O. Drawer 28510 uality Systems ration Laboratory 15 Fax 210-522-3692	ETM
	R	Certificate of	of Calibration	0972-01
	Submitted By: DIV20 Address: B57		Work Order: Date Issued: Colibertian Date:	444059999 Jul 22, 2004 Jul 22, 2004
Manuf	acturer Model: THUNDE Description: HUMIDI	E DONN R SCIENTIFIC 2500 FY GENERATOR	**Calibration Duce: Calibration Location:	Jul 22, 2004 Jul 22, 2005 Bldg. 64
	Serial No: 0210373 Asset No: 010231 Procedure: CL-53, JU	JN/99	Environment: *As Found: *As Left:	I emp. 68.0°F Hum. 40 %RH IN TOLERANCE IN TOLERANCE
his certification onforms to I: e reproduced nstrument de J. S. Governr Jncertainty er epresents an umber for ca The client ha n the Test Instability of the	te documents traceability to the Na SO/IEC 17025, 1999 and ANSIAN d, except in full, without the writte scribed above. This certificate sha ment. valuation includes the item under t expanded uncertainty using a cove alibration data. as sole responsibility for determina strument (TI) reading(s) and limits e T1.	ational Institute of Standards and Technol CSL Z540-1-1994 which are equivalent to n approval of the Southwest Research Ins all not be used to claim product endorsem test and is calculated in accordance with t erage factor of $k=2$ to approximate a 95% ation of in/out of tolerance or compliance/ s as reported. The reported uncertainty re	togy (NST) and the international System of Oni o relevant requirements of the ISO 9000-1994 se- stitute Calibration Laboratory. The results of thi nent by the American Association for Laboratory the ISO "Guide to the Expression of Uncertainty confidence level. See Remarks or attached Cal (noncompliance. An in/out of tolerance opinion elates only to the results at the time of calibration	is (SI). The Laboratory quality system eries of standards. This certificate may n is calibration relate only to the individual Accreditation (A2LA) or any agency of in Measurement" (GUM). The uncertain ibration Report with the same Work Order is provided for your convenience based on n and does not imply any short or long ter
*Calibration e out of toler. temarks: tandards	interval is determined by the clier ance before the next calibration da None Used	nt and does not assure the instrument will ate.	remain within tolerance until this date. Any nu	mber of factors may cause the instrument
Calibration cout of toler emarks: tandards Asset	interval is determined by the clier ance before the next calibration da None Used Manufacturer TROEMNER	nt and does not assure the instrument will ate. Model 5MG-100G	remain within tolerance until this date. Any nu Description WEIGHT SET, CLASS 1	mber of factors may cause the instrument Cal Due Feb 13, 05
Calibration out of toler emarks: candards Asset 203949 202856	interval is determined by the clier ance before the next calibration da None Used Manufacturer TROEMNER RUSKA	nt and does not assure the instrument will ate. Model 5MG-100G 2468-714-69900	remain within tolerance until this date. Any nu Description WEIGHT SET, CLASS 1 WEIGHT SET, CLASS N/S	mber of factors may cause the instrument Cal Due Feb 13, 05 Mar 10, 05
Calibration out of toler. emarks: andards Asset 003949 002856 003048	interval is determined by the clier ance before the next calibration da None Used Manufacturer TROEMNER RUSKA RUSKA	nt and does not assure the instrument will ate.	remain within tolerance until this date. Any nu Description WEIGHT SET, CLASS 1 WEIGHT SET, CLASS N/S PRESSURE CALIBRATOR	mber of factors may cause the instrument Cal Due Feb 13, 05 Mar 10, 05 Mar 10, 05
Calibration out of tolers emarks: candards Asset 003949 002856 003048 003220	interval is determined by the clier ance before the next calibration da None Used Manufacturer TROEMNER RUSKA RUSKA HASTINGS	nt and does not assure the instrument will ate. Model 5MG-100G 2468-714-69900 2468-758 VT-6B	remain within tolerance until this date. Any nu Description WEIGHT SET, CLASS 1 WEIGHT SET, CLASS N/S PRESSURE CALIBRATOR VACUUM CONTROLLER WI	mber of factors may cause the instrument Cal Due Feb 13, 05 Mar 10, 05 Mar 10, 05 TH GAGE TUBE Oct 22, 04
Calibration out of toler: emarks: andards Asset 003949 002856 003048 003220 009137	interval is determined by the clier ance before the next calibration da None Used Manufacturer TROEMNER RUSKA RUSKA HASTINGS HART SCIENTIFIC	nt and does not assure the instrument will ate.	Temain within tolerance until this date. Any nut Description WEIGHT SET, CLASS 1 WEIGHT SET, CLASS N/S PRESSURE CALIBRATOR VACUUM CONTROLLER WIT THERMOMETER	mber of factors may cause the instrument Cal Due Feb 13, 05 Mar 10, 05 Mar 10, 05 TH GAGE TUBE Oct 22, 04 Sep 05, 04
Calibration out of toler. emarks: tandards Asset 003949 002856 003048 003220 009137 008920	interval is determined by the clier ance before the next calibration da None Used Manufacturer TROEMNER RUSKA RUSKA HASTINGS HART SCIENTIFIC HART SCIENTIFIC	nt and does not assure the instrument will ate.	Temain within tolerance until this date. Any nut Description WEIGHT SET, CLASS 1 WEIGHT SET, CLASS N/S PRESSURE CALIBRATOR VACUUM CONTROLLER WI THERMOMETER PLATINUM RTD	mber of factors may cause the instrument Cal Due Feb 13, 05 Mar 10, 05 Mar 10, 05 TH GAGE TUBE Oct 22, 04 Sep 05, 04 Sep 09, 04
Calibration e out of toler. emarks: tandards Asset 003949 002856 003048 003220 009137 008920 002079	interval is determined by the clier ance before the next calibration da None Used Manufacturer TROEMNER RUSKA RUSKA HASTINGS HART SCIENTIFIC HART SCIENTIFIC RUSKA	nt and does not assure the instrument will ate. Model 5MG-100G 2468-714-69900 2468-758 VT-6B 1575 5614-17660-A-12 6200	remain within tolerance until this date. Any nu Description WEIGHT SET, CLASS 1 WEIGHT SET, CLASS N/S PRESSURE CALIBRATOR VACUUM CONTROLLER WI THERMOMETER PLATINUM RTD PRESSURE GAUGE	mber of factors may cause the instrument Cal Due Feb 13, 05 Mar 10, 05 Mar 10, 05 TH GAGE TUBE Oct 22, 04 Sep 05, 04 Sep 09, 04 Sep 25, 04
*Calibration e out of toler. emarks: tandards Asset 003949 002856 003048 003220 009137 008920 002079 005144	interval is determined by the clier ance before the next calibration da None Used Manufacturer TROEMNER RUSKA RUSKA HASTINGS HART SCIENTIFIC HART SCIENTIFIC RUSKA RUSKA RUSKA RUSKA	Model 5MG-100G 2468-714-69900 2468-758 VT-6B 1575 5614-17660-A-12 6200 2468 CAL DENCU	Description Description WEIGHT SET, CLASS 1 WEIGHT SET, CLASS N/S PRESSURE CALIBRATOR VACUUM CONTROLLER WIT THERMOMETER PLATINUM RTD PRESSURE GAUGE DEAD WEIGHT PISTON CAS ELOW CALUPATION CON	Cal DueCal DueFeb 13, 05Mar 10, 05Mar 10, 05TH GAGE TUBEOct 22, 04Sep 05, 04Sep 09, 04Sep 25, 04May 17, 06
*Calibration e out of toler. Remarks: 3tandards Asset 003949 002856 003048 003220 009137 008920 002079 005144 007502	interval is determined by the clier ance before the next calibration da None Used Manufacturer TROEMNER RUSKA RUSKA HASTINGS HART SCIENTIFIC HART SCIENTIFIC RUSKA RUSKA SIERRA	Model 5MG-100G 2468-714-69900 2468-758 VT-6B 1575 5614-17660-A-12 6200 2468 CAL-BENCH	Description WEIGHT SET, CLASS 1 WEIGHT SET, CLASS 1 WEIGHT SET, CLASS N/S PRESSURE CALIBRATOR VACUUM CONTROLLER WI' THERMOMETER PLATINUM RTD PRESSURE GAUGE DEAD WEIGHT PISTON GAS FLOW CALIBRATION S'	Cal DueCal DueFeb 13, 05Mar 10, 05Mar 10, 05TH GAGE TUBEOct 22, 04Sep 05, 04Sep 05, 04Sep 09, 04Sep 25, 04May 17, 06YSTEMJun 04, 05
*Calibration ee out of toler. Remarks: 5tandards 003949 002856 003048 003220 009137 008920 002079 005144 007502	interval is determined by the clier ance before the next calibration da None Used Manufacturer TROEMNER RUSKA RUSKA HASTINGS HART SCIENTIFIC HART SCIENTIFIC RUSKA RUSKA SIERRA	nt and does not assure the instrument will ate.	Description WEIGHT SET, CLASS 1 WEIGHT SET, CLASS 1 WEIGHT SET, CLASS N/S PRESSURE CALIBRATOR VACUUM CONTROLLER WI THERMOMETER PLATINUM RTD PRESSURE GAUGE DEAD WEIGHT PISTON GAS FLOW CALIBRATION S	mber of factors may cause the instrument Cal Due Feb 13, 05 Mar 10, 05 Mar 10, 05 TH GAGE TUBE Oct 22, 04 Sep 05, 04 Sep 09, 04 Sep 25, 04 May 17, 06 YSTEM Jun 04, 05

Metrology Group Leader m:\a2la1.rpt Rev date 11, May 04

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Metrology Technician

1 of 1

## Southwest Research Institute Calibration Laboratory Measurement Report

Work Order:	444059999	Mfr. Model	Thunder Scient	ific	Technician	SRK
Serial No.	0210373	Турє	Temp/Humidity	Chamber	Cal Date	22-Jul-04
Remarks:						
	Function/Range	Test Point	TI Reading	Difference	+/-Uncertainty	
	Degree C	Degree C	Degree C	Degree C	Degree C	
	Sat Temp	0.070	0.076	0.006	0.013	
		35.045	35.03	-0.02	0.013	
		69.988	69.99	0.00	0.013	
	Pr Sat Temp	0.070	0.152	0.082	0.013	
		35.045	35.02	-0.02	0.013	
		69.988	70.00	0.01	0.013	
	Expn Temp	0.070	0.151	0.081	0.013	
		35.045	35.02	-0.02	0.013	
		69.988	69.98	-0.01	0.013	
	Chmb temp	0.070	0.135	0.065	0.013	
	•	35 045	34 99	-0.05	0.013	

69.99

END OF REPORT

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0.013

69.988

Work Order	444059999	Mfr	Thunder Scientific	Technician	SRK
Asset No.	010231	Model	2500		
Serial No.	0210373	Туре	Pressure Transducer	Cal Date	22-Jul-04
Remarks:					
Calibration of all tr	ansducers was perfe	ormed"in the	system, as a system".		
Calibration is perfo	ormed on all of the tr	ansducers by	y solving for the coeffiecients A,	B, and C of the form	nula:
$Y=A+Bx+Cx^{2}(Y=$	The desired value for	or the transdu	icer being calibrated. X = The ne	ew count of A/D whil	le measuring
a transducer.					

Function/Range	Test Point	TI Reading	Difference	+/-Uncertainty	
Pressure	PSIA	PSIA	PSIA	PSIA	
	50.00400	49.96	-0.044	0.0117	
	100.00300	99.97	-0.033	0.0122	
	50.00400	49.98	-0.024	0.0117	
		END C	OF REPORT		

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#### Southwest Research Institute Calibration Laboratory Measurement Report

Work Order:	444059999	Mfr.	Thunder Scier	ntific	Technician	SRK
Asset No.	010231	Model	2500			
Serial No.	0210373	Туре.	Flow Meter		Cal Date.	22-Jul-04
Remarks:						
STP 70 Deg F	K Factor:	1.000		Test Gas:	Air	
29.92 InHg						
Function/Range	Test Point	TI Reading	Difference	+/-Uncertainty		
Flow Rate	SCCM	SCCM	SCCM	SCCM		
	10.23	9.89	-0.34	2.4		
	19.74	19.66	-0.08	2.4		
		END	OF REPORT			

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# SOUTHWEST RESEARCH INSTITUTE

**Calibration Laboratory** 

#### EQUIPMENT RECEIVED

## Processed by MROMERO at 10:36:00AM on 6/4/2004

<u>Status</u>	<u>Asset No.</u>	Charge Code	<u>Manufacturer</u>	Model	Description	<u>Serial Number</u>
N LINE	010231	00751.006 1.20	THUNDER SCIENTIFIC	2500	HUMIDITY GENERATOR	0210373
	010232	00751.006 1.20	QUADTECH	7600	LCR METER	3164285

Fotal Number of Instruments Processed: 2

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ENRECEIPT10.RPT ev 10 Oct 2000

# SOUTHWEST RESEARCH INSTITUTE

**Calibration Laboratory** 

## EQUIPMENT RECEIVED

# Processed by MROMERO at 10:36:00AM on 6/4/2004

<u>Status</u>	<u>Asset No.</u>	Charge Code	<u>Manufacturer</u>	Model	Description	<u>Serial Number</u>
IN LINE	010231	00751.006 1.20	THUNDER SCIENTIFIC	2500	HUMIDITY GENERATOR	0210373
IN LINE	010232	00751.006 1.20	QUADTECH	7600	LCR METER	3164285

Total Number of Instruments Processed: 2

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