SOUTHWEST RESEARCH INSTITUTE

Calibration Laboratory

WORK ORDER

Processed by RCRUZ at 9:31:33AM on 6/14/01

Work Order 444044065 **Arrived** 6/14/01

Asset No. 008768 **Manufacturer** VAISALA **Model** HMP235

Instrument Type/Class TEMPERATURE/HUMIDITY TRANSMITT **Serial No.** W1840037

Accessory No. **Calibration Procedure** CL-61, 6/99 **Location**

Div/Client DIV20 **Custodian** JIM PRIKRYL **Mail Stop** B57 **Tel.** X5667

Charge/Project No. 00751.006 1.20 **Delivered By / Telephone**

IN4CAL **Special Instructions**

WORK NOTES

Date	Hours	Remarks/Notes
6/18/01	1.5	Cal

REPAIR PARTS

Date	Hours	Part Name	Part Number	Failure Description	Cost
N/A					

WORK SUMMARY

Failure Description N/A

Repair Action N/A

Calibration Procedure CL-61, 6/99 **Temp** ~~76~~ F **Hum.** 52 %

Tech R Dykstra **Totals** **Cal Hours** 1.5 **Repair Hours** **Parts Cost**

Standards Used

Date Picked Up 6/22/01 **Picked Up By** James D. Pyle

Measurement uncertainty Budget for Visaila Temperature/Humidity transmitter model HMP235.

UUT Characteristics	Performance Specifications
Humidity	Range: 0 to 100 %RH
	Tolerance: 1.0%RH.(0 to 90), 2%RH (90 to 100)
Temperature	Tolerance: 0.2 Degree C @ 20 Degree C

The following are assumptions and estimates used in the measurement uncertainty budget.

a.) The formula for %R.H. is (mAmp reading - 4) * 6.25. The accuracy of the Amp meter is +/-(0.2% of reading + 2 counts.) @ +15 to 40 degree C Worst case using Tektronics DM501 meter.
1.) The indication at 25 % RH is 8 mA. The accuracy is +/- 0.018 mA. This would correspond to 0.1125 % RH.
2.) The indication at 50 % RH is 12 mA. The accuracy is +/- 0.026 mA. This would corespond to 0.1625 % RH.
3.) The indication at 75 % RH is 16 mA. The accuracy is +/- 0.032 mA. This would corespond to 0.20 % RH.
b.) The formula for %R.H. is (mAmp reading - 4) * 12.5. The accuracy of the Amp meter is +/-(0.2% of reading + 2 counts.) @ +15 to 40 degree C Worst case using Tektronics DM501 meter.
1.) The indication at 20 Degree C is 7.2 mA. The accuracy is +/- 0.016 mA. This would corespond to 0.20 % RH.

UUT Tolerance 1 % RH

Measurement uncertainty Budget for Relative Humidity at 25 % RH point.

Source of uncertainty	Value +/- % RH	Distribution	Divisor	Standard Uncertainty % RH
Standard	0.5	Normal	2	0.25
Standard Accuracy for Ind.	0.1125	Rectangular	Sqrt 3	0.06
Combined Uncertainty			RSS	0.26
Expanded Uncertainty			K=2	0.52

TUR 1.9 to 1

UUT Tolerance 1 % RH

Measurement uncertainty Budget for Relative Humidity at 50% RH point.

Source of uncertainty	Value +/- % RH	Distribution	Divisor	Standard Uncertainty % RH
Standard	0.5	Normal	2	0.25
Standard Accuracy for Ind.	0.1625	Rectangular	Sqrt 3	0.09
Combined Uncertainty			RSS	0.27
Expanded Uncertainty			K=2	0.53

TUR 1.87 to 1

UUT Tolerance 1 % RH

Measurement uncertainty Budget for Relative Humidity at 75% RH point.

Source of uncertainty	Value +/- % RH	Distribution	Divisor	Standard Uncertainty % RH
Standard	0.5	Normal	2	0.25
Standard Accuracy for Ind.	0.2	Rectangular	Sqrt 3	0.12
Combined Uncertainty			RSS	0.28
Expanded Uncertainty			K=2	0.55

TUR 1.82 to 1

UUT Tolerance 0.2 Degree C

Measurement uncertainty Budget for temperature @ 20 Deg C.

Source of uncertainty	Value +/- Deg C	Distribution	Divisor	Standard Uncertainty Deg C
Standard	0.03	Rectangular	Sqrt 3	0.02
Chamber uniformity	0.1	Rectangular	Sqrt 3	0.06
Standard Accuracy for Ind.	0.2	Rectangular	Sqrt 3	0.12
Combined Uncertainty			RSS	0.13
Expanded Uncertainty			K=2	0.3

TUR .7 to 1

Prepared By: R Dykstra **Date:** 6/18/01

Verified By: **Date:**

Southwest Research Institute
Calibration Laboratory
Calibration Data Sheet

Work Order 444044065	**Mfr.** Vaisala	**Technician** R Dykstra
Asset No. 008768	**Model** HMP235	**Procedure** CL-61, 6/99
Serial No. W1840037	**Type** Tempereature/Humidity Transmitter	**Cal Date** 6/18/01

Remarks: The following readings are provided with an expanded uncertainty K=2 with an approximate confidence level of 95%.

Parameter	Applied Value	Found/Left	Instrument Error	Uncertainty	
Temperature	20.262 Degree C	20.325 Degree C	0.063 Degree C	0.30 Degree C	
% Relative Humidity	25% RH	24.2 % RH	0.8 % RH	0.52 % RH	
	50 % RH	49.5 % RH	0.5 %RH	0.53 % RH	
	75 % RH	74.0 % RH	1.0 % RH	0.55 % RH	

VAISALA Certificate of Calibration

Report # 052401 W1840037 S.O.# 74327
Instrument Model: HMP235
Instrument Range: 0 to 100%RH
Accuracy: Relative Humidity: ±1%RH (0 to 90%RH), ± 2%RH (90 to 100%RH).
Accuracy: Temperature; ± 0.2 °C @ 20 °C

Calibration Date: 24 May 01
SeriaL Number : W1840037
Calibration Procedure: 11603019 Rev. F
Recommended calibration due date 24 May 02

Customer: SOUTHWEST RESEARCH INST.
City, State: SAN ANTONIO, TX

This unit was calibrated by adjusting its reading at 0% against dry nitrogen and at 75% against reference humidity and temperature instrument, Vaisala model HMP233. Additional instrument verification checkpoints were made against HMP233 reference at 11%RH and 97%RH. Calibration and instrument verification sequences utilize dry nitrogen and a set of controlled aqueous salt solutions Vaisala model HMK13B. Laboratory ambient conditions are maintained at a temperature of 22 °C ± 1 °C with relative humidity level of 50%RH ± 5%RH. The calibration uncertainty is presented at 95% confidence level, k=2. The calibration uncertainty is ±0.6%RH.

Calibration Data

Temperature Calibration (°C)

Reference	Unit Under Test	Error	Tolerance
+ 22.17	+ 22.30	+ 0.13	± 0.20 °C

Humidity Calibration (%RH)

Reference	Unit Under Test	Error	Tolerance
+ 0.10	+ 0.10	0.00	± 1.00
+ 11.30	+ 11.50	+ 0.20	± 1.00
+ 75.25	+ 75.20	- 0.05	± 1.00
+ 97.60	+ 96.00	- 1.60	± 2.00

The results of this calibration is traceable to the National Institute of Standards and Technology through NIST Test Report Number TN 264532 dated 02-Nov-00. Vaisala's calibration system has been established to meet the requirements of ANSI/NCS Z540-1-1994. This certificate can not be reproduced except in full, without the expressed written consent of Vaisala.

Calibration Equipment Used: Workstation 8

Model	Serial Number	Calibrate Date	Due Date
Power Supply	9800300	27-Nov-00	27-Nov-02
Fluke 45	6859005	25-Aug-00	25-Aug-01
HMK13B	S365000	12-Feb-01	12-Aug-01
HMP233	V4310011	30-Apr-01	30-Jul-01

Ambient Conditions
Humidity: 50.5%RH
Temperature: 22.2 °C

Technical Operator
Linda Hall

Laboratory Manager
Mike Johnson

Mailing address:
Vaisala Inc.
100 Commerce Way
Woburn, MA 01801-1068

Tel. (781) 933-4500
Fax (781) 933-8029
http://www.vaisala.com

Southwest Research Institute
6220 Culebra Road
San Antonio, TX 78238
(210) 522-5215
Department of Quality Assurance
Calibration Laboratory

Certificate #
0972-01

Certificate of Calibration

19 June 2001

Issued to: JIM PRIKRYL DIV20 B57
Manufacturer/Model: VAISALA HMP235
Description: TEMPERATURE/HUMIDITY TRANSMITTER
Serial Number: W1840037
Asset Number: 008768
Work Order Number: 444044065

This certifies the above item was calibrated in compliance with MIL-STD-45662A and ANSI/NCSL Z540-1-1994. The results of this calibration relate only to the individual item as described above. Standards used in this calibration, described in the referenced calibration procedure with associated uncertainties or tolerances, are traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to traceability is on file and available for examination upon request. This certificate is not to be reproduced, except in full, without the written approval of the Southwest Research Institute Department of Quality Assurance Calibration Laboratory.

This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) and the results of this calibration certificate were determined in accordance with the terms of accreditation unless stated otherwise below.

The uncertainty of the calibration was sufficient to determine that the item met the manufacturer's published specifications unless stated otherwise below.

Ambient Conditions: Temperature: 78.0 Degrees Fahrenheit Humidity: 52 % RH

Calibration Date: 18 Jun 01 **Calibration Procedure:** CL-61, 6/99

Condition as Received: SEE REMARKS

Condition as Released: SEE REMARKS

Remarks: SEE ATTACHED DATA SHEET FOR UNCERTAINTY

Approved by:

Walt Hill, Supervisor
Institute Calibration Laboratory

Measurements performed by:

Roger Dykstra, Technician

SOUTHWEST RESEARCH INSTITUTE

Calibration Laboratory

WORK ORDER

Received by AANDERSON,6/3/02 1:10:15PM

Arrived 6/3/02 Work Order **444048827**

Asset No. 008768 Manufacturer VAISALA Model HMP235

Equipment Type TEMPERATURE/HUMIDITY TRANSM Serial No. W1840037 Accessory No.

Interval 12 M Calibration Procedure CL-61, 6/99 Location

Div/Client DIV20 Custodian JIM PRIKRYL Mail Stop B57 Tel 5667

IN LINE Special Instructions

Notify before adjustments or repairs. ( ) Provide data with certificate ( ) Certificate Typ

Charge/Project No. 00751.006 1.20 Requester / Telephone JIM PRIKRYL

This information is correct for the work requested. James D. Prikryl

WORK NOTES

Date	Hours	Remarks/Notes

Date	Hours	Part Name	Part Number	Failure Description	Cos

WORK SUMMARY

Failure Description

Repair Action

Tech V Morales Cal Hrs. 3.0 Repair Hrs Parts Cost Temp 73 F Hum. 56 %

Standards Used

Date Picked Up 6/11/02 Picked Up By James D. Prikryl

4827

Southwest Research Institute
6220 Culebra Road
San Antonio, TX 78238
(210) 522-5215
Department of Quality Assurance
Calibration Laboratory

Certificate of Calibration

7 June 2002

Issued to:	JIM PRIKRYL DIV20 B57
Manufacturer/Model:	VAISALA HMP235
Description:	TEMPERATURE/HUMIDITY TRANSMITTER
Serial Number:	W1840037
Asset Number:	008768
Work Order Number:	444048827

This certifies the above item was calibrated in compliance with MIL-STD-45662A and ANSI/NCSL Z540-1-1994. Standards used in this calibration, described in the referenced calibration procedure with associated uncertainties or tolerances, are traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to traceability is on file and is available for examination upon request. This certificate is not to be reproduced, except in full, without the written approval of the Southwest Research Institute Department of Quality Assurance Calibration Laboratory.

The uncertainty of the calibration was sufficient to determine that the item met the manufacturer's published specifications unless stated otherwise below.

Ambient Conditions: Temperature: 73.0 Degrees Fahrenheit Humidity: 56 % RH

Calibration Date: 6 Jun 02 **Calibration Procedure:** CL-61, 6/99

Condition as Received: SEE REMARKS

Condition as Returned: SEE REMARKS

Remarks:

Approved by:

Walt Hill, Metrology Group Leader
Institute Calibration Laboratory

Measurements performed by:

Vince Morales, Technician

Southwest Research Institute
Calibration laboratory
Calibration Sheet. Z540

Work Order: 444048827	**Mfr.** Vaisala	**Technician** Vmorales
Asset No. 8768	**Model** HMP235	**Procedure** CL-61, 6/99
Serial No. W1840037	**Type.** Thermohygrometer	**Cal Date.** 6/5/02

Remarks: The reported uncertainty is based on a standard uncertainty multiplied by a coverage Factor of k=2, which provides a level of confidence of approximately 95 %. The test limits are specified in the Manual.
The error is equal to TI reading - Std reading.
The results can be Pass, Fail, or if blank not determinable. Up to end user to determine if TI meets needs.
The formula for Analog RH is (DVM reading ma - 4) *6.25 = % RH
The formula for Analog Temperature is ((DVM reading ma-4)*(200/16)-20

	Test Point	As Found	Error	Test Limits	Uncertainty	Results
Parameter	**%RH**	**%RH**	**%RH**	**%RH**	**%RH**	
Analog	25.02	25.38	**0.36**	**2**	**0.5**	**Pass**
	49.98	49.35	**-0.63**	**2**	**0.5**	**Pass**
	75.04	72.57	**-2.47**	**2**	**0.5**	
Parameter	**Degree C**	**Degree C**	**Error**	**Degree C**	**Degree C**	
Analog	20.36	20.51	**0.15**	**0.1**	**0.2**	

Southwest Research Institute
Calibration laboratory
Calibration Sheet. Z540

Work Order: 444048827	**Mfr.** Vaisala	**Technician** Vmorales
Asset No. 8768	**Model** HMP235	**Procedure** CL-61, 6/99
Serial No. W1840037	**Type.** Thermohygrometer	**Cal Date.** 6/6/02

Remarks: The reported uncertainty is based on a standard uncertainty multiplied by a coverage Factor of k=2, which provides a level of confidence of approximately 95 %. The test limits are specified in the Manual.
The error is equal to TI reading - Std reading.
The results can be Pass, Fail, or if blank not determinable. Up to end user to determine if TI meets needs.
The formula for Analog RH is (DVM reading ma - 4) *6.25 = % RH
The formula for Analog Temperature is ((DVM reading ma-4)*(200/16)-20

	Test Point	As Left	Error	Test Limits	Uncertainty	Results
Parameter	**%RH**	**%RH**	**%RH**	**%RH**	**%RH**	
Analog	25.00	24.90	**-0.10**	**2**	**0.5**	**Pass**
	50.03	50.65	**0.62**	**2**	**0.5**	**Pass**
	75.00	74.66	**-0.34**	**2**	**0.5**	**Pass**
Parameter	**Degree C**	**Degree C**	**Error**	**Degree C**	**Degree C**	
Analog	20.18	20.21	**0.03**	**0.1**	**0.16**	