

**ISO 9002 CERTIFIED**

**Calibration Laboratory**

**REPORT OF RELATIVE HUMIDITY CALIBRATION**

Report #: 97-1-0527-L3 S.O. #: 44298 Calibration Date: 05/27/97  
 Instrument Model: HMP235 Serial Number: S1240028  
 Instrument Range: 0 to 100% RH Calibration Procedure: 3-19-20c.doc  
 Accuracy: Relative Humidity;  $\pm 1\%$  RH (0 to 90% RH),  $\pm 2\%$  RH (90 to 100% RH)  
 Temperature;  $\pm 0.2^\circ\text{C}$  @  $20^\circ\text{C}$  Due Date: 1 year from above date  
 Customer: SOUTH RESEARCH INSTITUTE  
 City, State SAN ANTONIO, TX

**Calibration Information**

This unit was calibrated by comparing its readings at 0.0 and 75.5% RH to a reference humidity instrument: Vaisala model HMP 233, S/N: R1630016. Additional instrument verification checkpoints were made at 11.3% and 97.6% RH, respectively. Calibration and instrument verification sequences utilize dry nitrogen and a set of Controlled Aqueous Salt Solutions, Vaisala S/N: 500004. Interval: 6 months. Laboratory ambient conditions are maintained at a temperature of  $22 \pm 1^\circ\text{C}$  with a relative humidity level of  $50\% \pm 5\%$  RH. Sensor stabilization time is  $> 30$  minutes prior to adjustment. Calibration uncertainty is  $\pm 0.6\%$  RH @  $22^\circ\text{C}$ . The temperature is checked at ambient temperature against NIST standard traceable through a F250 (SN# 1297-030-597), PRT ASL T25/02 (SN# S257).

**Calibration Data**

|                                |                 | Unit as Calibrated |              | Acceptance Limits |              | Tolerance               |
|--------------------------------|-----------------|--------------------|--------------|-------------------|--------------|-------------------------|
| Temperature Standard           | Unit Under Test | (UUT)              | (REF)        | (Low)             | (High)       |                         |
|                                |                 | <u>22.5</u>        |              |                   |              |                         |
|                                |                 | <u>22.5</u>        |              |                   |              | $\pm 0.2^\circ\text{C}$ |
| Humidity Solution              | Nominal Value   | (UUT)              | (REF)        | (Low)             | (High)       |                         |
| Dry Nitrogen                   | 0.1% RH         | <u>0.1%</u>        | <u>0.1%</u>  | <u>-1.0%</u>      | <u>1.0%</u>  | $\pm 1.0\%$ RH          |
| NaCl                           | 75.5% RH        | <u>75.1%</u>       | <u>75.1%</u> | <u>74.1%</u>      | <u>76.1%</u> | $\pm 1.0\%$ RH          |
| LiCl                           | 11.3% RH        | <u>11.6%</u>       |              | <u>10.3%</u>      | <u>12.3%</u> | $\pm 1.0\%$ RH          |
| K <sub>2</sub> SO <sub>4</sub> | 97.6% RH        | <u>95.8%</u>       |              | <u>95.6%</u>      | <u>99.6%</u> | $\pm 2.0\%$ RH          |

  
 \_\_\_\_\_  
 Service Technician

  
 \_\_\_\_\_  
 Service Department Supervisor

This calibration report is traceable to the National Institute of Standards and Technology through NIST Test Report Number TN 258027 dated 28 January, 1997 and Report Number 0176 / 0177 dated 28 May, 1996. Vaisala's calibration system complies with the requirements ANSI/NCSL Z540-1-1994. This certificate can not be reproduced in full without the expressed written consent of Vaisala.



SOUTHWEST RESEARCH INSTITUTE  
Department of Quality Assurance  
Calibration Laboratory • 522-5215

**WORK ORDER**

CERTIFICATE # 75989 ASSET # 5603 DATE 7 July 97

ITEM DATA:

Manufacturer Vaisala Model HMP 235  
Description Humidity sensor Serial # S1240028  
Accessories \_\_\_\_\_

ACTION REQUESTED calibration (w/ manual)  
RUSIT

CUSTODIAN Ron Green BSI

Turned in by: Sunny Leppala Phone 5077 (5305 Ron Green)

CHARGE # 20 - 5708 - 661 Date Required \_\_\_\_\_

INSTRUMENT USED ON:  DOD/NASA  NUCLEAR  GLP  SPPE  ISO  
 OTHER \_\_\_\_\_

COPY OF CALIBRATION CERTIFICATE  Yes  No

NEW WORK  Yes  No If yes, an evaluation shall be made to verify capabilities.

By K. Leppala Date 7 July 97

CONDITION RECEIVED: \_\_\_\_\_ (F) Out of tolerance, repaired to specifications  
\_\_\_\_\_ (G) In tolerance, minor adjustments/repairs made  
\_\_\_\_\_ (J) In tolerance, no adjustments/repairs  
\_\_\_\_\_ (K) Out of tolerance, adjusted to specifications  
 (S) Received into system, introduced or reactivated

ACTION TAKEN: (Calibration/Repair/Parts) Calibrated Per Procedure

CAL ENVIRONMENT:  
Temperature 78°F Humidity 44%RH

CALIBRATED/REPAIRED:  
By [Signature] Cal Procedure [Signature]  
Date 11 Jul 97 Accuracy [Signature]  
Cal Interval 12 mos Reliability Code: 1  
Next Cal due 11 Jul 98 Cal Time 3.0 Repair Time \_\_\_\_\_  
Standards used (Asset#) 4296

DATE COMPLETED 14 Jul 97  
DATE PICKED UP \_\_\_\_\_ PICKED UP BY [Signature]

75989

# CALIBRATION UNCERTAINTY WORK SHEET

## "TYPE A" EVALUATION

Date 11 Jul 97 Work Order 25989 Technician 8216  
 A) Unit Under Test HUMIDITY SENSOR  
 Manufacturer VAUSA LA Model HMP235 Serial No. 51240028  
 Asset No. 5403 Range 0-100% Uncertainty ±1.1%

### B) Calibration Standards

|                       |             |                        |              |      |       |
|-----------------------|-------------|------------------------|--------------|------|-------|
| Standard 1) Asset No. | <u>4296</u> | Std Unc ( $u_{std1}$ ) | <u>±1.1%</u> | Type | _____ |
| Standard 2) Asset No. | _____       | Std Unc ( $u_{std2}$ ) | _____        | Type | _____ |
| Standard 3) Asset No. | _____       | Std Unc ( $u_{std3}$ ) | _____        | Type | _____ |
| Standard 4) Asset No. | _____       | Std Unc ( $u_{std4}$ ) | _____        | Type | _____ |
| Standard 5) Asset No. | _____       | Std Unc ( $u_{std5}$ ) | _____        | Type | _____ |
| Standard 6) Asset No. | _____       | Std Unc ( $u_{std6}$ ) | _____        | Type | _____ |

$$u_{std} = \sqrt{u_{std1}^2 + u_{std2}^2 + u_{std3}^2 + \dots} = \underline{\hspace{2cm}}$$

Env: Room Temp. N/A Humidity N/A Baro Press. N/A  
 Conversion Factor(s) \_\_\_\_\_

DATA :

N/A  
 1 44.2/45.6      2 55.7/54.8      3 46.8/47.2  
 4 45.2/46.1      5 44.6/44.9      6 42.6/43.4

$$(A) u_{unt} = \sqrt{\frac{\sum X^2 - \frac{(\sum X)^2}{n}}{n-1}} = \underline{1.67} \quad (B) \text{ MEAN} = \frac{\sum X}{n} = \underline{0.68}$$

(C) COMBINED UNCERTAINTY  $u_c = \sqrt{(u_{unt})^2 + (u_{std})^2} = \underline{\hspace{2cm}}$

(D) EXPANDED UNCERTAINTY  $U = k u_c$  \_\_\_\_\_  
 $k = \underline{\hspace{1cm}}$  explanation \_\_\_\_\_

(E) Std Deviation of the Mean  $\frac{u_{unt}}{\sqrt{n}} = \underline{0.26}$

(F) Per Cent of FS  $\frac{u_{unt}}{FS} (100) = \underline{\hspace{2cm}}$

(G) Per Cent of Mean  $\frac{u_{unt}}{MEAN} (100) = \underline{\hspace{2cm}}$

Notes:



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WORK ORDER

CERTIFICATE # 29819 ASSET # 005603 DATE 21 May 98

ITEM DATA:

Manufacturer Vaisala Model HM1225  
Description humidity & temp transmitter Serial # S1240688  
Accessories \_\_\_\_\_

ACTION REQUESTED cal

CUSTODIAN Dir. Don Poon

Turned in by: Melisa Phone 802

CHARGE # 20 04 Date Required \_\_\_\_\_

INSTRUMENT USED ON:  (DOD/NASA)  (NUCLEAR)  (GLP)  (SPPE)  (ISO)  
 OTHER \_\_\_\_\_

COPY OF CALIBRATION CERTIFICATE  (Yes)  (No)

NEW WORK  Yes  No If yes, an evaluation shall be made to verify capabilities.

By Melisa Date 05-21-98

Work involves proprietary/confidential information or equipment  (Yes)  (No)

- CONDITION RECEIVED:
- \_\_\_\_\_ (F) Out of tolerance, repaired to specifications
  - \_\_\_\_\_ (G) In tolerance, minor adjustments/repairs made
  - \_\_\_\_\_ (J) In tolerance, no adjustments/repairs
  - \_\_\_\_\_ (K) Out of tolerance, adjusted to specifications
  - \_\_\_\_\_ (S) Received into system, introduced or reactivated

ACTION TAKEN: (Calibration/Repair/Parts) Calibrated Per Mfg Specs.

CAL ENVIRONMENT:  
Temperature 77 °F Humidity 39 %RH

CALIBRATED/REPAIRED:  
By [Signature] Cal Procedure [Signature]  
Date 27 May 98 Accuracy [Signature]  
Cal Interval 12 Mths Reliability Code: [Signature]  
Next Cal due 27 May 99 Cal Time 2.0 Repair Time \_\_\_\_\_  
Standards used (Asset#) 4296, 219, 328

DATE COMPLETED 27 May 98  
DATE PICKED UP 27 May 98 PICKED UP BY [Signature]

29819

|                   |  | Delta         | Delta             |
|-------------------|--|---------------|-------------------|
|                   |  | Temp.C        | RH                |
|                   |  | HMP235-Azonix | HMP235-Protimeter |
| Mean Temp. Diff.C |  | 0.005541      | -2.28125          |
| Std Deviation     |  | 0.049466      | 0.642355          |
|                   |  |               |                   |

Chart1

HMP235(S/N S1240028) - Azonix Temp. Diff.

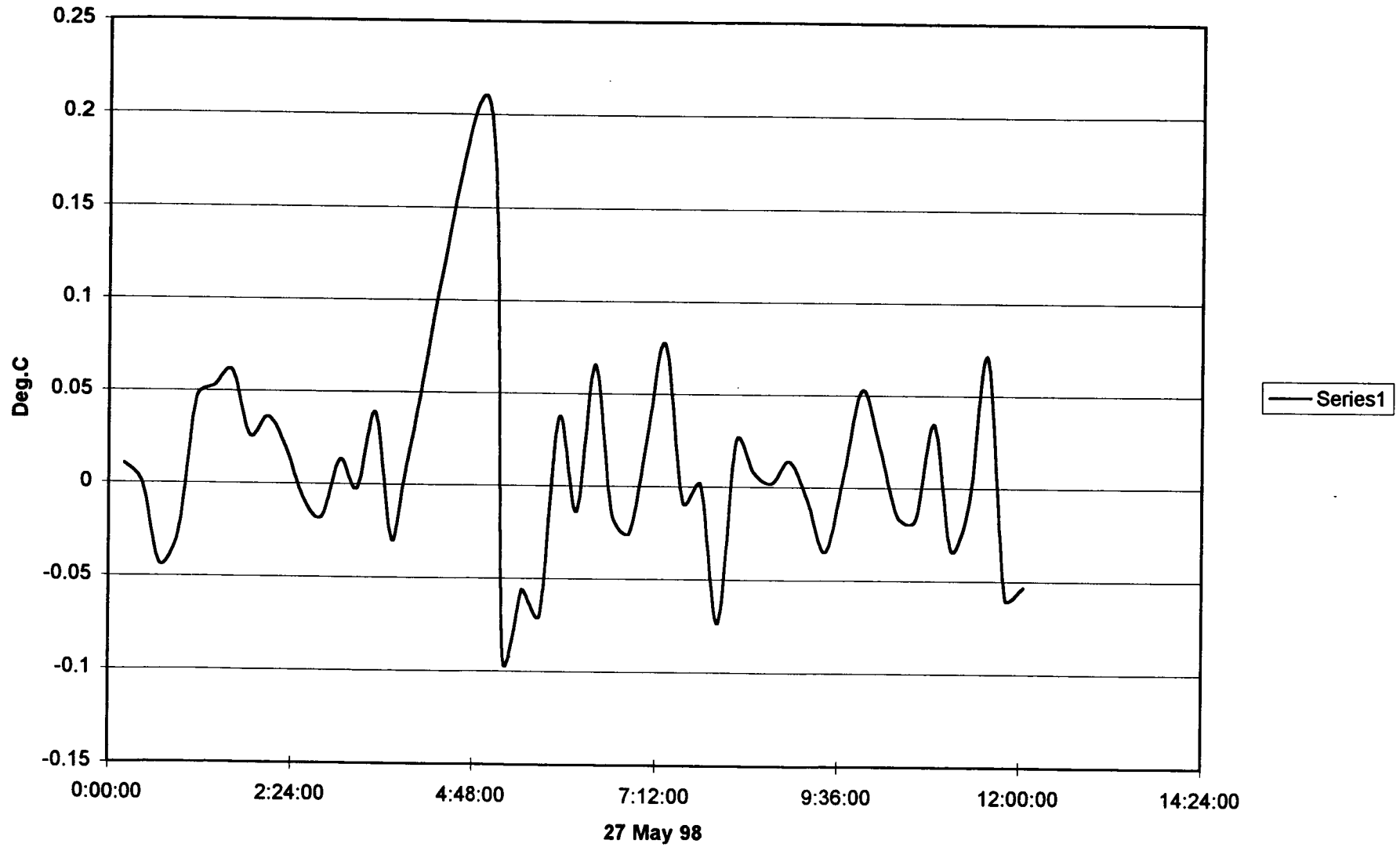
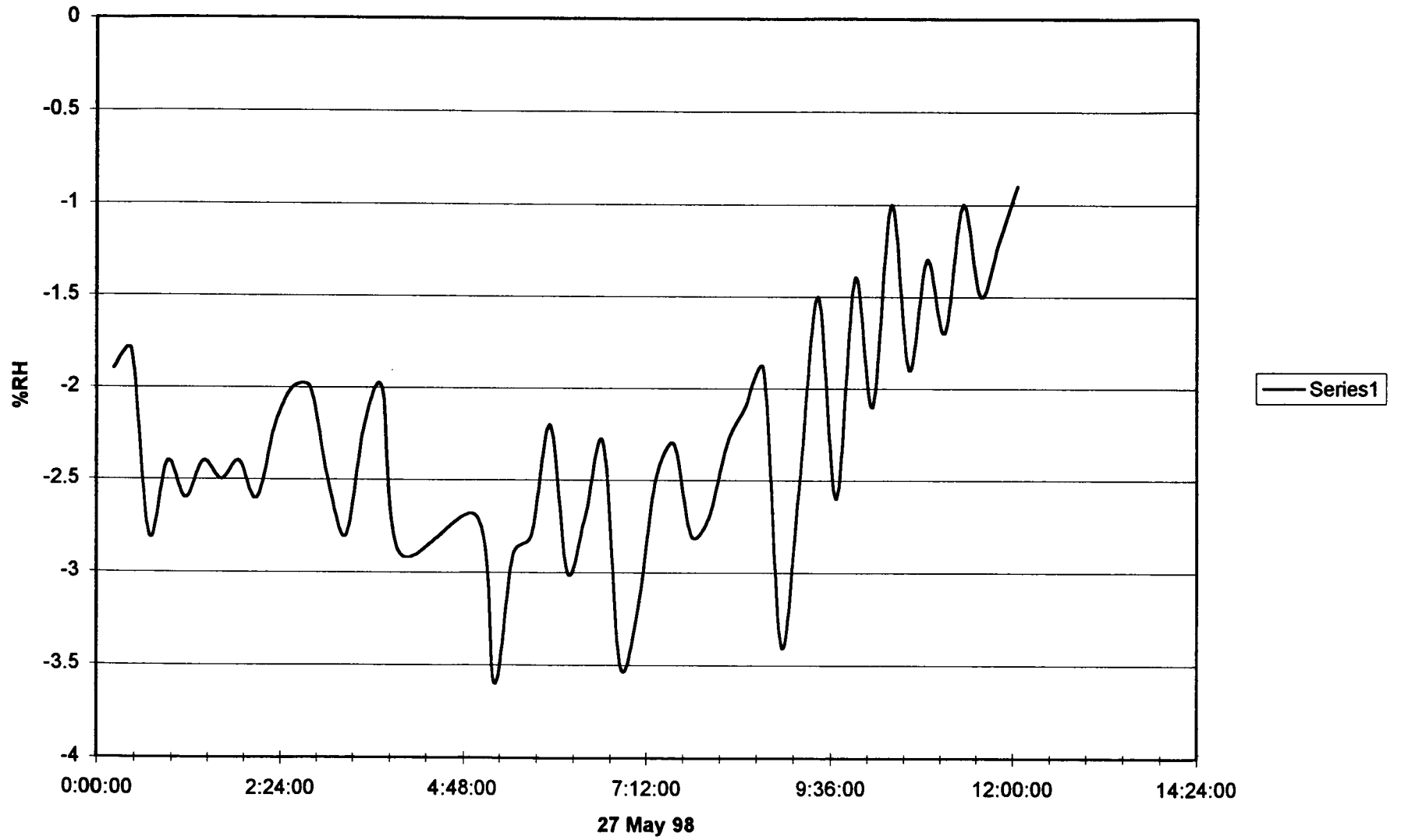


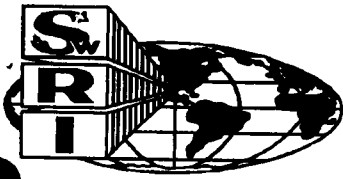


Chart2

RHP235(S/N S1240028) - Protimeter %RH Diff.



05/27/98 00:12:15 PR: 26.0 C 54.5 % AZ: 25.98955 C RO: 26.0 C 52.6 %  
05/27/98 00:26:27 PR: 25.9 C 51.8 % AZ: 26.09999 C RO: 26.1 C 50.0 %  
05/27/98 00:40:32 PR: 26.0 C 54.9 % AZ: 26.14349 C RO: 26.1 C 52.1 %  
05/27/98 00:54:43 PR: 26.0 C 54.2 % AZ: 26.12708 C RO: 26.1 C 51.8 %  
05/27/98 01:08:53 PR: 26.1 C 52.8 % AZ: 26.15355 C RO: 26.2 C 50.2 %  
05/27/98 01:22:56 PR: 26.0 C 55.2 % AZ: 26.04734 C RO: 26.1 C 52.8 %  
05/27/98 01:37:10 PR: 25.9 C 53.6 % AZ: 26.03923 C RO: 26.1 C 51.1 %  
05/27/98 01:51:19 PR: 26.0 C 53.2 % AZ: 26.07396 C RO: 26.1 C 50.8 %  
05/27/98 02:05:25 PR: 25.9 C 55.7 % AZ: 25.96384 C RO: 26.0 C 53.1 %  
05/27/98 02:19:40 PR: 25.9 C 53.3 % AZ: 25.98055 C RO: 26.0 C 51.1 %  
05/27/98 02:33:45 PR: 25.9 C 53.0 % AZ: 26.00777 C RO: 26.0 C 51.0 %  
05/27/98 02:47:49 PR: 25.8 C 55.3 % AZ: 25.91744 C RO: 25.9 C 53.3 %  
05/27/98 03:02:00 PR: 25.8 C 53.6 % AZ: 25.88675 C RO: 25.9 C 51.1 %  
05/27/98 03:16:00 PR: 25.9 C 54.3 % AZ: 26.00212 C RO: 26.0 C 51.5 %  
05/27/98 03:30:09 PR: 25.7 C 55.7 % AZ: 25.86109 C RO: 25.9 C 53.5 %  
05/27/98 03:44:16 PR: 25.8 C 53.0 % AZ: 25.93061 C RO: 25.9 C 51.0 %  
05/27/98 03:58:14 PR: 25.9 C 54.7 % AZ: 25.97934 C RO: 26.0 C 51.8 %  
05/27/98 04:59:19 PR: 25.1 C 59.2 % AZ: 24.99087 C RO: 25.2 C 56.5 %  
05/27/98 05:13:10 PR: 25.7 C 59.4 % AZ: 26.09360 C RO: 26.0 C 55.8 %  
05/27/98 05:27:19 PR: 25.7 C 55.0 % AZ: 25.95614 C RO: 25.9 C 52.1 %  
05/27/98 05:41:12 PR: 25.7 C 55.3 % AZ: 25.86993 C RO: 25.8 C 52.5 %  
05/27/98 05:55:17 PR: 25.6 C 56.1 % AZ: 25.76292 C RO: 25.8 C 53.9 %  
05/27/98 06:09:21 PR: 25.6 C 55.0 % AZ: 25.71367 C RO: 25.7 C 52.0 %  
05/27/98 06:23:16 PR: 25.6 C 58.3 % AZ: 25.63413 C RO: 25.7 C 55.6 %  
05/27/98 06:37:19 PR: 25.4 C 55.7 % AZ: 25.51477 C RO: 25.5 C 53.4 %  
05/27/98 06:51:09 PR: 25.4 C 60.5 % AZ: 25.62544 C RO: 25.6 C 57.0 %  
05/27/98 07:05:16 PR: 25.3 C 56.1 % AZ: 25.57203 C RO: 25.6 C 52.9 %  
05/27/98 07:19:02 PR: 25.4 C 57.9 % AZ: 25.52277 C RO: 25.6 C 55.4 %  
05/27/98 07:33:11 PR: 25.3 C 55.3 % AZ: 25.50873 C RO: 25.5 C 53.0 %  
05/27/98 07:47:06 PR: 25.3 C 56.1 % AZ: 25.49880 C RO: 25.5 C 53.3 %  
05/27/98 08:01:14 PR: 25.4 C 56.8 % AZ: 25.57388 C RO: 25.5 C 54.1 %  
05/27/98 08:15:17 PR: 25.5 C 53.0 % AZ: 25.57529 C RO: 25.6 C 50.7 %  
05/27/98 08:29:16 PR: 25.4 C 55.7 % AZ: 25.49219 C RO: 25.5 C 53.6 %  
05/27/98 08:43:30 PR: 25.5 C 52.6 % AZ: 25.69816 C RO: 25.7 C 50.7 %  
05/27/98 08:57:30 PR: 25.5 C 55.0 % AZ: 25.58620 C RO: 25.6 C 51.6 %  
05/27/98 09:11:47 PR: 25.7 C 53.6 % AZ: 25.80678 C RO: 25.8 C 51.1 %  
05/27/98 09:26:02 PR: 25.7 C 50.6 % AZ: 25.73507 C RO: 25.7 C 49.1 %  
05/27/98 09:40:08 PR: 25.6 C 54.3 % AZ: 25.79399 C RO: 25.8 C 51.7 %  
05/27/98 09:54:28 PR: 25.6 C 49.3 % AZ: 25.74729 C RO: 25.8 C 47.9 %  
05/27/98 10:08:36 PR: 25.6 C 53.3 % AZ: 25.67651 C RO: 25.7 C 51.2 %  
05/27/98 10:22:59 PR: 25.6 C 49.0 % AZ: 25.61548 C RO: 25.6 C 48.0 %  
05/27/98 10:37:12 PR: 25.7 C 51.9 % AZ: 25.81722 C RO: 25.8 C 50.0 %  
05/27/98 10:51:34 PR: 25.7 C 49.9 % AZ: 25.76555 C RO: 25.8 C 48.6 %  
05/27/98 11:05:43 PR: 25.7 C 50.9 % AZ: 25.83370 C RO: 25.8 C 49.2 %  
05/27/98 11:20:09 PR: 25.7 C 47.4 % AZ: 25.80710 C RO: 25.8 C 46.4 %  
05/27/98 11:34:18 PR: 25.7 C 50.9 % AZ: 25.72949 C RO: 25.8 C 49.4 %  
05/27/98 11:48:44 PR: 25.7 C 48.1 % AZ: 25.85927 C RO: 25.8 C 46.9 %  
05/27/98 12:03:06 PR: 25.8 C 48.4 % AZ: 25.85336 C RO: 25.8 C 47.5 %  
#halted at 05/27/98 12:07:10



Southwest Research Institute  
 6220 Culebra Road  
 San Antonio, TX 78238  
 Department of Quality Assurance  
 Calibration Laboratory



# Certificate of Calibration

27 May 1998

Issued to: RON GREEN                      DIV20                      B57  
 Manufacturer/Model: VAISALA HMP235  
 Description: HUMIDITY & TEMPERATURE TRANSMITTER  
 Serial Number: S1240028  
 Asset Number: 005603

## Environmental Conditions

Temperature: 77.00 Deg. F                      Humidity: 39 % RH

## Calibration Information

Calibration was in accordance with requirements of MIL-STD-45662A and ANSI/NCSL Z540-1-1994. Measurements are traceable to the National Institute of Standards and Technology (NIST). This report may not be reproduced except in full without written approval of the originator. Inspection and test data are on file and available for inspection.

Calibration Date: 27 May 98                      Calibration Procedure: MFG  
 Interval: 12 months                      Tolerance: MFG SPECS  
 Next Calibration Due: 27 May 99                      Received: 1

Remarks: TEST UNCERTAINTY RATIO OF TEMP.,RH TO CAL  
 STD IS 1:1. CALIBRATION RESULTS ATTACHED

## Standards Used

| Asset  | MFR        | Model  | Description           | Serial No. | Due Cal   |
|--------|------------|--------|-----------------------|------------|-----------|
| 000219 | AZONIX     | A1011  | RTD THERMOMETER       | T1587-2078 | 16 Apr 99 |
| 000328 | AZONIX     | A12001 | RTD TEMPERATURE PROBE | 351477     | 27 Apr 99 |
| 004296 | PROTIMETER | DP989M | DEWPOINT METER        | MF-410501  | 2 Jul 98  |

Signed: *Randy*

Title: *Cal Lab*

LAST PAGE OF REPORT  
 Total Pages Printed: 1

Certificate # 29819

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WORK ORDER

WORK ORDER # 36482 ASSET # 005603 DATE 20 Oct 99

ITEM DATA:

Manufacturer Vaisala Model HMP235  
Description humidity and temp transmitter Serial # 91240028  
Accessories box

ACTION REQUESTED cal

CUSTODIAN Dr. D. Don Green

Turned in by: Jim Priddy Phone \_\_\_\_\_

CHARGE # 20.01402.66P Date Required \_\_\_\_\_

INSTRUMENT USED ON:  (DOD/NASA)  (NUCLEAR)  (GLP)  (SPPE)  (ISO)  
 OTHER \_\_\_\_\_

COPY OF CALIBRATION CERTIFICATE  (Yes)  (No)

NEW WORK  Yes  No If yes, an evaluation shall be made to verify capabilities.

By mas Date 10.20.99

Work involves proprietary/confidential information or equipment  (Yes)  (No)

CONDITION RECEIVED:  Out of tolerance  
 In tolerance  
 Damaged (Contact customer)  
 Contact \_\_\_\_\_ Date \_\_\_\_\_  
 Received into system, introduced or reactivated

ACTION TAKEN: (Calibration/Repair/Parts) calibrated by Anderson

CAL ENVIRONMENT:  
Temperature 75 °F Humidity 45 %RH

CALIBRATED/REPAIRED:  
By Anderson Cal Procedure CL-61, Jul 96  
Date 2 Nov 99 Accuracy 1% Span  
Cal Interval 12 Mos Reliability Code 2-1  
Next Cal Due 2 Nov 00 Cal Time 3.0 Repair Time \_\_\_\_\_  
Standards used (Asset #) 5373, 5174, 174, 688, 6404

DATE COMPLETED 3 Nov 99

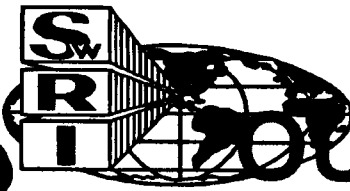
DATE PICKED UP 11/3/99 PICKED UP BY Anderson Hill

36482

# CALIBRATION WORKSHEET

Date Calibrated 2 Nov 99 Work Order 36482  
 Technician 8216 Calibration Procedure CL-61 07/99  
 Unit Under Test Humidity & Temperature Meter  
 Manufacturer VAISALA Model HMP235 SN 5124028 ASN 5623

| STEP | FUNCTION OR RANGE  | APPLIED | TOLERANCE       |     | MEASURED VALUES    |          | P/F |
|------|--|---------|-----------------|-----|--------------------|----------|-----|
|      |  |         | MIN             | MAX | AS FOUND           | RELEASED |     |
|      | Humidity Accuracy: $\pm 2\%RH$ from 0 to 90%RH at 20°C<br>Temperature Accuracy: $\pm 0.2^\circ C$ at 20°C<br>Standard: Thunder Scientific 2500 Humidity 10 to 95%RH $\pm 0.5\%RH$ ( $k=2\sigma$ )<br>Azonic A1011w/A12001 RTD Temperature 0 to 60 °C $\pm 0.02^\circ C$<br>DC mA Meters (2), TEK DM501(), (4 to 20 mA with +/-0.2% of rdg. Uncertainty)<br>DC Power Supply, (12 to 36 VDC, uncertainty not specified by mfg.)<br><br>Formulars: $\%RH = \text{milliamp meter reading} - 4 * (\%RH \text{ range} / 16)$<br>$^\circ C = \text{milliamp meter reading} - 4 * (UUT \text{ range} / 16) - 20$<br>Examples: %RH range is 0 to 100 %RH and meter reads 12.00 mA<br>$12.00 - 4 * (100/16) = 50\%RH$<br>°C range is -40 to 160°C and meter reads 7.20 mA<br>$7.20 - 4 * (200/16) - 20 = 20^\circ C$ |         |                 |     |                    |          |     |
|      | Humidity   | 25 % RH | 23 to 27 %RH    |     | 28.75%<br>24.6%    |          | F/P |
|      | Temperature  | 20° C   | 19.8 to 20.2 °C |     | 20.25°C<br>19.99°C |          | F/P |
|      | Humidity   | 50%RH   | 48 to 52 %RH    |     | 54.43%<br>49.5%    |          | F/P |
|      | Humidity   | 75%RH   | 73 to 77 %RH    |     | 78.56%<br>74.28%   |          | F/P |
|      |  |         |                 |     |                    |          |     |
|      |  |         |                 |     |                    |          |     |
|      |  |         |                 |     |                    |          |     |



Southwest Research Institute  
 6220 Culebra Road  
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 Department of Quality Assurance  
 Calibration Laboratory

# OUT OF TOLERANCE

## Out of Tolerance Notice

# OUT OF TOLERANCE

31 October 1999

The following asset was found to be out of tolerance when submitted for calibration. Please be aware measurements made with this instrument may be inaccurate.

### Instrument Information

**OUT OF TOLERANCE**

Issued to: FOLI GREEN IV2 B57  
 Manufacturer/Model: VAISALA HMP235  
 Description: TEMPERATURE/HUMIDITY TRANSMITTE  
 Serial Number: S1240028  
 Asset Number: 005603  
 SwRI Cap No.: NONE Accuracy: MFG SPECS  
 Calibration Interval: 12 months Calibration Procedure: Cl-61, J11-99  
 Remarks:

# OUT OF TOLERANCE

### Calibration Results

Out of Tolerance Date: 27 Oct 99 Last Valid Calibration Date: 27 May 98

# OUT OF TOLERANCE

| NOMINAL | RECEIVED  | LIMIT: |       |
|---------|-----------|--------|-------|
|         |           | LOWER  | UPPER |
| 25% RH  | 28.75% RH | 23     | 27    |
| 50% RH  | 54.43% RH | 48     | 52    |
| 75% RH  | 78.56% RH | 73     | 77    |

UNIT WILL BE ADJUSTED TO MANUFACTURER SPECIFICATIONS

# OUT OF TOLERANCE

# OUT OF TOLERANCE

# OUT OF TOLERANCE

# OUT OF TOLERANCE

Signed:   
 Checked by:

# CALIBRATION WORKSHEET

Date Calibrated 2 Nov 99 Work Order 36482  
 Technician 8214 Calibration Procedure CL-61 07/99  
 Unit Under Test Humidity & Temperature Meter  
 Manufacturer VAISALA Model HMP235 SN 5124028 ASN 5603

| STEP | FUNCTION OR RANGE   | APPLIED | TOLERANCE       | MEASURED VALUES |          | P/F |
|------|---|---------|-----------------|-----------------|----------|-----|
|      |   |         | MIN - MAX       | AS FOUND        | RELEASED |     |
|      | Humidity Accuracy: $\pm 2\%RH$ from 0 to 90%RH at 20°C<br>Temperature Accuracy: $\pm 0.2^\circ C$ at 20°C<br>Standard: Thunder Scientific 2500 Humidity 10 to 95%RH $\pm 0.5\%RH$ ( $k=2\sigma$ )<br>Azonic A1011w/A12001 RTD Temperature 0 to 60 °C $\pm 0.02^\circ C$<br>DC mA Meters (2), TEK DM501( ), (4 to 20 mA with $\pm 0.2\%$ of rdg. Uncertainty)<br>DC Power Supply, (12 to 36 VDC, uncertainty not specified by mfg.)<br><br>Formulars: $\%RH = \text{milliamp meter reading} - 4 * (\%RH \text{ range} / 16)$<br>$^\circ C = \text{milliamp meter reading} - 4 * (UUT \text{ range} / 16) - 20$<br>Examples: %RH range is 0 to 100 %RH and meter reads 12.00 mA<br>$12.00 - 4 * (100/16) = 50\%RH$<br>°C range is -40 to 160°C and meter reads 7.20 mA<br>$7.20 - 4 * (200/16) - 20 = 20^\circ C$ |         |                 |                 |          |     |
|      | Humidity  | 25 % RH | 23 to 27 %RH    | 28.75%          | 24.6%    | F/P |
|      | Temperature   | 20° C   | 19.8 to 20.2 °C | 20.25°          | 19.93°   | F/P |
|      | Humidity  | 50%RH   | 48 to 52 %RH    | 54.43%          | 49.5%    | F/P |
|      | Humidity  | 75%RH   | 73 to 77 %RH    | 78.56%          | 74.28%   | F/P |
|      |   |         |                 |                 |          |     |
|      |   |         |                 |                 |          |     |
|      |   |         |                 |                 |          |     |



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0972-01

## Certificate of Calibration

3 November 1999

**Issued to:** RON GREEN DIV20 B57  
**Manufacturer/Model:** VAISALA HMP235  
**Description:** TEMPERATURE/HUMIDITY TRANSMITTER  
**Serial Number:** S1240028  
**Asset Number:** 005603

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.

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: 75.0 Degrees Fahrenheit Humidity: 45 % RH

**Calibration Date:** 2 Nov 99 **Calibration Procedure** CL-61, JUL99

**Condition as Received:** OUT OF TOLERANCE

**Condition as Released:** IN TOLERANCE, ADJUSTED

**Remarks:**


**Approved by:**

  
\_\_\_\_\_  
Jim Patterson, Supervisor or Walt Hill, Metrologist

Certificate # 36482

m:\a2la.rpt Rev date 10 Mar 99

**Measurements performed by:**

  
\_\_\_\_\_  
Ken Harp, Technician

Page 1 of 1



# SOUTHWEST RESEARCH INSTITUTE

## Calibration Laboratory

### WORK ORDER

Received by RCRUZ, 8/20/01 3:35:18PM

ASSET NO. 005603

Arrived 8/20/01

Work Order **444044905**

Manufacturer VAISALA

Model HMP235

Instrument Type/Class HUMIDITY/TEMP TRANSMITTER

Serial No. S1240028

Accessory No. \_\_\_\_\_ Calibration Procedure CL-61, 7/99

Location B57

Div/Client DIV20

Custodian RON GREEN

Mail Stop B57

Tel. 5305

**IN4CAL**

Special Instructions \_\_\_\_\_

Notify before making adjustments or repairs.  Provide measurement readings

Charge/Project No. 00751-006-1.20 <sup>RL</sup>

Requested By / Telephone HILL MELISSA X2636

The above is correct for the work requested. 01402.661 1.20

Melissa Hill

### WORK NOTES

| Date        | Hours      | Remarks/Notes      |
|-------------|------------|--------------------|
| <u>8-22</u> | <u>2.0</u> | <u>Calibration</u> |
| <u>8-23</u> | <u>2.0</u> | <u>Calibration</u> |
|             |            |                    |
|             |            |                    |
|             |            |                    |

SWRI Cal-Lab By: lh  
CAL: 11/02/99 DUE: 11/02/00  
AN: 005603 SN: S1240028

| Date | Hours | Part Name | Part Number | Failure Description | Cost |
|------|-------|-----------|-------------|---------------------|------|
|      |       |           |             |                     |      |
|      |       |           |             |                     |      |
|      |       |           |             |                     |      |
|      |       |           |             |                     |      |

### WORK SUMMARY

Failure Description Reading were marginal

Repair Action Adjusted

Calibration Procedure CL-61, 7/99 Temp 76 F Hum. 50 %

Tech R Dykstra Totals Cal Hours 4.0 Repair Hours \_\_\_\_\_ Parts Cost \_\_\_\_\_

Standards Used 0328, 0219, 6404, 01AA, 0688

Date Picked Up 10-12-01

Picked Up By [Signature]

**444044905**



HMP235 uncertainty.xls

UUT Tolerance

1 % RH

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

| Source of uncertainty      | Value<br>+/- % RH | Distribution | Divisor | Standard<br>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<br>+/- Deg C | Distribution | Divisor | Standard<br>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                           |

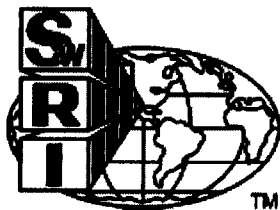
TUR

.7 to 1

Prepared By: R Dykstra  
Verified By:

Date: 6/18/01  
Date:





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

23 August 2001

**Issued to:** RON GREEN DIV20 B57  
**Manufacturer/Model:** VAISALA HMP235  
**Description:** HUMIDITY/TEMP TRANSMITTER  
**Serial Number:** S1240028  
**Asset Number:** 005603  
**Work Order Number:** 444044905

This certifies the above item was calibrated in compliance with MIL-STD-45662A and ANSI/NCCL 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: 76.0 Degrees Fahrenheit Humidity: 50 % RH

**Calibration Date:** 23 Aug 01 **Calibration Procedure:** CL-61, 7/99

**Condition as Received:** SEE ATTACHED DATA

**Condition as Released:** SEE ATTACHED DATA

**Remarks:**

**Approved by:**

Walt Hill, Supervisor  
Institute Calibration Laboratory

**Measurements performed by:**

Roger Dykstra, Technician

116 313

# SOUTHWEST RESEARCH INSTITUTE

6220 CULEBRA ROAD • POST OFFICE DRAWER 28510 • SAN ANTONIO, TEXAS, 78228-0510 • TEL (210) 522-5215 • FAX (210) 522-3692

**To:** Ron Green, Div. 20, Bldg. 57

**From:** Walt Hill, Metrology Group Leader  
Institute Calibration Laboratory

**Date:** August 12, 2002

**Subject:** Out-of-tolerance Notice

The purpose of this notice is to alert you of a condition, which may have caused erroneous measurements affecting safety or the quality of products or services your organization provides. The attached as-found readings are provided for your evaluation to determine if the instrument listed below had an impact and if further action is required.

When the as-found results are near the specification limit, +/- a margin less than the measurement uncertainty, it is not possible to state in-tolerance or out-of-tolerance with a 95% level of confidence. It is the Institute Calibration Laboratory policy that the client is made aware of this situation because the end-user is taking some of the risk that the instrument listed below may not meet the end-user measurement requirements.

Your review/evaluation should be conducted in accordance with your organizational quality policy and procedural requirements. If we can be of further assistance, please contact the Calibration Laboratory at 522-5215.

**Manufacturer:** Vaisala **Model:** HMP235

**Description:** Humidity Transmitter **Serial Number:** S1240028

**Asset Number:** 5603 **User ID Number:** None

**Last Calibration:** August 23, 2001

**Date Received for Service:** August 8, 2002 **Work Order Number:** 444049770

**Service Requested:** Scheduled calibration

**Remarks:** Received OUT OF TOLERANCE at 50% RH. See attached Data Sheet.

OUT OF TOLERANCE

Southwest Research  
Calibration Laboratory  
Calibration Data Sheet

Found

|                         |                           |                          |
|-------------------------|---------------------------|--------------------------|
| Work Order: 444049770   | Manufacturer: Vaisala     | Technician: V Morales    |
| Asset Number: 5603      | Model: HMP235             | Procedure: CL-61, 7/99   |
| Serial Number: S1240028 | Type: Temp RH Transmitter | Cal Date: August 9, 2002 |
| Remarks:                |                           |                          |

%RH Tolerance:    +-2       0 to 90 %RH  
                      +/-3       90 to 100 %RH

| Applied Value | TI Reading | Difference | Tolerance | Uncertainty | Results |
|---------------|------------|------------|-----------|-------------|---------|
| % RH          | % RH       | % RH       | % RH      | % RH        |         |
| 25            | 25.8       | -0.8       | 2.0       | 0.5         |         |
| 50            | 52.4       | -2.4       | 2.0       | 0.5         | Fail    |
| 75            | 76.6       | -1.6       | 2.0       | 0.5         |         |

Temperature Tolerance:       0.2       Degree C @ 20 Degree C

| Applied Value | TI Reading | Difference | Tolerance | Uncertainty | Results |
|---------------|------------|------------|-----------|-------------|---------|
| Deg C         | Deg C      | Deg C      | Deg C     | Deg C       |         |
| 20            | 20.1       | -0.1       | 0.2       | 0.2         |         |

Southwest Research  
Calibration Laboratory  
Calibration Data Sheet

Left

|                         |                           |                          |
|-------------------------|---------------------------|--------------------------|
| Work Order: 444049770   | Manufacturer: Vaisala     | Technician: V Morales    |
| Asset Number: 5603      | Model: HMP235             | Procedure: CL-61, 7/99   |
| Serial Number: S1240028 | Type: Temp RH Transmitter | Cal Date: August 9, 2002 |
| Remarks:                |                           |                          |

Due  
Aug 9, 03

%RH Tolerance:    +-2        0 to 90 %RH  
                         +/-3        90 to 100 %RH

| Applied Value | TI Reading | Difference | Tolerance | Uncertainty |         |
|---------------|------------|------------|-----------|-------------|---------|
| % RH          | % RH       | % RH       | % RH      | % RH        | Results |
| 25            | 23.5       | 1.5        | 2.0       | 0.5         |         |
| 50            | 50.0       | 0.0        | 2.0       | 0.5         |         |
| 75            | 74.1       | 0.9        | 2.0       | 0.5         |         |

Temperature Tolerance:        0.2        Degree C @ 20 Degree C

| Applied Value | TI Reading | Difference | Tolerance | Uncertainty |         |
|---------------|------------|------------|-----------|-------------|---------|
| Deg C         | Deg C      | Deg C      | Deg C     | Deg C       | Results |
| 20            | 20.1       | -0.1       | 0.2       | 0.2         |         |





Southwest Research Institute  
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(210) 522-5215  
Department of Quality Assurance  
Calibration Laboratory

## Certificate of Calibration

12 August 2002

**Issued to:** RON GREEN DIV20 T1  
**Manufacturer/Model:** VAISALA HMP235  
**Description:** HUMIDITY/TEMP TRANSMITTER  
**Serial Number:** S1240028  
**Asset Number:** 005603  
**Work Order Number:** 444049770

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: 75.0 Degrees Fahrenheit Humidity: 51 % RH


**Calibration Date:** 12 Aug 02 **Calibration Procedure:** CL-61, 7/99

**Condition as Received:** OUT OF TOLERANCE

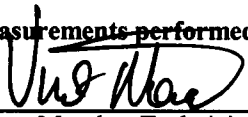
**Condition as Returned:** IN TOLERANCE

**Remarks:**

**Approved by:**

  
Walt Hill, Metrology Group Leader  
Institute Calibration Laboratory

**Measurements performed by:**

  
Vince Morales, Technician