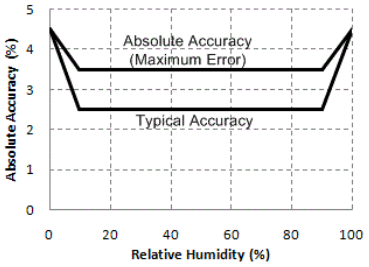
Testing the Accuracy of Sensirion Relative Humidity Sensors in HOBO® Data Loggers White Paper

This white paper explains the recommended procedure for testing the accuracy of Sensirion relative humidity sensors in HOBO data loggers and sensors (including logger models U12-011, U14-001, U23-00x, UX100-0xx, and ZW-00x loggers and the S-THB-M00x smart sensor, which works with the U14-002, H21-00x, H22-002 and U30 series loggers). The accuracy is ±2.5% from 10% to 90% typical to a maximum of ±3.5% including hysteresis (see plot at right).



Overview

Testing the accuracy of Sensirion relative humidity sensors in HOBO data loggers can be a technical challenge. The preferred method for testing is to place them in a humidity chamber, such as the Thunder Scientific Corporation Series 2500 Benchtop Two-Pressure Humidity Generator, that can accurately and rapidly generate any level of humidity by changing the air pressure of the saturator. Although this allows you to quickly make large and accurate changes in the test environment, it does not reflect the real-world environment. The Sensirion sensors do not rapidly respond to large changes of humidity because the sensing element is a polymer that needs time to absorb and desorb water molecules. The humidity in the real-world environment is driven by slowly moving weather systems for large-scale changes and by quick small-scale changes in humidity generated by building HVAC systems. The Sensirion sensors respond well to these real-world conditions and need to be tested in much the same way. A humidity chamber can be used for testing the HOBO data loggers with Sensirion sensors, but sufficient time must be allowed for both large humidity changes and the quick, small-scale changes needed to measure hysteresis.

Test Procedure and Resulting Plot

This is the recommended procedure for testing a HOBO data logger with a Sensirion relative humidity sensor at 25°C (77°F) in a humidity chamber, such as the Thunder Scientific Corporation model noted in the previous section, with an airflow of 20 liters per minute. This procedure covers the full range of % RH (at 15%, 30% RH, 50% RH, 70% RH, and 85% RH) while also testing the hysteresis of each measurement. Launch the logger with HOBOware® before placing it in the chamber. Program the chamber to run as follows:

1. Four hours to below 15% RH (to completely dry out the sensor).
2. Four hours to 15% RH (first measurement point).
3. One hour to 20% RH.
4. Four hours back to 15% RH.
5. Four hours to 30% RH (second measurement point).
6. One hour to 35% RH.
7. Four hours back to 30% RH.
8. Four hours to 50% RH (third measurement point).
9. One hour to 55% RH.
10. Four hours back to 50% RH.
11. Four hours to 70% RH (fourth measurement point).
12. One hour to 75% RH.
13. Four hours back to 70% RH.
14. Four hours to 85% RH (fifth measurement point).

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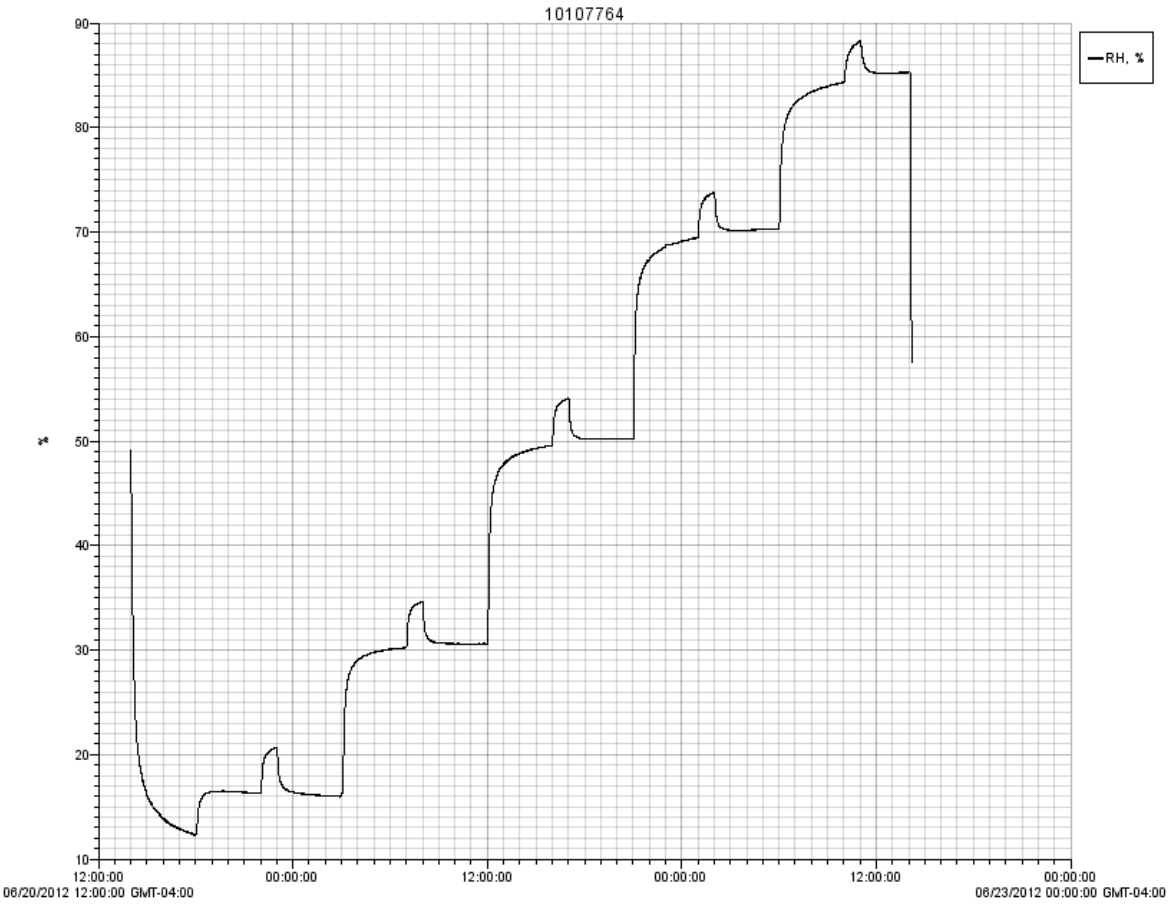
15. One hour to 90% RH.
16. Four hours back to 85% RH.

Example of Resulting Plot

This is an example of the resulting plot generated in HOBOware after applying the test procedure to a U12-001 model HOBO data logger and reading it out.



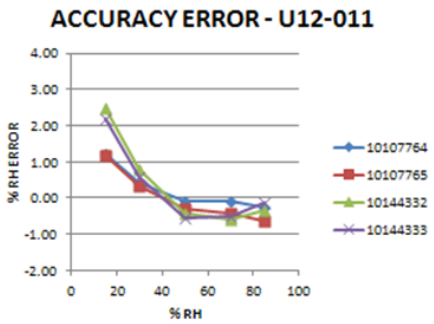
Calculations

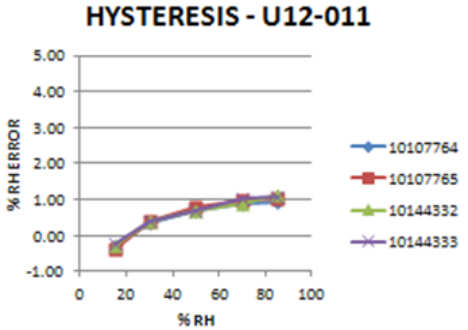
After performing the test procedure on your data logger, read it out with HOBOware. Use the logged data points to perform calculations to verify the accuracy and hysteresis for each measurement point. Follow these steps:

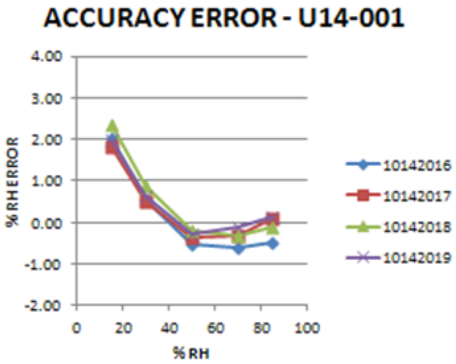
1. To calculate the accuracy of the 15% RH point, take the average of the logger value (data point) at the end of Test Procedure Step 2 and the logger value at the end of Test Procedure Step 4 and subtract the average from 15% RH.
2. To calculate the hysteresis of the 15% RH point, calculate the difference of the logger value at the end of Test Procedure Step 2 and the logger value at the end of Test Procedure Step 4.
3. Repeat the above calculations for the 30% RH, 50% RH, 70 % RH, and 85% RH points.

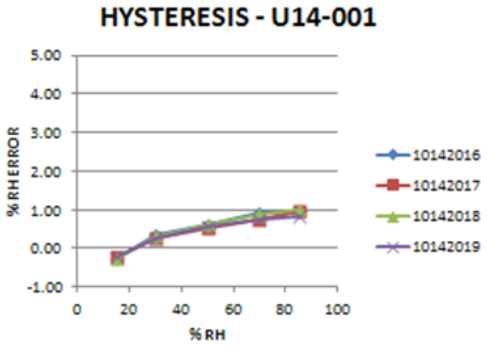
Accuracy and Hysteresis Plots

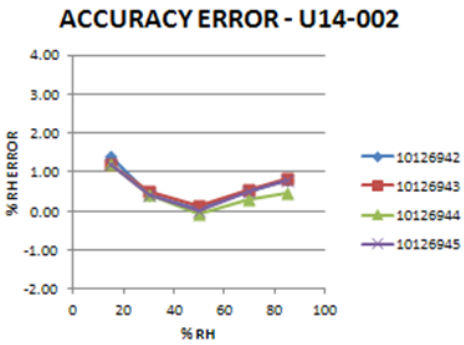
We performed the test procedure on the following logger models: U12-011, U14-001, U14-002 with smart sensor S-THB-M002, U23-001, and UX100-011. Note that the U14-002 with smart sensor S-THB-M002 has the same sensor configuration as the U23-002 and all smart sensor products, such as the H21, H22, and U30 series. Below are the accuracy and hysteresis plots for each model using the calculations described in the previous section.

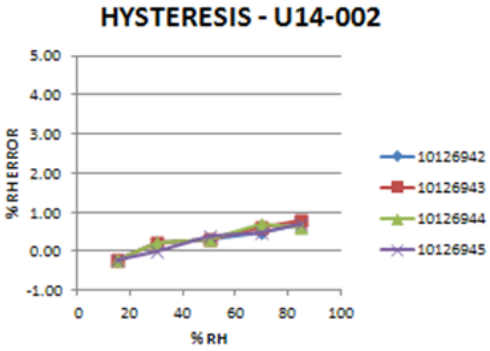


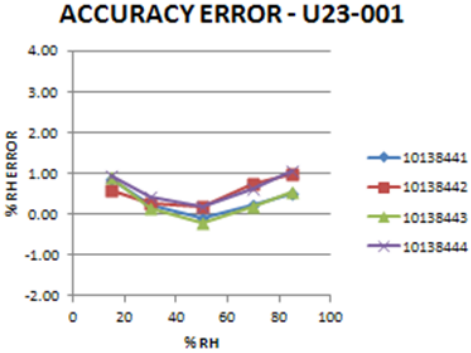


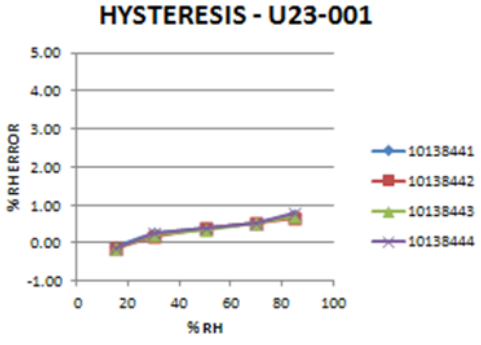












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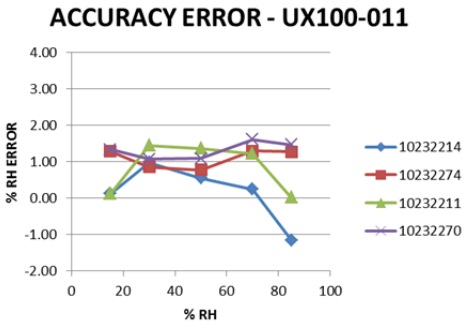

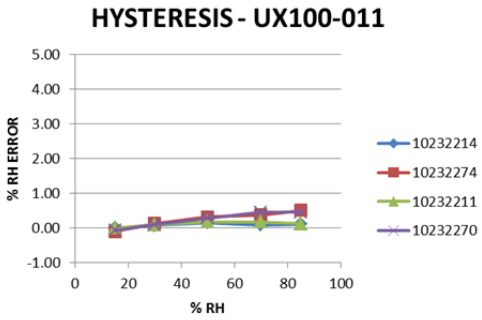

Observations

1. All the loggers tested achieve accuracy better than the specified accuracy of ±2.5% from 10% to 90% typical to a maximum of ±3.5% including hysteresis (see plot on page 1).
2. Higher accuracy is achieved with the externally mounted sensor in the Smart Sensor Cable (S-THB-M002) and the U23-001 in which the sensor is located in a small volume, or space, in the logger housing.

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