

Vaisala Radiosonde RS92 Humidity measurement



*The New Shape of
Upper-Air Weather Observation*



RS92 Heated HUMICAP® Humidity Sensor

The new RS92 radiosonde family introduces a higher level of humidity measurement performance. The humidity sensor used in RS92 radiosondes is based on the humidity measurement technology originally introduced with the Vaisala Radiosonde RS90.

- The calibration accuracy of the HUMICAP® humidity sensor and its time response capability have been proven in operational use with the RS90 radiosonde. Special attention has now been paid to such factors as sensor stability, calibration accuracy after storage, and the elimination of the possible condensation of water vapor during sounding. As a result, some significant improvements have been made.

Heated HUMICAP® Thin Film Humidity Sensor

Accuracy

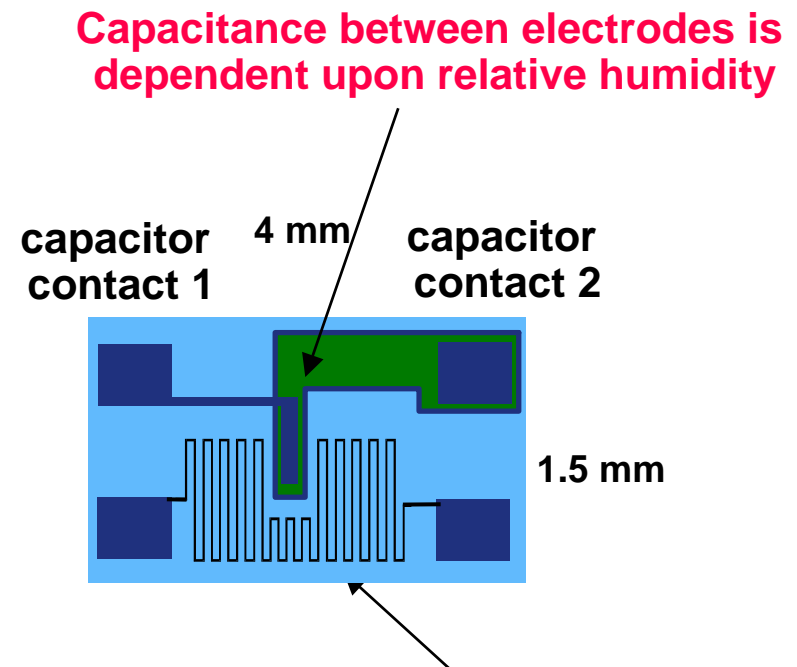
- Stable H-polymer as the active material
 - Low hysteresis
 - Accurate calibration
- Reconditioning removes any sensor contamination acquired during storage

Fast response time

- Fast sensor to monitor the fine structures of clouds

Reduces condensation and icing

- Phenomenon occurs in supercooled clouds
- Improved defrosting method with two heated sensors



Humidity sensor factory calibration accuracy

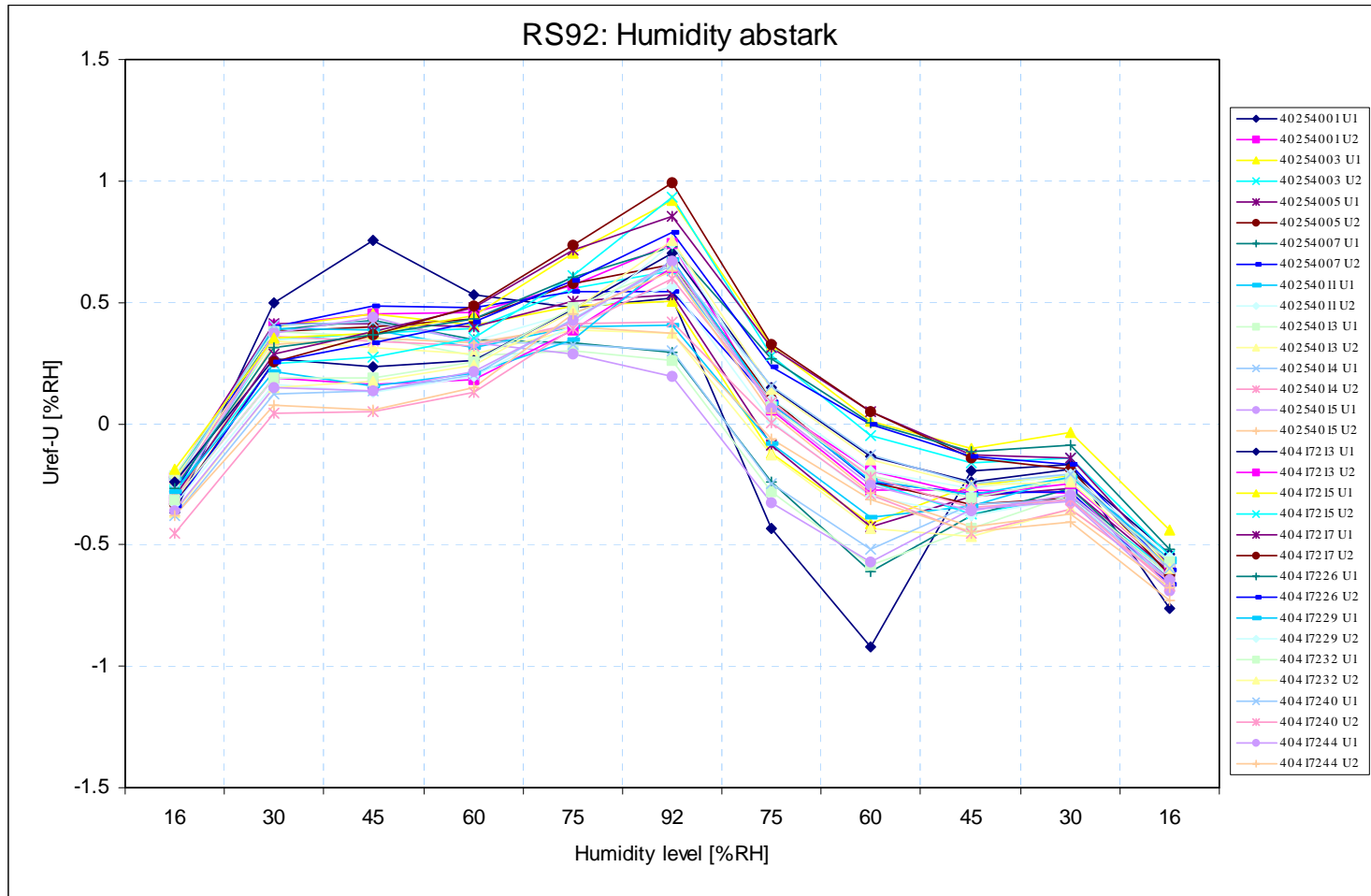
Calibration equipment uncertainties of relative humidity measurement

(2-sigma confidence level, k=2)

	Short term [%RH]	Long term [%RH]	Combined [%RH]
0% RH...90% RH, calibration	< 0,5	< 0,6	< 0,8
30%RH @ -33°C, check	< 0,7	< 0,9	< 1,2

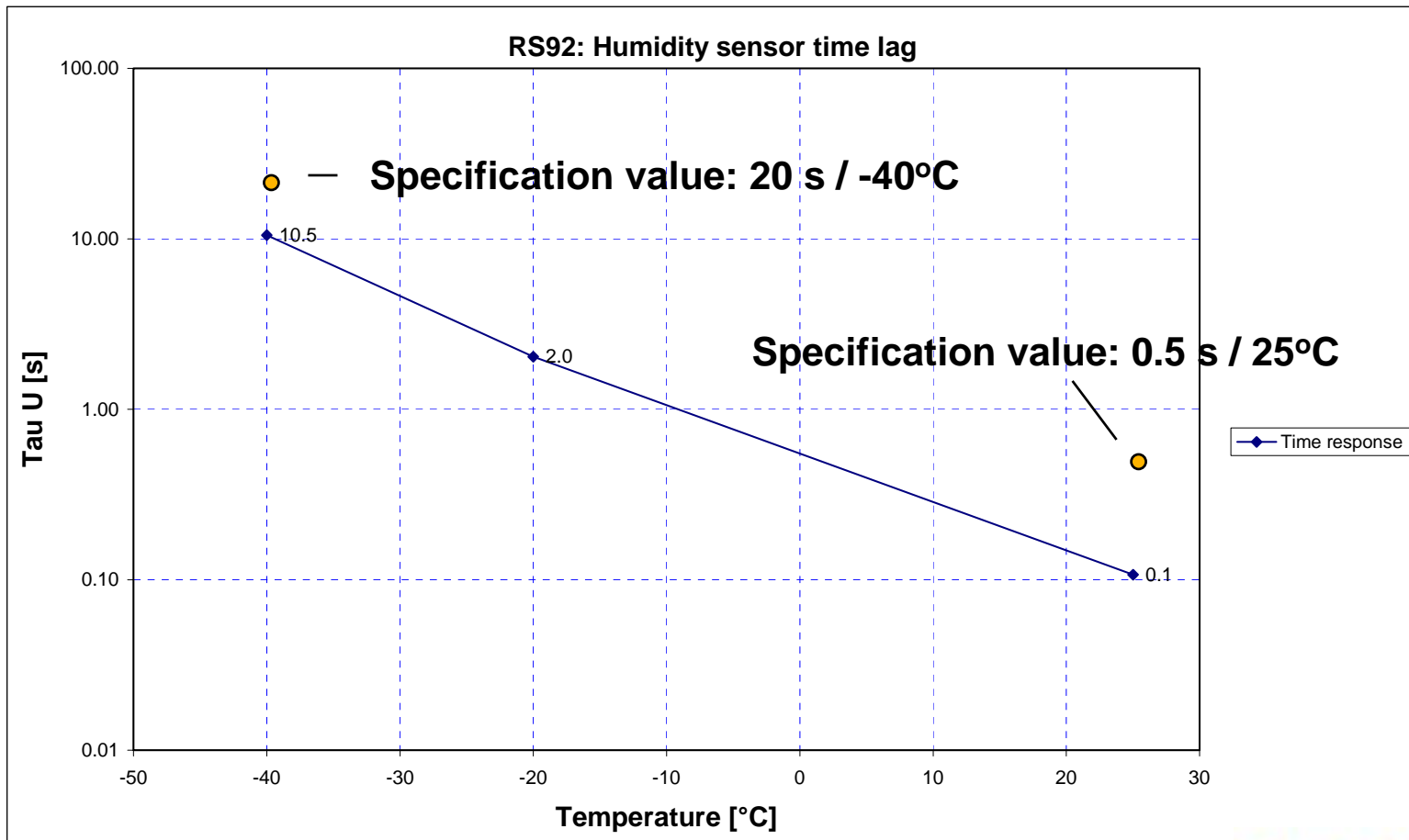
RS92 Vaisala Humicap: Accuracy measurement in chamber

Test temperature °25 C, non condensing



RS92 Humidity sensor: Time response

Humidity time response was measured over temperature range -40 °C... + 25 C
Ventilation speed 5 m/s

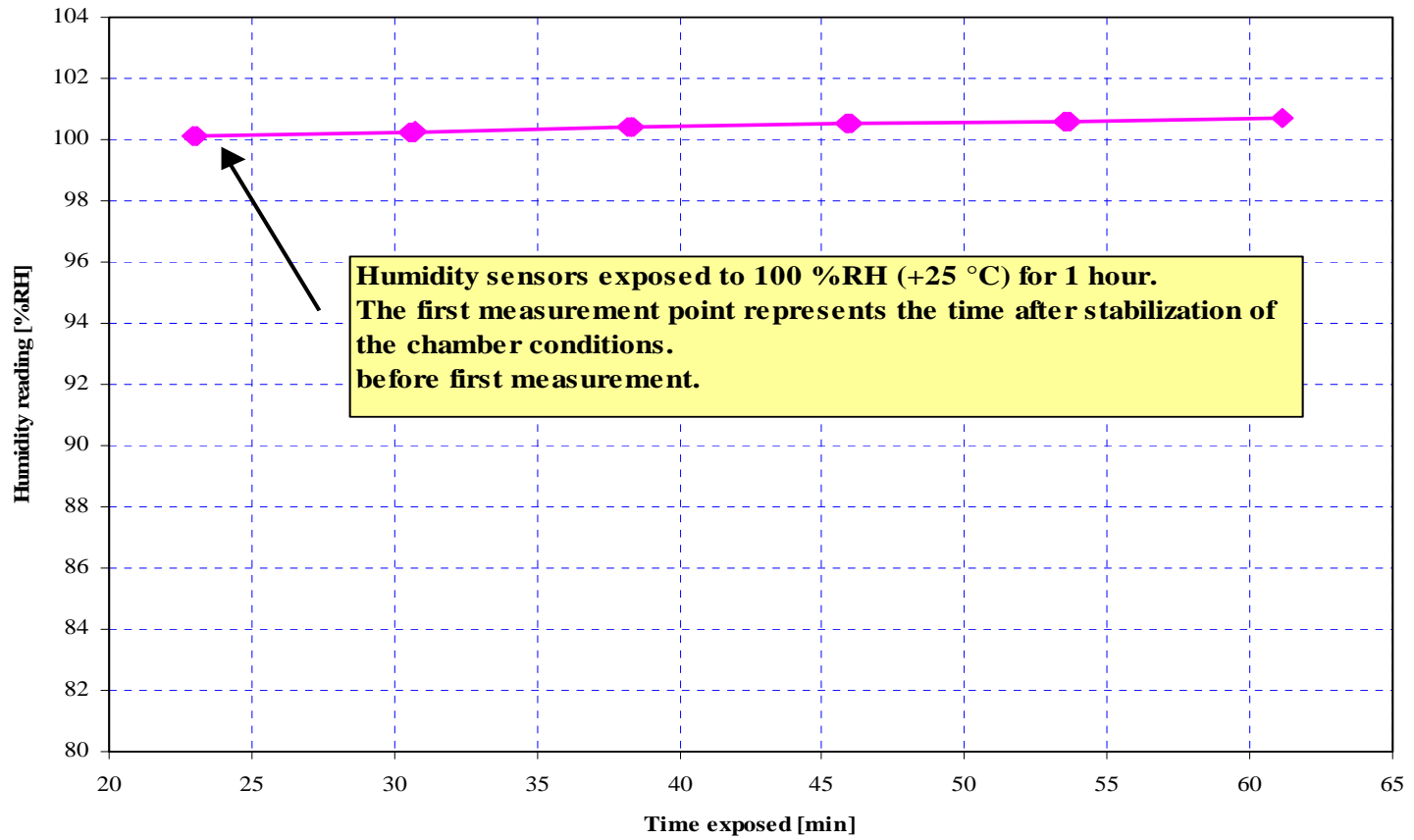


RS92 humidity sensor stability at high humidity

The stability of the RS92 humidity sensor in high humidity has been tested. The humidity sensors were exposed to 100 %RH (+25 °C). The first measurement was done after stabilization of the test chamber conditions. The humidity sensors were measured several times for a period of 62 minutes.

The 100 %RH level humidity drift in 62 minutes for the RS92 humidity sensor is around 0.5 %RH. The RS90 humidity sensor drifts several %RH in the same conditions and time period.

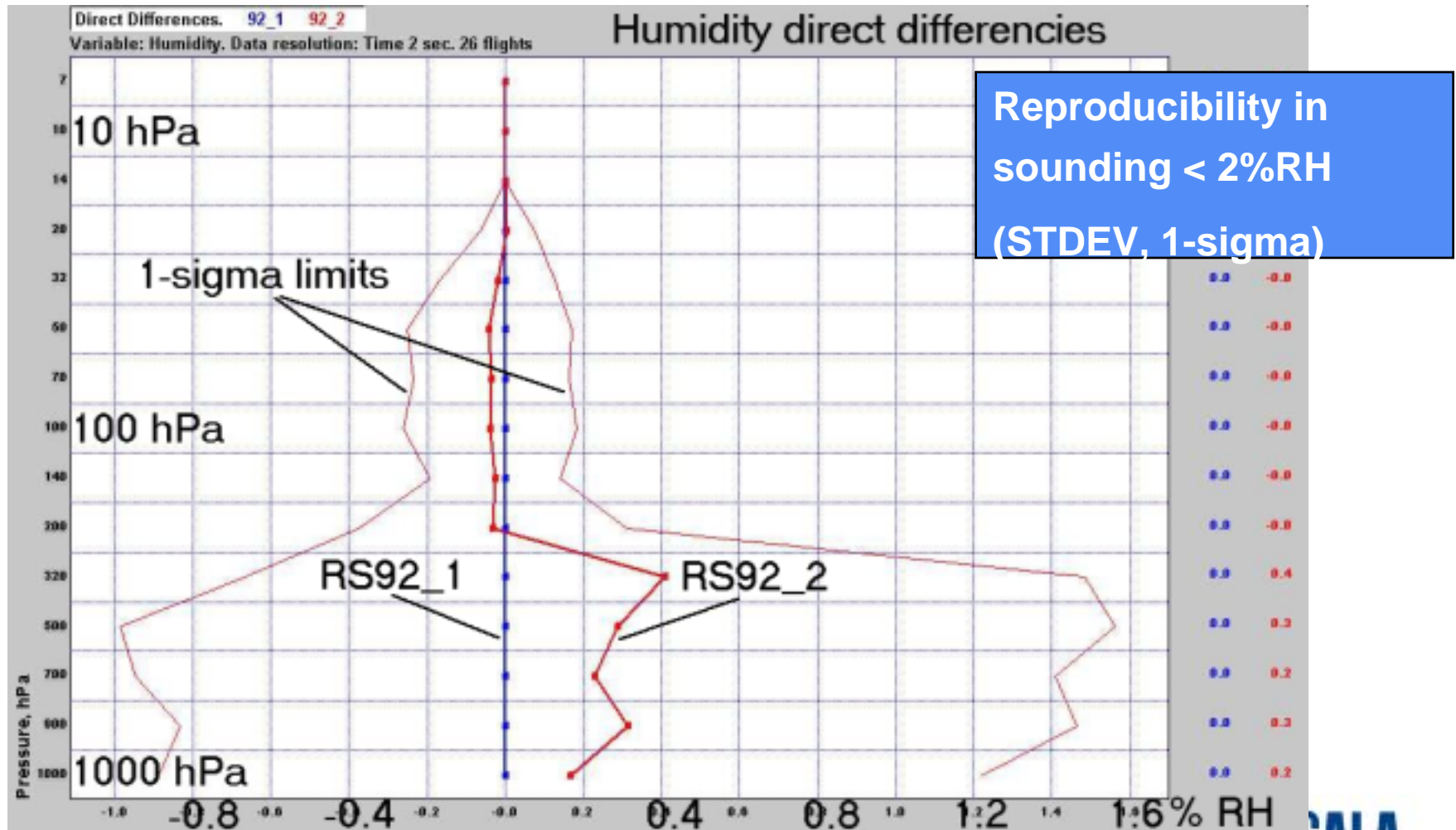
100 %RH humidity level drift of RS92 humidity sensor, sample size 16 pcs



RS92 Release Soundings: Humidity

Location: Jokioinen observatory, Finland

Time: May 2003



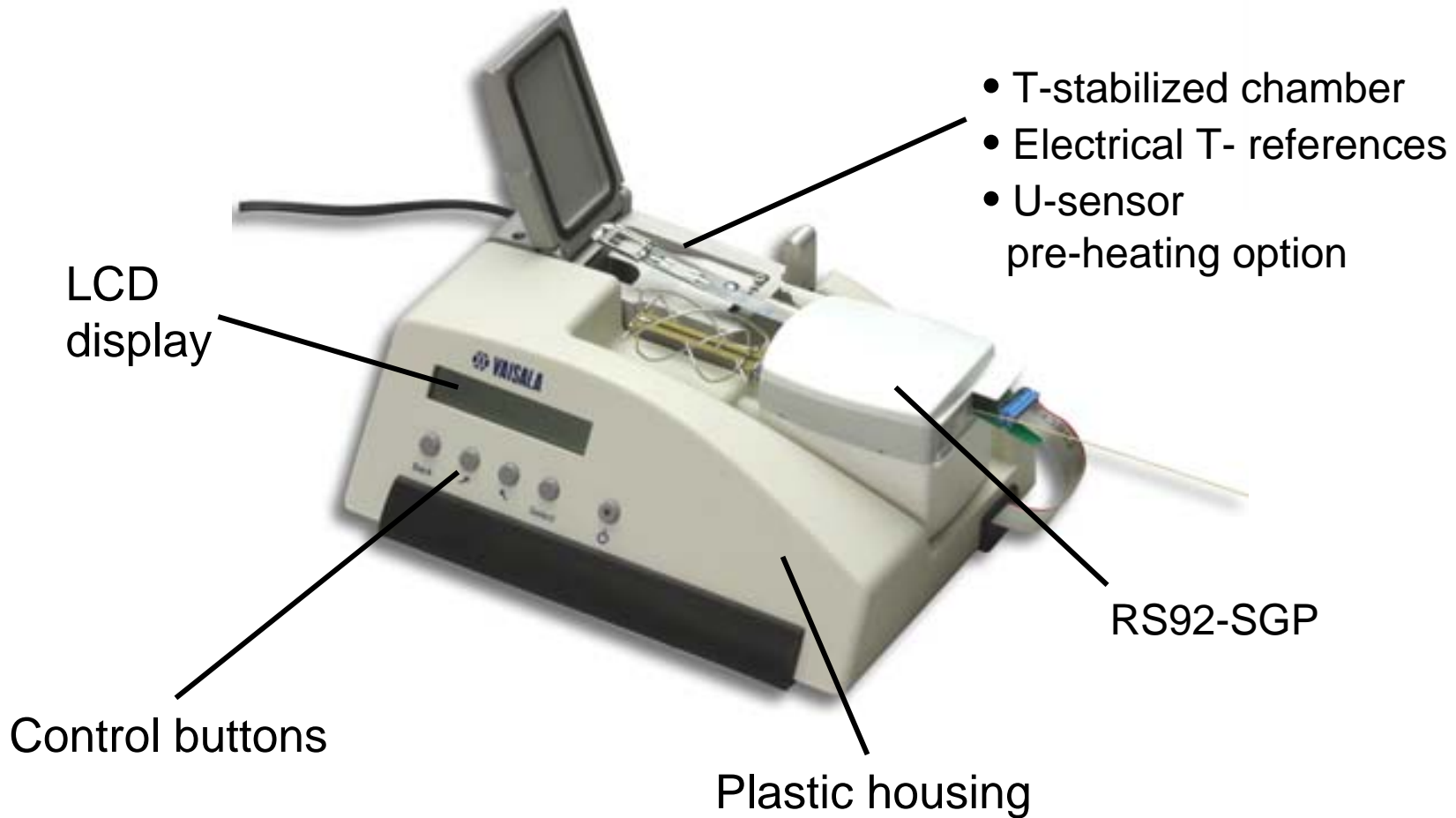
Humidity sensor reconditioning

With the RS92 radiosonde, Vaisala introduces a new reconditioning procedure which removes all contaminants from the humidity sensor surface.

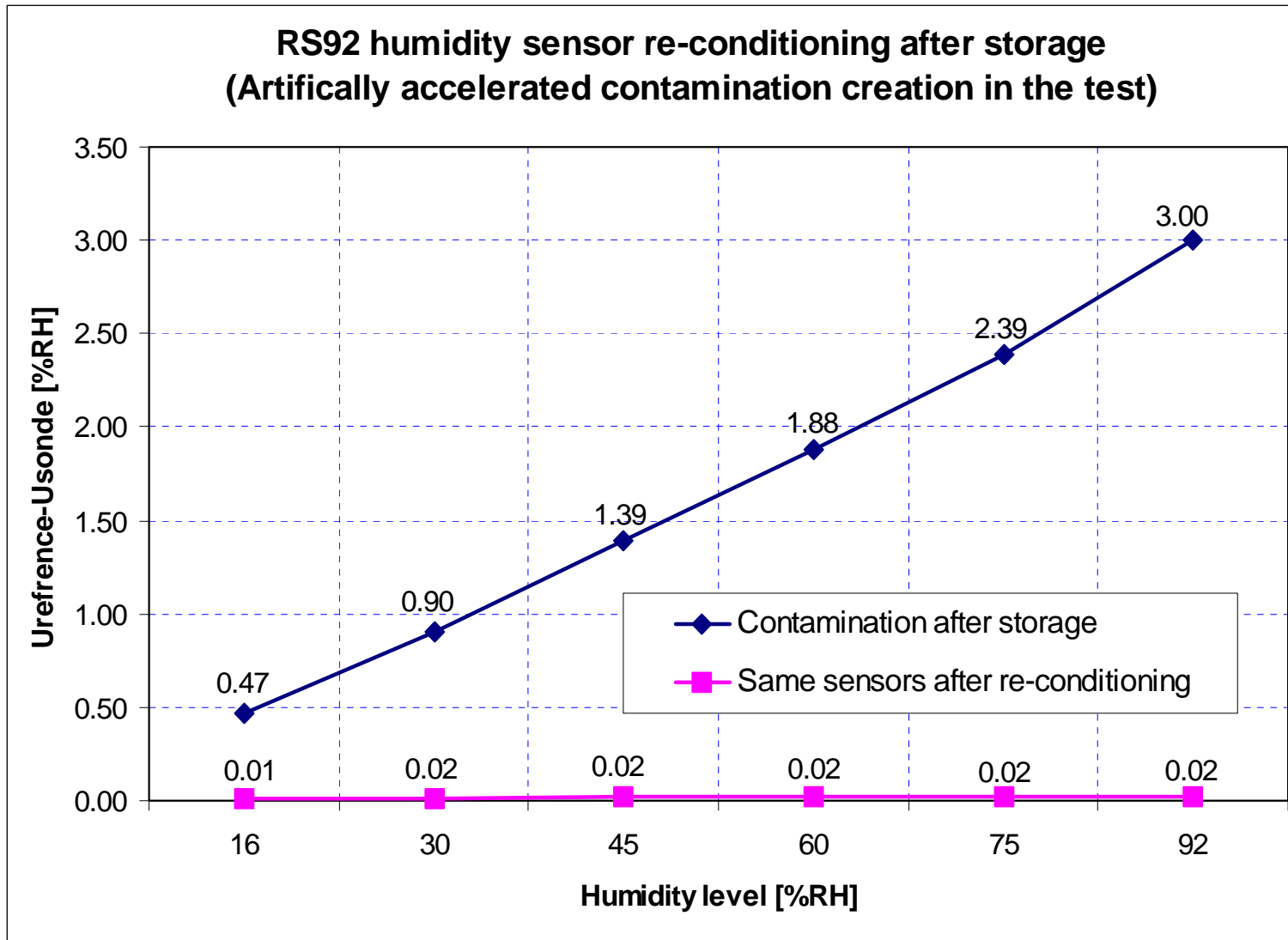
In this reconditioning procedure, the humidity sensors are heated just before sounding in order to remove possible contaminants from the sensor surface and restore the original calibration accuracy.

The test was made using an artificial, highly accelerated chemical contamination environment. According to Vaisala statistics, the worst-case contamination in a real environment leads to a measurement error of less than 5 % RH; a typical level of contamination leads to an error of 0 - 3 % RH.

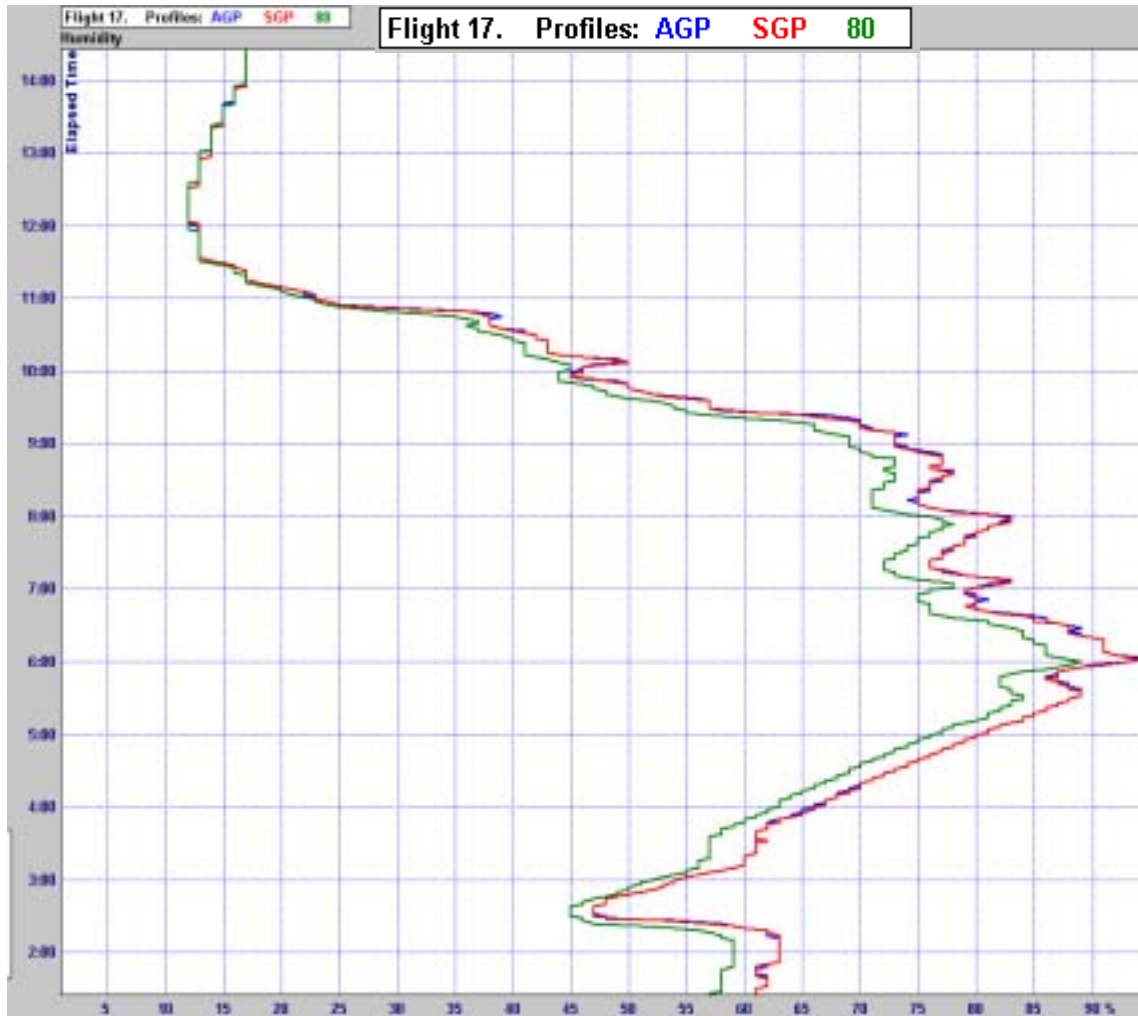
New Vaisala Ground Check Set GC25



Effect of Reconditioning



Result of reconditioning in sounding



Old RS80 sensor shows too low humidity because of contamination

Reconditioned RS92-AGP and RS92-SGP sondes show 100 %RH level accurately

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2003-12

Heated HUMICAP® Humidity Sensor

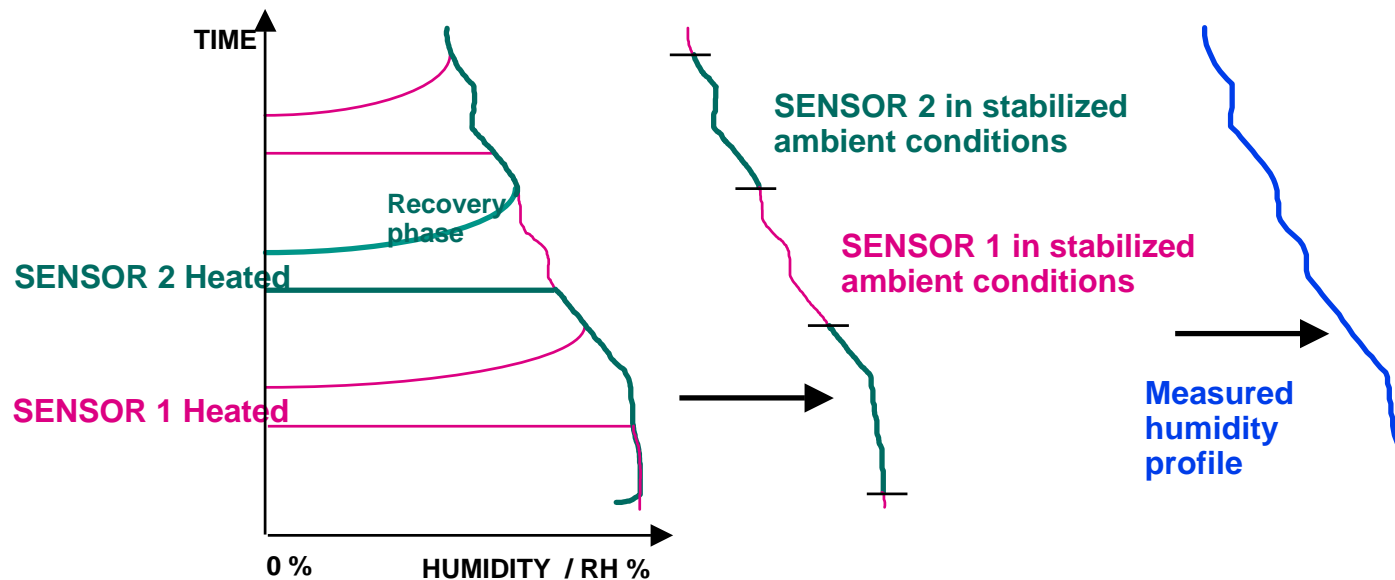
“Pulse heating” heats one humidity sensor to remove any ice or water condensation from the sensor surface while the other humidity sensor measures relative humidity during the radiosonde’s ascent. After the heating cycle, the “cleaned” sensor is cooled down and starts its measuring cycle while the other sensor is heated, and so on. As a result, a clean humidity sensor is always used for measurement.

In previous RS90 radiosondes, the heating time is the same throughout the sounding. Also, the recovery time is not altered.

Heated HUMICAP[®] Humidity Sensor

Defrosting method with two heated sensors

- Two sensors are heated alternately
- While first sensor is measuring, the second is heated. After a recovery phase to ambient conditions the latter is measured.



Optimized timing of sensor heating to prevent sensor icing

With the RS92, the heating cycle is adjusted as a function of temperature measured by the RS92.

- The pulse heating cycle is now much faster in the lower atmosphere, which significantly reduces the likelihood that water vapor will condense on the humidity sensor surface when the radiosonde emerges from low cloud cover. As a result, the RS92 radiosonde detects the tops of low-level clouds more precisely than was previously possible.
- Also, the cut-off temperature for pulse heating can be lowered to under -40 °C as compared to the RS90 radiosonde. Heating is extended to colder temperatures to prevent icing at high altitudes

Optimized timing of sensor heating to prevent sensor icing



**RS80 sensor
suffers from
icing. Two RS92
sondes operate
correctly**

**UK Met Office
Camborne
2003-12**

Accurate measurement in cold temperatures

Vaisala has improved the facilities for accurate humidity measurement. Temperature dependence of the RS92 humidity sensor has been determined more accurate than ever before in Vaisala radiosondes.