

# RH Generator Calibration

## Application Overview

Relative Humidity (RH) generators are widely used for the calibration of RH instruments on-site and in laboratories. These generators have the advantages of being lightweight, compact and fast to stabilize. This allows engineers to calibrate probes on-site in a fraction of the time it would take using, for example, salt solutions.

Some RH generator types also incorporate temperature control. This means that RH and temperature conditions may be generated to match the working conditions of the instrument under test. This is particularly useful in the validation of instruments used in stability cabinets, during pharmaceutical R&D or Quality Assurance tests.



## Calibration and Validation

Any system used for the calibration of instruments must itself be calibrated or validated periodically to comply with procedural requirements of Quality Systems or regulatory structures, such as those defined by the FDA.

Generators that are controlled by RH probes should either have the control probe calibrated, or be regularly compared with a transfer standard. When used in the laboratory, the transfer standard can also be used as the calibration reference. This is where chilled mirror instruments are increasingly used. The transfer standard can be used to validate the generator calibration at any time. Typically the validation is done before and after a series of on-site calibrations were performed, meaning that the generator can be used on-site without the need for the transfer standard to be connected.

Two pressure systems generate precise and stable RH values based on pressure/temperature measurement and control. As such they are less likely to suffer from drift. Typically instruments need to be sent back to the manufacturer or to a laboratory for calibration. Using a dew point mirror, the generated RH value can be compared to the mirror transfer standard. This allows the user to determine the stability of the system and provide measurement traceability without having to send the generator away.

## Uncertainty

The correct method to define the 'precision' of a measurement is to assign an uncertainty. Calibration laboratories, working according to the standards of ISO 17025, calculate the overall uncertainty from a mathematical combination of all possible uncertainty components. Industrial users are increasingly finding that this approach provides a useful, and more importantly, validated means of defining measurement performance. Thanks to its inherent precision and long term stability, the use of a chilled mirror dew point hygrometer provides the best measurement capability in RH generator monitoring and calibration. If needed MBW/RH Systems are able to provide example uncertainty budgets for support.

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## Measurement Options

The integration of chilled mirror measurements with transportable RH generators depends very much on the type used. In all cases, since RH is highly temperature dependent, careful consideration of temperature measurement is essential. The temperature measured by the dew point mirror must be the same as the generator chamber and any instrument under test. The table below shows the effect of a  $\pm 1\text{ }^\circ\text{C}$  temperature error at various RH/temperature conditions:

Relative Humidity	$\pm 1\text{ }^\circ\text{C}$ Temperature				
	10 $^\circ\text{C}$	20 $^\circ\text{C}$	30 $^\circ\text{C}$	50 $^\circ\text{C}$	70 $^\circ\text{C}$
10 %rh	$\pm 0.7\text{ %rh}$	$\pm 0.6\text{ %rh}$	$\pm 0.6\text{ %rh}$	$\pm 0.5\text{ %rh}$	$\pm 0.5\text{ %rh}$
50 %rh	$\pm 3.5\text{ %rh}$	$\pm 3.2\text{ %rh}$	$\pm 3.0\text{ %rh}$	$\pm 2.6\text{ %rh}$	$\pm 2.3\text{ %rh}$
90 %rh	$\pm 6.3\text{ %rh}$	$\pm 5.7\text{ %rh}$	$\pm 5.4\text{ %rh}$	$\pm 4.6\text{ %rh}$	$\pm 4.1\text{ %rh}$

The integration of a chilled mirror into RH generators must not influence temperature. The following methods should be evaluated and selected according to the type of system in use.

## External Sampling from Generator Chamber

A sample of the chamber gas is pumped through a chilled mirror measuring head where the dew point is measured. A separate probe is used for the measurement of temperature. In closed loop systems, sample extraction may cause instability in the generator. Therefore, if possible, return the sample gas to the generator. When measuring at RH and temperature conditions that resolve a high dew point, heated sampling is required.

### Products:

373H, 373HX, 573H for dew points up to  $+70\text{ }^\circ\text{C}$

373S, 573S, 973 for dew points up to ambient temperature



## Direct Insertion of Mirror into Generator Chamber

The measuring heads of the 473 Dew Point Mirror are designed to be directly inserted into the working volume of RH generators. This is the simplest and most cost effective method of validating the RH generator conditions.

The type of measuring head must be chosen depending on the type of application. The RP2 is designed to fit into a hole in the chamber door and is only suitable for the use in generators with moving air. For larger chambers the SH2 measuring head is more suitable. The SH2 is equipped with a fan that generates the necessary flow over the mirror. The measuring head can thus be placed within the working volume of generators without moving air.

To calculate an RH value from a frost/dew point measurement a temperature value is needed. Therefore, both measuring heads are supplied with external PRT's. For best measurement capability, the probes must be correctly applied and any temperature related effects must be taken into consideration.



Products: 473-RP2, 473-SH2

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## Multiple Point Temperature Measurement

Precise temperature measurement is a fundamental requirement for the determination of relative humidity. All MBW/RH Systems instruments are supplied with a probe for the measurement of temperature.

Temperature gradients significantly contribute to the overall uncertainty of measurement. Thus, it is desirable to be able to measure spatial temperature using a number of temperature probes. The T12 multi-channel thermometer can measure at up to 12 different positions using high performance PRT probes. Each temperature reading can then be used in combination with a dew point measurement to determine relative humidity gradients. Please refer to our Chamber Validation application note for additional information.

Product: Thermometer T12



## MBW Calibration & RH Systems

MBW Calibration (CH) and RH Systems (USA) work closely together to develop and manufacture chilled mirror dew point hygrometers that are used by standards laboratories worldwide at national, accredited and industrial level.

The available range of chilled mirrors cover frost/dew points over the range of -95 to +95 °C and incorporates the features necessary to provide reliable and accurate measurements in all conditions.

### Advantages of Chilled Mirrors in the Validation of Climatic Chambers

- Low drift measurement of dew/frost points and temperature
- Automated gas sampling at temperatures up to 100 °C
- Probe format chilled mirrors for direct insertion into the chamber working volume
- Self aspirated measurement head option
- Simultaneous measurement of temperature to permit calculation of relative humidity
- Fully self contained and easily transportable
- Integrated calibration verification function to allow on-site verification of instrument performance

### Process Insights

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