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Hygrometers: Relative Humidity Measurement

Introduction

The hygrometer is an instrument used to measure relative humidity (RH), that is, the quantity of water vapor present in the air. Hygrometers are often available in versions that also measure temperature–these are normally called thermohygrometers.

Relative humidity is expressed as the ratio of the quantity of water vapor present in the air to the quantity at which the air would reach saturation (100%) at a given temperature.

Accurate and Efficient RH Measurement

HANNA offers a wide range of relative humidity (RH) meters. Calibration is performed at the factory using humidity chambers and tuned at 3 different points (14%, 50%, 80%). Each model has been designed around certain field applications and environments.

Principle of Operation

The measurement system is made up of a meter connected to a probe. The probe measures capacitance, a capacitor with a polymer or plastic dielectric material with a fixed dielectrical constant from 2 to 15. Increased humidity causes the dielectric to dilate, hence distancing the plates with consequent variation of the capacitor's geometry and reduction of its capacitance. These capacitance variations in turn cause a frequency change in the instrument's electronics, resulting in a frequency modulation which is a function of relative humidity. The frequency is then converted into voltage, which is converted into a relative humidity value displayed on the LCD.

The hygrometers precision essentially depends on how insusceptible it is to the following three factors: the first is the "linearity error" caused by the typical non-linearity of RH sensors. HANNA hygrometers compensate for the effects of this error. It is advisable, however, to calibrate the meter periodically to reduce the probability of this error reoccurring.

The second factor is the "temperature error" caused by the variation of the hygroscopic properties of the sensor's dielectric material as a function of temperature. In fact, the ratio between the quantity of water vapor present in the dielectric and the relative humidity is not directly proportional, but varies with temperature.

The third factor is the "calibration error" caused by an incorrect calibration procedure.

Calibration

The RH probe is first immersed in the low RH chamber and allowed to stabilize. The meter is then calibrated at the RH value of the chamber being used. The procedure is repeated with the high RH chamber. Since RH is dramatically affected by temperature changes, kits do not provide accurate calibration due to the practical difficulties in performing the calibration at a constant temperature. Climatic chambers that simulate different humidity levels are the ideal solution to calibrate hygrometers accurately. Hygrometers are also calibrated using two different levels of relative humidity in this calibration procedure, and then the accuracy is checked by simulating other RH values in the chamber.

HANNA service centers are equipped with calibration chambers to provide for the highest accuracy.

Dew Point

The dew point is defined as the temperature to which air must be cooled in order for condensation (saturation) to occur. The dew point is dependent on the concentration of water vapor present, and therefore, the relative humidity. HI 9565 not only measures relative humidity, but automatically measures and displays the dew point as well.

HI 7101 Calibration Chamber

Comparison Guide

GUIDE	RH Range	Temperature Range	Dew Point Range	BEPS	HOLD	Backlit LCD	Page
Portable Meters							
HI 9565	•	°C/°F	•	•	•	•	15.3
HI 9564	•	°C/°F		•	•		15.3
HI 93640	•	°C/°F		•			15.4
HI 8666	•	°C					15.5

HI 9564 • HI 9565

Thermohygrometers with Dew Point and Calibration Data-Logging Probe

- **Backlit LCD**
- **Auto shut-off**
- **HOLD button**
- **BEPS and low battery warning**

HI 9564 and HI 9565 are two portable thermohygrometers designed to provide peak performance in harsh environments. For poorly lit areas the HI 9565 features a backlit LCD.

In addition to RH and temperature, HI 9565 will display the dew point with the press of a button. The dew point indicates the presence of water vapor in the air at a given temperature. With this feature HI 9565 permits quick and effective environmental monitoring where a controlled microclimate is necessary, like greenhouses, museums, clean rooms and laboratories.

These instruments also feature a HOLD button to freeze readings on the display for manual recording and BEPS (Battery Error Prevention System) which alerts the user in the event that low battery power could adversely affect readings.

HI 70602 RH probe features a built-in microchip that can store calibration data. When the probe is connected to another hygrometer, the microchip transfers the stored calibration data and eliminates the need to recalibrate the instrument.

Both instruments feature auto-off after 20 minutes of inactivity, temperature readings in Celsius and Fahrenheit, and online help to indicate anomalies and direct procedures.

SPECIFICATIONS		HI 9564	HI 9565
Range	RH	20.0 to 95.0%	
	Temperature	0.0 to 60.0°C / 32 to 140.0°F*	
	Dew Point	–	-20.0 to 60.0°C / -4.0 to 140.0°F
Resolution	RH	0.1% RH	
	Temperature	0.1°C / 0.1°F	
	Dew Point	–	0.1°C / 0.1°F
Accuracy	RH	±3 % RH (50 to 85 % RH and 15 to 40°C); ±5% RH (outside)	
	Temperature	±0.5°C / ±1°F	
	Dew Point	–	±2°C /±4°F (50 to 85 % RH and 15 to 40°C); ±4.5°C /±9°F (outside)
Probe		HI 70602 RH probe with thin, ABS body, perforated cap, internal temperature sensor with DIN connector and 1 m (3.3') cable (included)	
Battery Type / Life		9V / approximately 250 hours of continuous use; auto-off after 20 minutes of non-use (can be disabled)	
Environment		0 to 60°C (32 to 140°F); RH max 98% non-condensing	
Dimensions		164 x 76 x 45 mm (6.5 x 3 x 1.8 ")	
Weight		340 g (12 oz.)	

* Note: The meter measures temperature from -30 to 80°C, but the RH measurement can only be taken within the range 0 to 60 °C.

ORDERING INFORMATION

HI 9564 and **HI 9565** are supplied with HI 70602 relative humidity probe, battery and instructions.

ELECTRODES

HI 70602	RH probe with thin, ABS body, perforated cap, internal temperature sensor, DIN connector and 1 m (3.3') cable
HI 70602/5	RH probe with thin, ABS body, perforated cap, internal temperature sensor, DIN connector and 5 m (16.5') cable

ACCESSORIES

HI 710015	Blue protective boot
HI 710016	Orange protective boot

HI 93640

Compact Thermo-Hygrometer with Built-in Sensor

- **Portability and simplicity**
- **Low battery indicator**
- **Dual temperature range**
- **BEPS and low battery warning**

H 93640 is a compact, portable and versatile thermo-hygrometer that monitors relative humidity, anywhere. This simple to use meter is ideal for the HVAC field.

The built-in thin-film capacitance sensor assures accurate humidity measurements from 10 to 95% RH with a resolution of 0.1%.

Designed to be operated with just one hand, the compact housing fits easily in your palm. The design of the rubber keys resists the ingress of dust and protects the instrument from accidental splashes.

A sintered cap can be placed on the sensor shaft for protection in dusty environments. If faster response is desired, the cap can be removed.

The HI 93640 is equipped with BEPS (Battery Error Prevention System) which alerts the user in the event that low battery power could adversely affect readings.

ORDERING INFORMATION

HI 93640 is supplied with built in RH sensor, protective sintered cap for RH sensor, battery and instructions.

ACCESSORIES

HI 710011	RH probe protective sintered cap
HI 7102	Calibration chamber for probes with sintered cap
HI 7111/P	LiCl RH calibration salts for low humidity calibration, 15 g (6)
HI 7121/P	NaCl RH calibration salts for high humidity calibration, 33 g (6)
HI 710007	Blue Shockproof rubber boot
HI 710008	Orange Shockproof rubber boot
HI 710031	Rugged carrying case

SPECIFICATIONS		HI 93640
Range	**RH**	10.0 to 95.0% RH
	Temperature	0.0 to 60.0°C / 32.0 to 140.0°C
Resolution	**RH**	0.1%
	Temperature	0.1°C / 0.1°F
Accuracy	**RH**	±3% RH (50 to 85 % RH); ±4% RH (outside)
	Temperature	±0.5°C / ±1°F
Battery Type / Life		1.5 AA (3) / approximately 1,000 hours of continuous use
Environment		0 to 60°C (32 to 140°F); RH max 98% non-condensing
Dimensions		190 x 80 x 36 mm (7.5 x 3.1 x 1.4")
Weight		250 g (8.8 oz.)

Relative Humidity and Temperature Transmitter

- **Dual-range transmitter**
- **Removable sintered metal cap**
- **Can be quickly removed for maintenance with minimal downtime**
- **Wall mounted**

This solid-state transmitter plugs into its wall-mounted receptacle for on-site, continuous monitoring of relative humidity and temperature in critical or controlled environments.

The HI 8666 has an excellent accuracy of ±2% RH and ±1% °C. Each 4-20 mA analog signal can be sent to remote panel meters, controllers or data acquisition systems. The signals are to be powered by separate external voltage sources.

Equipped with a removable sintered cap, the HI 8666 sensor is well protected for the long run against the ingress of dust or unclean environments.

With the sintered cap removed, the sensor's response time is faster but it is no longer protected from dust or debris.

With the sintered cap installed, the life of the sensor and the instrument is prolonged and less maintenance is needed. This is ideal in some applications, such as food and industrial applictions where reliability rather than response time is the primary objective.

SPECIFICATIONS		HI 8666
Range	RH	0% (4 mA) to 100% (20 mA)
	Temperature	-20°C (4 mA) to 60°C (20 mA)
Accuracy	RH	±2% (5% to 95% RH)
	Temperature	±1% f.s.
Response Time		six seconds without sintered cap; sixty seconds with sintered cap
Power Supply		10-30 Vdc
Output Signal		4 to 20 mA
Environment		0 to 60°C (32 to 140°F)
Panel Cutout		73 x 42 mm (2.9 x 1.6")
Dimensions		79 x 49 x 150 mm (3.1 x 1.9 x 5.9")
Weight		150 g (5.3 oz.)

ORDERING INFORMATION

HI 8666 is supplied with built-in RH sensor, protective sintered cap for RH sensor, mounting brackets and instructions.

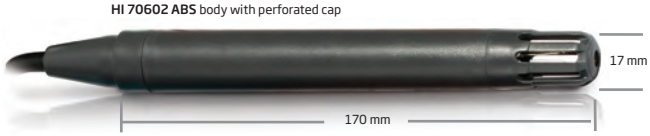
ACCESSORIES

HI 710011 RH probe protective sintered cap
HI 7102 Calibration chamber for probes with sintered cap
HI 7111/P LiCl RH calibration salts for low humidity calibration, 15 g (6)
HI 7121/P NaCl RH calibration salts for high humidity calibration, 33 g (6)

Relative Humidity Probe

HANNA humidity probes utilize a high-tech Thin-Film Polymer Capacitance (TFPC) humidity sensor. This sensor enables rapid response and high accuracy.

For rapid response, HANNA recommends a probe with a perforated cap. For industrial environments with dust and powders, HANNA recommends a probe with a protective sintered cap.



PROBE	CABLE LENGTH	PROBE LENGTH	CONNECTOR	SENSORS	USED WITH
HI 70602	1 m (3.3')	170 mm (6.5")	DIN	RH (resistive) & °C	HI 9564, HI 9565 (included)
HI 70602/5	5 m (16.5')	170 mm (6.5")	DIN	RH (resistive) & °C	HI 9564, HI 9565 (optional)

HI 7102 Calibration chamber for probes with sintered cap

HI 7111/P LiCl RH calibration salts for low humidity calibration, 15 g (6)
HI 7121/P NaCl RH calibration salts for high humidity calibration, 33 g (6)

HI 710007 Blue Shockproof rubber boot
HI 710008 Orange Shockproof rubber boot

HI 710011 RH probe protective sintered cap

HI 97500

Portable Lux Meter

- **Three measurement ranges**
- **Light sensor attached to 1.5 meter coaxial cable**
- **Rugged, waterproof case**
- **Low-battery indicator**

HI 97500 is a portable lux meter designed to perform light measurements simply and accurately. The instrument is supplied with a light sensor connected by a fixed 1.5 m coaxial cable to allow measurements to be taken from a distance without any interference from the operator.

By simply pressing the RANGE key, users can switch among three ranges to choose the best resolution according to the environment being tested. The HI 97500 lux meter has a rugged and water-resistant body for frequent outdoor use.

HI 97500 features a low battery indicator and automatic shut-off feature that turns the meter of after 7 minutes of non-use. Powered by a single 9V battery, this instrument guarantees about 200 hours of continuous operation.

The Quality of Light

Quality of light is very important in the workplace, schools, greenhouses and public buildings. Too little light (or luminous intensity) affects the quantity and quality of performance of both people and crops. HANNA's light meter uses special optic filters to match the spectral sensitivity of the human eye.

Luminous intensity is measured and reported in foot-candle or lux (lx). Light meters are commonly referred to as lux meters. One lux is equal to one lumen per square meter and one foot-candle is equal to one lumen per square foot. To convert measurements, use the following formula:

foot-candle = 10.764 lux

lux = 0.0929 foot-candle

SPECIFICATIONS	HI 97500
Range	0.001 to 1.999 Klux 0.01 to 19.99 Klux 0.1 to 199.9 Klux
Resolution	0.001 Klux 0.01 Klux 0.1 Klux
Accuracy	±6% of reading ±2 digits
Sensor	human-eye-response silicon photodiode with 1.5 m coaxial cable (fixed)
Battery Type / Life	9V / approximately 200 hours of continuous use; auto-off after 7 minutes of non-use
Environment	0 to 50°C (32 to 122°F); RH 100%
Dimensions	164 x 76 x 45 mm (6.5 x 3.0 x 1.8")
Weight	180 g (6.3 oz.)

ORDERING INFORMATION

HI 97500 is supplied with battery, protective case and instructions.