

How to select the right humidity instrument for your high-humidity application

High-humidity environments are tough for humidity measurement. Saturation in the environment causes condensation to form on all surfaces including measurement sensors, which can be fatal for some technologies. While Vaisala HUMICAP® technology can withstand condensation, it still needs time to recover from the effects of moisture before it can once again provide reliable measurements. Typical applications where high humidity or occasional condensing are expected include drying processes, test chambers, combustion air humidifiers, meteorological measurements, and fuel cells.

Keeping measurements accurate and reliable even in condensing environments calls for Vaisala's probe warming technology. A warmed probe keeps the sensor continuously above the ambient temperature, ensuring condensation never forms. The disadvantage of probe heating is that relative humidity can no longer be measured because the sensor won't know the ambient temperature. However, this doesn't prevent other temperature-independent parameters from being measured, such as dew point or mixing ratio. It is also possible to measure relative humidity using an additional temperature sensor.

Operating principle

The heating element inside the probe body heats the entire probe. In this illustration, the probe and filter are glowing red to illustrate how the probe warming keeps the microclimate inside the filter at an elevated temperature. The actual temperature is only a few degrees above the ambient temperature, as seen in the example below:

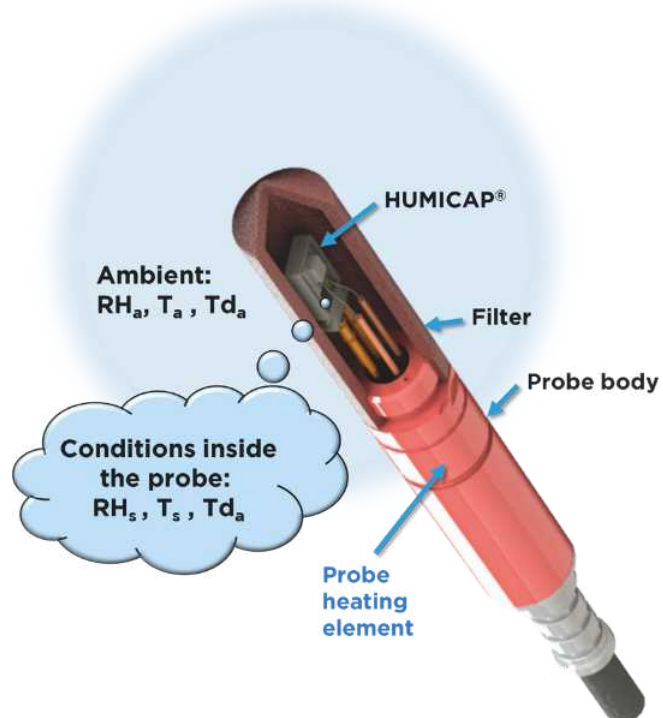
Ambient temperature:

$T_a = 14\text{ °C}$
 $RH_a = 97\%RH$
 $T_{da} = 13\text{ °C}$

Humidity sensor:






$T_s = 16\text{ °C}$
 $RH_s = 83\%RH$
 $T_{da} = 13\text{ °C (calculated)}$

As shown in this example, heating does not affect dew point. If relative humidity or another temperature-related parameter is needed, then the ambient temperature can be measured with a separate temperature probe, allowing these parameters to be calculated as well.



Products

Several Vaisala solutions include warmed probe technology. All of the following products are configurable when ordering: HMM170, HMT317, HMT337, and HMP7. The following table will help you to find the right solution for your high-humidity industrial application.

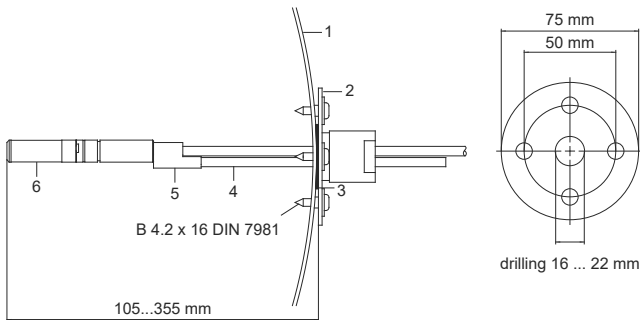
Product	HMP7	HMT317	HMT337	HMM170
				
Probe warming	Yes	Configurable	Configurable	Configurable
IP rating	IP66	IP66	IP66/IP65	N/A
Ambient temperature sensor allows RH calculation	**Possible with external temperature measurement	No	¹⁾ Configurable	**Possible with external temperature measurement
Available measurement parameters	T_d, T_{dp}, x, ppm, p_w **(RH, T, a, T_w, p_{ws}, h, dT)	T_d, T_{dp}, x, p_w	T_d, T_{dp}, x, p_w ¹⁾ (RH, T, a, T_w, p_{ws}, h, dT)	T_d, T_{dp}, x, ppm, p_w **(RH, T, a, T_w, p_{ws}, h, dT)
Supply voltage	18 ... 30 VDC	10 ... 35 VDC	Configurable: 10 ... 35 VDC, 24 VAC, 100 ... 240 VAC, 50/60 Hz	15 ... 35 VDC
Digital output	RS-485: Modbus RTU	RS-232: serial ASCII	Configurable RS-485: Modbus RTU or serial ASCII Ethernet: Modbus TCP or serial ASCII	RS-485: Modbus RTU
Analog output	Requires additional Indigo transmitter 	2 x	2 x (3 rd optional)	3 x
Display		No	Configurable	No
Parametrization	Insight software	Terminal program (e.g. Putty)	Terminal program (e.g. Putty)	Insight software
USB cable (sold separately)	USB2	238607	219685	219690

** Relative humidity calculation is possible by writing external temperature information on a Modbus register

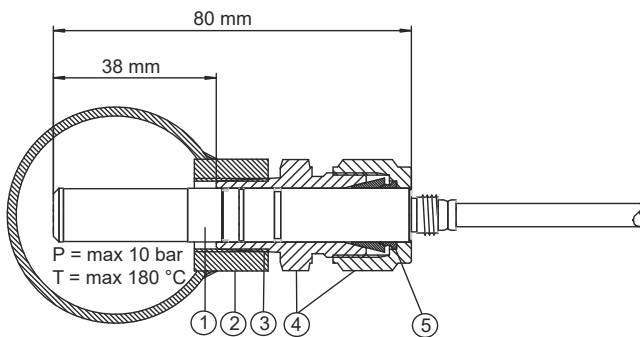
¹⁾ Configurable: additional temperature probe needed

Probe installation

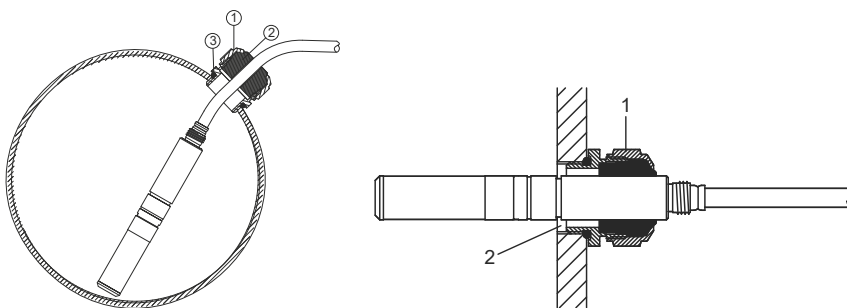
All the products listed in the table above share the same 12 mm sensor head. Depending on the application, there are different mounting accessories available:



Duct installation kit **10697** (215003 for HMT337 temperature probe).



Pressure-tight Swagelok installation kits **SWG12ISO38** with ISO3/8" or **SWG12NPT12** with NPT1/2" thread (SWG6ISO18 with ISO1/8" or SWG6NPT18 with NPT1/8" thread for HMT337 temperature probe).



HMP247CG: Vapor-tight installation with cable gland.

Insulation and leak-proof process connections

Choosing where to install a humidity probe can be challenging when there is high humidity combined with temperature variation.

For example, in a drying application where the exhaust air humidity is close to saturation (RH 95%) and the temperature is 40 °C, what happens when the sensor head is installed so that the filter is in the process and half of the sensor is in the 25 °C ambient temperature? In this situation even probe warming may not be able to compensate for the heat loss caused by thermal conduction through the metallic probe body; the heat loss will form a cold spot on the process side and condensation will result in inaccurate measurement. The solution here is to thoroughly insulate the probe.

If the process gas is colder than the ambient air it is critical to have a tight process connection for the probe. A leaking connection will allow warm and possibly humid air into the system, which can condensate near the sensor and cause measurement problems.

Extreme conditions, such as PEM fuel cell applications

There are also extreme applications where warming just few degrees above the ambient temperature is just not enough. One example of such application is a Polymer Electrode Membrane (PEM) Fuel cell. Application specific configurations can be found in the order forms of HMT330- and HMT310-series. These configuration versions are designed to withstand the extreme conditions by heating the probe head at a higher power. It is also possible to use HMP7 and HMM170 in these applications, since the heating functionalities are freely configurable with the Insight PC software.

Summary

Sensor saturation can be avoided in high-humidity and condensing conditions by using an instrument that has probe warming technology. In addition to this, proper insulation and leak-free installation guarantees the best possible environment for reliable humidity measurement.

The comparison table in this document will help you to choose the right product for your application. More detailed product information and features can be found in datasheets, user manuals, and order forms.

