6. Calibration curves

Product name	Product type	Compressed density	Unit	Measuring range	Sensor
Hops ~4% a²	Hops bales / loose	100 - 160 kg/m³	% WC	6 % - 40 %	13158 / 13736
Hops ~7% a²	Hops bales / loose	100 - 160 kg/m³	% WC	6 % - 40 %	13158 / 13736
Hops ~10% a²	Hops bales / loose	100 - 160 kg/m³	% WC	6 % - 40 %	13158 / 13736
Hops ~15% a²	Hops bales / loose	100 - 160 kg/m³	% WC	4 % - 40 %	13158 / 13736
Hops ~20% a²	Hops bales / loose	100 - 160 kg/m³	% WC	4 % - 40 %	13158 / 13736
Hops ~4% a² RT¹	Hops bales	100 - 160 kg/m³	% WC	6 % - 40 %	13158
Hops ~7% a² RT¹	Hops bales	100 - 160 kg/m³	% WC	6 % - 40 %	13158
Hops ~10% a² RT¹	Hops bales	100 - 160 kg/m³	% WC	6 % - 40 %	13158
Hops ~15% a² RT¹	Hops bales	100 - 160 kg/m³	% WC	4 % - 40 %	13158
Hops ~20% a² RT¹	Hops bales	100 - 160 kg/m³	% WC	4 % - 40 %	13158
Straw	Straw bales	100 - 160 kg/m³	% WC	8 % - 40 %	13158
Hay	Hay bales	100 - 160 kg/m³	% WC	8 % - 40 %	13158
Hemp RT	Hemp flower	100 - 160 kg/m³	% WG	6 % - 25 %	13158
Hemp	Hemp flower	100 - 160 kg/m³	% WG	6 % - 25 %	13158 / 13736
Digit	Special products			0 - 100	13158 / 13736
abs. humidity g/m³	Kiln		g/m³	0 - 100 g/m³	12032 & 12004
rel. humidity %	Kiln		% rh	0 - 100 %	12032 & 12004
EMC hops	conditioning chamber		% EMC		12032 & 12004
IR temperature	No glossy surfaces		C°/F°	-25 to 125 °C -13 to 257 °F	12513
Empty 1	free curve for special products				13158 / 13736

Empty 2	free curve for special products		13158 / 13736
Empty 3 RT	free curve for special products		13158 / 13736
Empty 4 RT	free curve for special products		13158 / 13736
Test block	! Only for testing the moisture meter !		13158

- [1] RT ... room temperature
- [2] a ... alpha acid content

Always select the calibration curve that most closely matches the indicated alpha acid content.

The device automatically recognises the connected sensor and provides the corresponding calibration curves.

6.1 How moisture is defined

The device measures and shows the material moisture content. The moisture content readings are calculated in relation to the material's overall mass:

$$\%WG = \frac{M_n - M_t}{M_n} \times 100$$

M_n: Mass of the sample with average moisture content

M_t: Mass of the sample with zero moisture content

%WG: Moisture content (in accordance with EBC 7.2 - Moisture Content of Hops and Hop Products)

6.2 Selecting the calibration curve

If you are not sure which calibration curve is the best suited for your material, it is recommended to carry out a reference measurement by kiln-drying (EBC 7.2 - Moisture Content of Hops and Hop Products).

Schaller GmbH will be happy to advise you on the selection of the right calibration curve for your product.

6.2.1 Insertion probe

Information about the insertion probe:

Caution: In case of a high frequency of measurements and high bale density, the insertion probe may heat up due to friction. If the shown temperature rises more than 3 °C/°F compared to the actual sample temperature, the calibration curve „hops RT“ has to be used!

» In case the material temperature is not in the range of room temperature, keep on using the curve „hops“, but let the probe cool down before every new measurement.

Hops ~4% α: Hops calibration curve for hops types of approx. 4 % alpha acid content

- Shows the current water content of the hops bale in %.

» If the shown temperature rises more than 3 °C/°F compared to the actual sample temperature, let the probe cool down.

- Not suitable for measurements of several bales in a row!

Hops ~7% α: Hops calibration curve for hops types of approx. 7 % alpha acid content

- Shows the current water content of the hops bale in %.

» If the shown temperature rises more than 3 °C/°F compared to the actual sample temperature, let the probe cool down.

- Not suitable for measurements of several bales in a row!

Hops ~10% α: Hops calibration curve for hops types of approx. 10 % alpha acid content

- Shows the current water content of the hops bale in %.

» If the shown temperature rises more than 3 °C/°F compared to the actual sample temperature, let the probe cool down.

- Not suitable for measurements of several bales in a row!

Hops ~15% α: Hops calibration curve for hops types of approx. 15 % alpha acid content

- Shows the current water content of the hops bale in %.

» If the shown temperature rises more than 3 °C/°F compared to the actual sample temperature, let the probe cool down.

- Not suitable for measurements of several bales in a row!

Hops ~20% α: Hops calibration curve for hops types of approx. 20 % alpha acid content

- Shows the current water content of the hops bale in %.

» If the shown temperature rises more than 3 °C/°F compared to the actual sample temperature, let the probe cool down.

- Not suitable for measurements of several bales in a row!

Hops ~4% α RT: Hops calibration curve for hops types of approx. 4 % alpha acid content

- Shows the current water content of the hops bale in %.
- The temperature of the bale has to be in the range of room temperature (+/- 3 °C).

» If the temperature is not in the range of room temperature, the calibration curve "Hops ~4% α" has to be used.

- For short measuring intervals (warmed-up insertion probe)

Hops ~7% α RT: Hops calibration curve for hops types of approx. 7 % alpha acid content

- Shows the current water content of the hops bale in %.
- The temperature of the bale has to be in the range of room temperature (+/- 3 °C).

» If the temperature is not in the range of room temperature, the calibration curve "Hops ~4% α" has to be used.

- For short measuring intervals (warmed-up insertion probe)

Hops ~10% α RT: Hops calibration curve for hops types of approx. 10 % alpha acid content

- Shows the current water content of the hops bale in %.
- The temperature of the bale has to be in the range of room temperature (+/- 3 °C).

» If the temperature is not in the range of room temperature, the calibration curve "Hops ~10% α" has to be used.

- For short measuring intervals (warmed-up insertion probe)

Hops ~15% α RT: Hops calibration curve for hops types of approx. 15 % alpha acid content

- Shows the current water content of the hops bale in %.
- The temperature of the bale has to be in the range of room temperature (+/- 3 °C).

» If the temperature is not in the range of room temperature, the calibration curve "Hops ~15% α" has to be used.

- For short measuring intervals (warmed-up insertion probe)

Hops ~20% α RT: Hops calibration curve for hops types of approx. 20 % alpha acid content

- Shows the current water content of the hops bale in %.
- The temperature of the bale has to be in the range of room temperature.

» If the temperature is not in the range of room temperature, the calibration curve "Hops ~20% α" has to be used.

- For short measuring intervals (warmed-up insertion probe)

Straw:

- Shows the current water content of the straw bale in %.
- For high sample temperature range
  - » If the shown temperature rises more than 3 °C/°F compared to the actual sample temperature, let the probe cool down.
- Not suitable for measurements of several bales in a row!

Hay:

- Shows the current water content of the hay bale in %.
- For high sample temperature range
  - » The temperature of the bale must be within the range of room temperature (+/- 3°C)!
- Not suitable for measurements of several bales in a row!

Hemp RT:

- Displays the current water content of the hemp flower in %.
- For high sample temperature range
- If the shown temperature rises more than 3 °C/°F compared to the actual sample temperature, let the probe cool down.
  - » If the temperature is not within the range of the room temperature, the calibration curve "Hemp" must be used.

Hemp:

- Displays the current water content of the hemp flower in %.
- For high sample temperature range
  - » If the shown temperature rises more than 3 °C/°F compared to the actual sample temperature, let the probe cool down.

Digit:

- Has a unitless measuring range between 0 and 100,
  - » which corresponds to the entire measurement range of the device.
- The higher the indicated value, the wetter is the material:
  - » Very dry: 0 to very wet: 100
  - » By means of a comparative measurement by a reference method, a table with comparison values can be created.

Free calibration curves 1-4:

- There are four free product curves on the device .
  - » They can be used for measuring special products (temperature compensated).
  - » On request Schaller GmbH can develop customer-specific calibration curves for your product.

Test block:

- This curve is only destined for checking the device with the optionally available test block, article no. 12308.

6.2.2 Umbel sensor

Hops ~4% α: Hops calibration curve for hops types of approx. 4 % alpha acid content

- Shows the current water content of the hops in %.
- The device has to have nearly the same temperature than the product being measured (+/- 3 °C).

» If the temperature difference is more than +/- 3 °C, let the temperature adjust.

Hops ~7% α: Hops calibration curve for hops types of approx. 7 % alpha acid content

- Shows the current water content of the hops in %.
- The device has to have nearly the same temperature than the product being measured (+/- 3 °C).

» If the temperature difference is more than +/- 3 °C, let the temperature adjust.

Hops ~10% α: Hops calibration curve for hops types of approx. 10 % alpha acid content

- Shows the current water content of the hops in %.
- The device has to have nearly the same temperature than the product being measured (+/- 3 °C).

» If the temperature difference is more than +/- 3 °C, let the temperature adjust.

Hops ~15% α: Hops calibration curve for hops types of approx. 15 % alpha acid content

- Shows the current water content of the hops in %.
- The device has to have nearly the same temperature than the product being measured (+/- 3 °C).

» If the temperature difference is more than +/- 3 °C, let the temperature adjust.

Hops ~20% α: Hops calibration curve for hops types of approx. 20 % alpha acid content

- Shows the current water content of the hops in %.
- The device has to have nearly the same temperature than the product being measured (+/- 3 °C).

» If the temperature difference is more than +/- 3 °C, let the temperature adjust.

Hemp:

- Shows the current water content of the hemp in %.
- The device has to have nearly the same temperature than the product being measured (+/- 3 °C).

» If the temperature difference is more than +/- 3 °C, let the temperature adjust.

Free calibration curves 1-2:

- There are two free product curves on the device.
  - » They can be used for measuring special products (temperature compensated).
  - » On request Schaller GmbH can develop customer-specific calibration curves for your product.

Test block:

- This curve is only destined for checking the device with the optionally available test block, article no 13888.

6.2.3 Air humidity sensors

Information about conditioning of the sensor

The conditioning time of the sensor (time until the device shows the actual measuring value) depends on several parameters. The parameter responsible for the highest measuring error is a temperature discrepancy between the sensors resp. the whole measuring instrument and the material to measure resp. the air. For that reason, make sure to let the sensor adjust for an adequate time period.

Absolute humidity:

- Quantity of water contained in grams per cubic metre of air
- The absolute humidity is a direct degree for the amount of water vapour contained in a certain air volume.
- It shows how much moisture can maximally condense or how much water has to be evaporated to receive a certain desired air humidity.

Relative air humidity:

- Indicates the relation between the current water vapour pressure and the maximum possible water vapour pressure (called saturation vapour pressure).
- The relative humidity shows the degree the air is saturated with water vapour.
  - » 50% relative humidity: At the current temperature and the current pressure the air is saturated with water vapour for half of its value.
  - » 100% relative humidity: At the current temperature and the current pressure the air is totally saturated.
  - » >100% relative humidity: The excessive moisture would condense or form fog.

EMC hops:

- Shows the hops equilibrium moisture content (for hops stored under these conditions) in % water content and the temperature in the selected unit (°C or °F).

6.2.4 Infrared sensor

IR temperature sensor:

- Shows the current temperature of the object beamed by the sensor.
- The sensor has a 1:10 optics,
  - » which means a measuring area of 16 cm at a distance of 1 meter.
- Not suitable for measurements of glossy or reflective materials!

6.3 Notes for comparative measurement with oven-drying method

The device uses a much higher sample quantity than the drying oven (12-fold to 20-fold quantity of kiln-drying method). Furthermore, to determine a more accurate average moisture value in case of inhomogeneous material, there can be effected several measurements within a short time.

Considering a sampling error due to the considerably smaller sample quantity as well as the content of volatile matters (resin etc.) that are not water, the kiln-drying method will practically reach an accuracy of approx. +/-3 %. Therefore, if the measuring values of these two very different methods of determining the water content are compared, differences of +/- 3 % can be considered to be normal.

In the standard EBC 7.2 - Moisture Content of Hops and Hop Products it is declared that the drying oven method provides no absolute values, but only comparable values.