Alcohol Measurement with Snap 41

Relevant for: Distillers, producers and bottlers of spirits or related products

Tipps and tricks for Snap 41

Correct handling and measurement with Snap 41

Based on example measurements of ethanol and water mixtures

1 Snap 41

Snap 41 is a portable alcohol meter for the determination of the alcohol concentration in distilled spirits that can be considered to be binary mixtures of ethanol and water. The concentration determination is based on density measurement by the oscillating U-tube method.

Snap 41 measures samples with temperatures from 0 °C to 40 °C. It automatically converts the result to the alcohol content at 20 °C in % v/v.

2 Measuring Principle

The sample is introduced into a U-shaped tube, made of Hastelloy, that is being excited to vibrate at its characteristic frequency. The characteristic frequency changes depending on the density of the sample. With the determination of the characteristic frequency, the density of the sample can be calculated.

Due to the temperature dependency of the density value, the metal tube surrounding the measuring cell has to stay immersed in the sample during the measurement. This ensures quick temperature equilibrium between the sample in the cell and the material surrounding the cell whilst eliminating the influence of the ambient temperature. Density and temperature are measured simultaneously and are the basis for the calculation of the alcohol content, which is temperature compensated to correlate with a certain reference temperature.

3 Preparing the Instrument

Perform a water check every day before you start the measurements to verify that the instrument is measuring with adequate accuracy.

Perform a water adjustment if the water check advises you to do so.

Alternatively, or additionally, measure a reference sample.

Tip: Perform the water check or the measurement of the reference sample at the same temperature as your sample measurement.

Refer to the instruction manual chapter "Checks and Adjustments" for more detailed information.

4 Preparing the Sample

For accurate results, make sure that the samples are

- stable
- in a well equilibrated temperature state
- homogenous
- do not contain dissolved gases
- mainly consist of ethanol and water
- do not contain sugar

Tip: Samples containing dissolved CO_2 create bubbles in the measuring cell leading to invalid measurement results. Degas the sample properly before measurement stirring it vigorously for 5 to 15 minutes until bubbling ceases, or putting it into an ultrasonic bath for approximately 5 to 10 minutes until bubbling ceases. Be aware that degassing should not change the alcohol content in your sample.

Tip: From experience we know that freshly mixed solutions of ethanol and water can be measured, but

most accurate measurement results are achieved after a waiting time of at least some hours or vigorous stirring for good sample equilibration.

5 Sample filling and measurement

5.1 Filling for most accurate results

Before starting a measurement make sure that the instrument is clean and dry.

1. Press down the pump lever as far as it will go.
2. Sink the metal tube into the sample with the pump lever down (see fig 1).
3. Slowly release the pump lever (see fig 1).
4. Now the instrument is filled with sample. Discard this sample in a waste bottle (see fig 2).
5. Repeat steps 1 to 4 one more time.
6. Now slowly fill and discard the sample while the instrument remains standing on the sample (see fig 2).
7. Repeat step 6 one more time.
8. Now slowly fill again, this filling is now taken for the measurement.
9. Start the measurement by pressing the data storage key and leave the instrument immersed in the sample during the measurement (see fig 3 and 4).
10. Discard the sample into the sample vessel and fill again directly from the sample vessel and start a new measurement to see if the result is well repeatable.

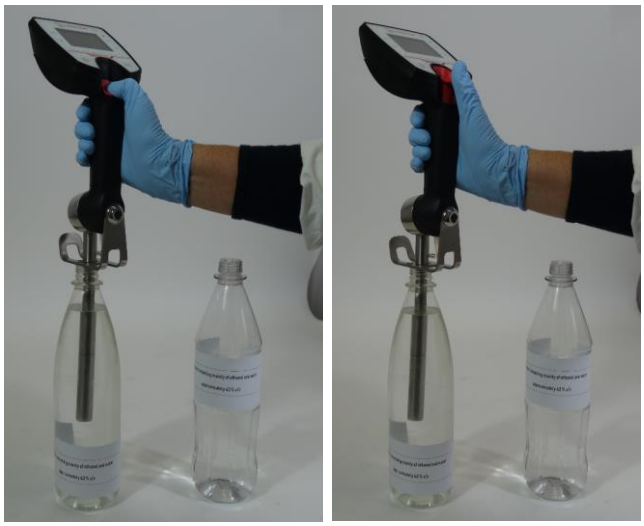

Figure 1: Immerse Snap 41 and release the pump lever

Figure 2: Discard the first 2 fillings, fill again, discard and fill while the instrument remains on the sample vessel

5.2 Tipps and tricks for filling & cleaning

To avoid contamination of your sample, clean the metal tube before and after measurement.

If the instrument contains “old” sample and this sample is mixed into the new measurement sample, this can lead to less accurate results.

Sample replacement without intermediate cleaning is only recommended for similar samples and for measurements directly one after another.

If the sample differs to the sample before, or the instrument was not used for a longer time, we recommend using a little of the new sample in any available clean vessel, only for filling, discarding and filling again, in order to avoid mixing the old sample in the new sample container. Afterwards proceed as explained above.

Refer to the instruction manual for more detailed information.

Figure 3: Best accuracy is reached if the metal tube is well immersed in the sample during the measurement due to best temperature equilibration

Figure 4: Quick temperature equilibrium as tube stays in the sample. Due to high temperature dependence of the density, this is the basis for an accurate measurement

6 Tipps and tricks for measurements

For accurate results leave the instrument immersed in the sample.

Flush the instrument with sample by pumping in a slow way e.g. 2 or 3 times while the instrument remains immersed in the sample.

Snap 41 can only measure quasi-binary mixtures of ethanol and water. Samples consisting of ternary solutions (ethanol, water, sugar) like liqueurs cannot be measured accurately with Snap 41.

At least one third of the metal tube should be submerged in the sample to ensure quick and precise temperature equilibrium. A marking on the tube helps you to find the minimum immersion depth (approx. 80 mm / 3.15 in).

Tip: To obtain the highest possible accuracy, submerge two thirds of the metal tube in the sample (second marking, approx. 150 mm / 5.9 in). By doing so, you eliminate any external temperature influence.

Tip: We recommend to use the measurement mode “Precise”.

7 Typical measurement results

For these tests we used two in-house Snap 41 instruments, no special verification of their adjustments was made prior to the tests and the tests were made under normal lab conditions. Before starting, we performed a water check with each instrument at ambient temperature of 22 °C, which was passed for both instruments.

We prepared a sample containing ethanol and ultra-pure water and filled it into 1 L bottles as shown in fig 1. We measured the reference value with an Alcolyzer Spirits Analyzing System from Anton Paar. The measured reference value is 44.133 % v/v at 20 °C.

We put the closed bottles in a climate chamber at 40 °C and waited for 20 hours. Then we measured the sample at 40 °C in the climate chamber. In a next step we let the closed sample bottles cool down in our lab and measured again when they reached approximately 30 °C. We measured again after they were cooled down and well equilibrated to ambient temperature.

The aim was to see if the ethanol concentration can be well measured at different sample temperatures and is within the specified limits, using normal lab conditions and well-used Snap 41 instruments.

When measuring as described in this application report, the temperature value and alcohol concentration show a good repeatability and accuracy. The accuracy of the alcohol concentration is always within the specified accuracy of 0,1 % v/v.

Instrument S/N	Result sample temperature / °C	Result alcohol@20 °C / % v/v	Result density / g/cm^3
00000002	39.33	44.07	0.9269
00000002	39.36	44.06	0.9269
00000002	39.23	44.08	0.9270
00000002	39.38	44.06	0.9269
82623845	39.24	44.13	0.9269
82623845	39.15	44.14	0.9269
82623845	39.07	44.15	0.9270
82623845	39.07	44.14	0.9270

Table 1: Measurement of the same sample filled in two different bottles (1 L each, see fig 1) with two different instruments in a climate chamber with a temperature of 40 °C with method “Ethanol” and measurement mode “Precise”

Instrument SN	Result sample temperature / °C	Result alcohol@20 °C / % v/v	Result density / g/cm³
00000002	31.65	44.12	0.9326
00000002	31.69	44.08	0.9327
00000002	31.62	44.07	0.9327
00000002	31.43	44.09	0.9328
82623845	31.25	44.15	0.9329
82623845	31.15	44.14	0.9330
82623845	31.22	44.14	0.9329
82623845	31.25	44.13	0.9329

Table 2: Measurement of the same sample filled in two different bottles (1 L each, see fig 1) with two different instruments in a laboratory with an ambient temperature of 22 °C, the samples were cooling down after the measurements in the climate chamber, method "Ethanol" and measurement mode "Precise"

Instrument SN	Result sample temperature / °C	Result alcohol@20 °C / % v/v	Result density / g/cm³
00000002	22.22	44.10	0.9395
00000002	22.35	44.10	0.9395
00000002	22.38	44.10	0.9334
00000002	22.30	44.09	0.9395
82623845	22.26	44.08	0.9396
82623845	22.22	44.08	0.9396
82623845	22.21	44.08	0.9396
82623845	22.20	44.07	0.9395

Table 3: Measurement of the same sample filled in two different bottles (1 L each, see fig 1) with two different instruments in a laboratory with an ambient temperature of 22 °C with method "Ethanol" and measurement mode "Precise"

8 Summary

For accurate alcohol measurement with Snap 41, correct filling and measurement is important. In this report we explain how to measure the alcohol concentration with Snap 41.

Following this guide line Snap 41 will give you an accuracy of 0.1% v/v in the specified measuring range.

Figure 5: Snap 51 for measurement of distilled spirits

Contact Anton Paar GmbH

Tel: +43 316 257-0

Support-ldc@anton-paar.com | www.anton-paar.com