


VST LAB Coffee III Coffee-Espresso Refractometer

How to ensure accurate and repeatable measurements

All VST LAB Coffee Refractometers are run through a series of 50 measurements at five reference points on incoming inspection and prior to shipment.

VST, inc. © 2010-2016		Final QA Test MADE in U.S.A.			CALIBRATION SUMMARY	
	S/N	14517			Date	9/11/2016_B
	Model	VST LAB Coffee III			Tech	BRF
	REFERENCE FLUID Acceptable Range	REF: 0.00 +/- 0.01%	REF: 1.40 +/- 0.02%	REF: 4.00 +/- 0.03%	REF: 9.70 +/- 0.05	REF: 18.30 +/- 0.05
	TEMP °C	19.50	19.54	19.58	19.62	19.66
	Actual REF Value (NIST)	0.000	1.397	3.995	9.700	18.305
	AVG Measurement	0.000	1.402	3.998	9.696	18.298
	Accuracy	0.000	0.005	0.003	-0.004	-0.007
	2σ Precision	0.000	0.006	0.000	0.008	0.000

The performance summary includes average accuracy measurements at each point as well as the **2-sigma precision*** at each point. The reference points are prepared using standards that are accurate to a few parts in 10E-06 refractive index, which is the internal resolution of the VST refractometer. The temperature is resolved to 0.01 Deg C. Both the sapphire optical engine and temperature sensors are quite rugged and designed in a manner to virtually eliminate drift over time, and are also shock resistant.

The biggest factors in maintaining very high accuracy **and precision** (*repeatability*) of measurements are as follows.

- Store the instrument, distilled water and a supply of cupping glasses for your samples together on a table at ambient temp. Avoid taking the glasses used for the sample out of a cupboard near an outside wall.

- Zero-Set using DI water prior to a session, and during a session if the temp changes by more than one (1) Deg C during the session. To see the temp the instrument is measuring, press both buttons, then release the **go** first, then release the **menu** button. The raw temperature will be displayed in hundredths of a Deg C.

- After brewing, stir the batch to eliminate stratification, filter if necessary using a VST COF/ESP Syringe filter, then transfer a small sample (0.5ml or 0.5g weight) to the cupping glass with a pipette (use a heavy bottom glass), **wait 20-30 seconds for the sample to equilibrate to ambient temperature**, then transfer to the sample well of the instrument. Wait 20-seconds, then take your measurement(s). You should note that successive measurements are usually w/in 0.01% or ±0.01%. Following this protocol will avoid raising or lowering the temperature of the prism from the ambient temp at which it was last zero-set.

-If you're using an immersion brew method, or other method that relies on metallic woven mesh or perforated metal filters, you will need to first filter the sample using a VST COF/ESP syringe filter prior to depositing the sample into the cupping glass, otherwise, non-dissolved sediment of cellulose solids will settle on the prism and cause erratic, inaccurate readings. Measurements in all refractometers require a clarified sample in order to realize manufacturer specifications of accuracy and precision. Use a VST COF/ESP syringe filter whenever the coffee being measured appears to be cloudy when held up to window daylight. If the coffee appears to be clarified and clear, then pre-filtering is usually not necessary.

-Note on VST COF/ESP Syringe Filters

In the case of espresso, or immersion brew methods, where large amounts of non-dissolved solids may be present, the VST Syringe Filters not only eliminate the non-dissolved solids which contribute to refractive index measurement errors, but they also degas the CO₂ infused into solution, which lowers density and refractive index. For cold brew, CO₂ is not an issue, but non-dissolved solids should be removed and the sample clarified prior to measurement for best precision and accuracy.

In conclusion, always use a small (0.5g) clarified sample transferred to a cupping glass (one with a heavy glass bottom), as this allows thermal transfer from the sample to quickly attain the glass [ambient] temperature, then transfer to the refractometer sample well. *This avoids changing the sapphire prism temperature.* Following this procedure with each use will become second nature after a few measurement sessions, and will result in the specified ~0.01% precision without drift.

* Standard deviation (sigma, σ) is a measure in statistical math used to quantify the amount of variation of a set of data measurements. For a normal Gaussian distribution (a probability density function) 95% of the probability is within 2σ of the mean. If you randomly pick one data point from a set of 100 measurements that is normally distributed, there is a 95% probability that its value is within 2σ of the average value. VST has designed its' instruments for a 2σ precision of $[\pm] 0.01\%$. This means that 95 of 100 measurements of the same sample will measure $\pm 0.01\%$ of the average value of all of the measurements.

