



Thermometry 101 For The
Homebrewer
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Thermometry

- The measurement of temperature.
- Temperature is probably one of the easiest things a homebrewer can affect but seems like one of the hardest to control.
- Temperature is important from step one all the way to step drink.

Why?

- Why is it hard to control?
 - Temperature is constantly changing.
 - Homebrewers never trust their instruments
 - *How many thermometers do you own/use?
 - Our processes and outcomes depend on staying within a tight¹ window.

¹-Tight is a relative term

Calibration, The First Step To Recovery

- Even a single point calibration should give you enough confidence.
- Two points, a curve does not make.
- The problem is not many of us have access to a third reference point.
- The truth of the matter is, with a good digital thermometer, the ice bath check is good enough.

Accuracy vs, Precision

- Accuracy defines how close we are to the true value.
- Precision is how repeatable is the measurement no matter how close we are to the true value.
- Accuracy with precision is nice, but, as long as we know the error good precision is fine.
- Lack of precision will kill the homebrewer.

Ice Bath Calibration

- Fill a glass with chipped ice to the brim
- Fill with water to within 0.75"-0.5" of the brim
- Allow the water to stabilize for about a minute
- Place the probe in the center, do not touch the sides or the bottom.

So What is The Best Thermomter For The Homebrewer?

- It depends.
 - IR
 - Liquid-Glass
 - Digital
 - Bi-Metal
 - Thermocouple

Pros and Cons IR

- Easy to use (seemingly)
- Decent precision and accuracy
- Good Range (-30 to 900 C, -25 to 1600 F)
- +/- 0.75%
- Fast Reading
- However, really only good for fermentation temperature

Pros and Cons Liquid in Glass

- Cheap
- Precise from week to week, month to month, but the precision drifts slowly.
- Accuracy is questionable. Do you think a each mass produced spirit thermometer is calibrated? How tight are the tolerances between each capillary column?
- Calibration is critical the first time you use it, but less so over time.
- Your choice of chemical in the thermometer is usually limited to toxic things you probably don't want in your beer.

Pros and Cons of Bimetal

- Once calibrated they are extremely stable
- Little if any memory
- Usually very easy to calibrate
- Durable
- Can be slow
- External sources of heat can change the reading, especially sunlight
- Excellent for temperature ranges between freezing and boiling.
- Used to hate these and had zero trust in them, my mind has changed somewhat.

Pros and Cons of Digital

- Cheap, and even the cheapest ones are pretty good
- Easy to read
- Usually about 0.7-1.0 degree error in our ranges
- Can self heat, better ones will compensate for this

Pros and Cons Thermocouple

- For the last 2 years I lived and died by the thermocouple.
- Very good for temperatures between 400C and 1000C (Type K +/- 0.004 C).
- Not so great between 0C and 212 C (Type K +/- 2.5 C)
- Measures a voltage gradient between the hot end (measurement end) and the cold end (reference end). You must know the temperature for the reference end, in handheld instruments or industrial applications this is done electronically to 32 F.

Why Do Thermocouples Stink At Low Tight Temperature Ranges

- They don't really, it's the measurement device that stinks.
- For example, Type K thermocouple has a Seebeck coefficient of $51 \mu\text{V per } ^\circ\text{C}$, so if cold junction is $0 ^\circ\text{C}$ and mash temp is $68 ^\circ\text{C}$ the voltage would be 3.5 mV .
- Now plug $400 ^\circ\text{C}$ into the equation you have a voltage of 20.4 mV . Cheap instruments and cheap probes equal poor precision and poor accuracy

Take Aways

- Find something(s) you are comfortable with, use it and maintain it
- Based on my research I am buying a digital with a long probe and will continue to trust my Blichmann brewmometer
- IR's are almost useless
- If you are going to calibrate take the time to do it right