



Hydrometer & Refractometer Calibration CR Beer Nuts Tech Topic

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Outline

- Background Info
- Calibration Solutions
- Calibration Tables

Goals:

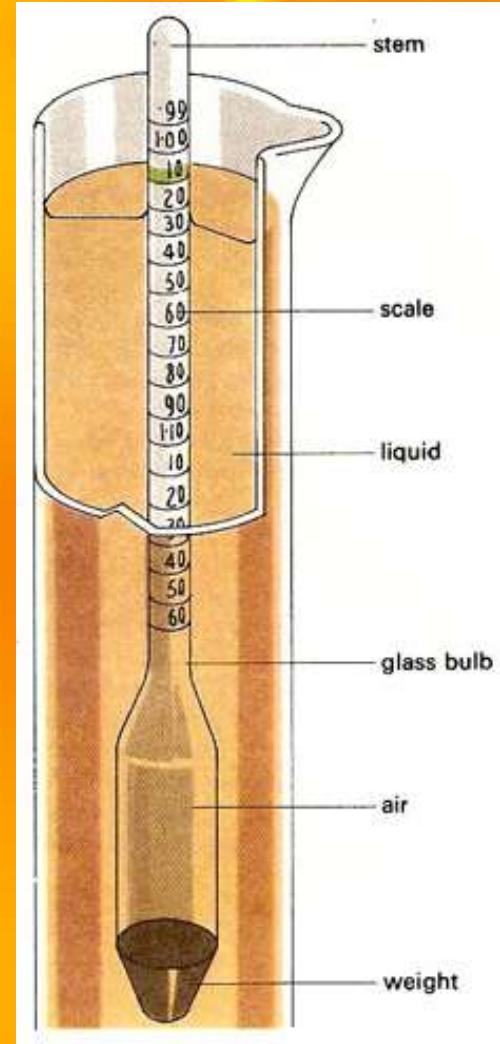
- Brief Introduction
- Calibrate SG-measuring equipment
- Discuss Future Topics





Hydrometer

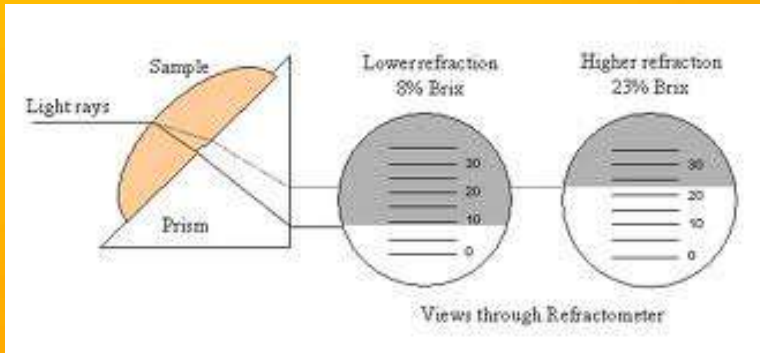
- Direct measurement of SG via bouyancy
- Straightforward to measure FG & calculate ADF (Apparent Degree of Fermentation)
- Must be corrected vs temp





Refractometer

- Direct measurement of Brix via index of refraction
 - Calibrated vs a pure sugar solution not wort
- SG must be calculated
- FG must be calculated from OG
- Readings do not change with sample temp
- Readings may change with lens temp





Useful equations

- Brix-to-Plato
 - $1\text{ }^{\circ}\text{B} = 1\text{ }^{\circ}\text{P}$
- Wort Correction Factor (WCF)
 - $1\text{ }^{\circ}\text{Brix}_{\text{Actual}} = 1\text{ }^{\circ}\text{Brix}_{\text{Meas}} / \text{WCF}$
 - The non-sugar content of wort artificially increases the index of refraction (WCF is commonly 1.02 – 1.06)
 - Can be measured directly by comparing calibrated Brix & SG measurements of the same wort
- Brix-to-SG
 - <http://www.brewersfriend.com/brix-converter/>
 - <http://seanterrill.com/2012/01/06/refractometer-calculator/>
 - $\text{SG} = (\text{Brix} / (258.6 - ((\text{Brix} / 258.2) * 227.1))) + 1$
- Hydrometer temp correction
 - <http://www.brewersfriend.com/hydrometer-temp/>
- Late fermentation Brix Measurements
 - <http://seanterrill.com/2012/01/06/refractometer-calculator/>





What Else

- Calibrated equipment will not fix poor practices
- Mix well before taking a gravity reading
 - This applies to both MLT & BK readings
- Compensate for temp offsets
 - This applies to both SG & Volume!
 - Leave your refractometer indoors
- A tip I've found helpful
 - $V_0 * G_0 = V_f * G_f$
 - V_0 & V_f must be at the same temp
 - The difference in the two products will give you a sense of your measurement uncertainty





Calibration Solutions

- $^{\circ}\text{Brix} = \% \text{ weight} / \text{weight}$
 - Defined relative to a sugar solution
- A 10 $^{\circ}\text{B}$ standard solution would be 90% water, 10% sugar, by weight
- Highly sensitive scales make a standard Brix solution straightforward to build.
- Error Analysis:
 - $\pm 0.5 \text{ gm}$ uncertainty
 - 30 gm sugar = 29.5-30.5 gm
 - 270 gm Water = 269.5 – 270.5 gm
 - $^{\circ}\text{Brix} = 9.83 - 10.17$ (1.0393 – 1.0407)





Calibration Solutions

°Brix	Sugar (gm)	Water (gm)	Nom SG	Brix Error	SG Error	
0	0	300	1.000	0	0	0
5	15	285	1.0197	4.83- 5.17	1.019- 1.0204	±0.7
10	30	270	1.040	9.83- 10.2	1.0393- 1.0409	-0.7 +0.9
15	45	255	1.061	14.8- 15.2	1.0603- 1.062	-0.7 +1.0
20	60	240	1.083	19.8- 20.2	1.0821- 1.0839	±0.9
25	75	225	1.1057	24.8- 25.2	1.1047- 1.1066	-1.0 +0.9
30	90	210	1.129	29.8- 30.2	1.1282- 1.1302	-0.8 +1.2





Calibration Table

°Brix	SG	Meas Brix	Brix Offset	Meas SG	SG Offset
0	1.000				
5	1.020				
10	1.040				
15	1.061				
20	1.083				
25	1.106				
30	1.129				

Meas Temp:

