Fermentation Monitoring Chart [using an ATC-Refractometer]

Lookup Specific Gravity (SG) and True BRIX using Refractometer (RBRIX)

As the amount of sugar dissolved in water increases, the ability of the combined solution to bend (or refract) light also increases. A **refractometer** is an instrument that measures the angle of refraction through a sample of liquid; and, hence, is commonly used to assess the amount of sugar in grapes. The most common refractometers used by winemakers have their optical displays calibrated in units known as **Brix** (1 Brix = 1g of sugar per 100 mg of solution ≈ 1% sugar concentration).

Refractometers with automatic temperature compensation (ATC) are accurate, relatively inexpensive and easy to use. It comes as a surprise to many veteran winemakers that a refractometer can also be used to monitor the progress of a fermentation from start to finish – just like their trusty hydrometer. The historical preference for using a hydrometer stems from the fact that Brix refractometers are NOT calibrated to account for the interfering effects of ever increasing alcohol levels as fermentation moves towards its end point. That is, the observed Brix reading made with a refractometer is the direct result of the change in the refractive index of the wine. However, <u>two opposing processes</u> are responsible for determining the change in the refractive index of the wine: (1) The reduction in the concentration of sugars due to yeast metabolism acts to reduce the refractive index of the wine. At the same time, however, (2) the increasing concentration of alcohol acts to increase the refractive index of the wine (albeit at a different rate than the effects of the changing level of sugar). These opposing influences on wine's ability to refract light as the fermentation process progresses are depicted in Figure 1.

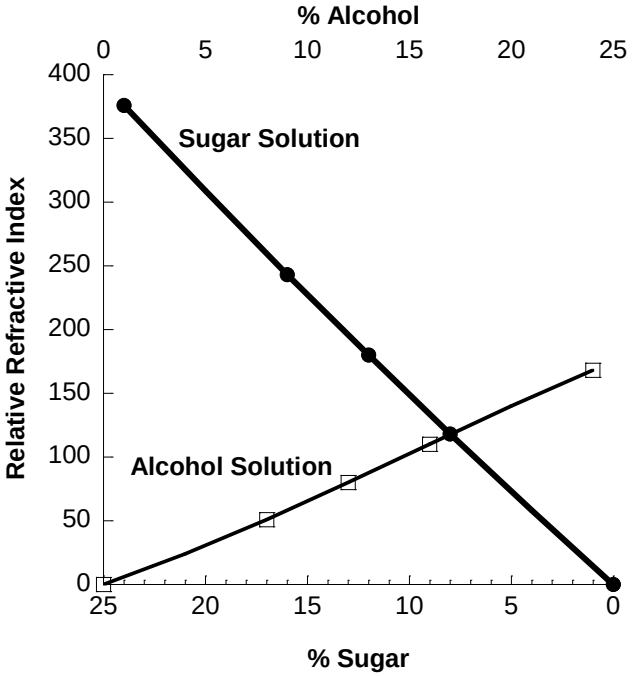

Figure 1. Relative contributions to the refractive index of wine due to the opposing influences of sugar depletion and alcohol accumulation during fermentation.

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Because these opposing influences on the refractive index of wine are so lawful, it should be possible to derive an equation to "correct" a refractometer Brix reading for the effects of alcohol. Indeed, the folks at Valley Vintner have developed an Excel spreadsheet which can be used to apply such a compensatory model. A web page describing the equations together with a link to the spreadsheet can be found at http://valleyvintner.com/Refrac_Hydro/Refract_Hydro.htm.

Hence, armed with your refractometer and the Valley Vintner spreadsheet you can accurately estimate the specific gravity and "true" Brix of your fermentation using just a few drops of your precious wine. The only catch is that you need to make sure that you measure and save the original (or starting) Brix level made prior to pitching the yeast.

Since I often spend many hours at a time in my wine cellar and find it inconvenient to climb two flights of stairs to access the computer in my home office, I have prepared a two page table that allow me to convert my original Brix and current refractometer Brix readings into corrected estimates of specific gravity and "true" Brix. Use this table as follows: (1) measure and record the **original Brix** prior to pitching the yeast, (2) find the table column designated for your original brix level, (3) measure the current Brix (RBRIX) with your refractometer and (4) lookup the specific gravity (SG) and "true" Brix estimates in the appropriate row for the current RBRIX value. If you use a disposable transfer pipette to collect your wine sample, you can maintain the ultimate level of sanitation in your wine making endeavors.

The Equations

```
%estimate SG using current (rbrix) and original brix (obrix) readings
sg=1.001843-(0.002318474*obrix)-(0.000007775*(obrix^2))-
   (0.000000034*(obrix^3))+(0.00574*(rbrix))+(0.00003344*(rbrix^2))
   +(0.000000086*(rbrix^3));

%calculate true brix using estimated SG value
tbrix=-676.67+(1286.4*sg)-(800.47*(sg^2))+(190.74*(sg^3));
```

Notes

These equations are used in the spreadsheet implemented by Valley Vintner and can also be found at http://www.primetab.com/formulas. Unfortunately, I have been unable to track them down to an original source. Nonetheless, special thanks to their creator even if it must be anonymous.

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Original Brix

	15		16		17		18		19		20		21	
RBRIX	SG	BRIX	SG	BRIX	SG	BRIX	SG	BRIX	SG	BRIX	SG	BRIX	SG	BRIX
21.0	-----	---	-----	---	-----	---	-----	---	-----	---	-----	---	1.085	20.5
20.5	-----	---	-----	---	-----	---	-----	---	-----	---	-----	---	1.082	19.7
2---	-----	---	-----	---	-----	---	-----	---	-----	---	1.081	19.5	1.078	18.9
19.5	-----	---	-----	---	-----	---	-----	---	-----	---	1.077	18.7	1.075	18.1
19.0	-----	---	-----	---	-----	---	-----	---	1.076	18.5	1.074	17.9	1.071	17.2
18.5	-----	---	-----	---	-----	---	-----	---	1.073	17.7	1.070	17.0	1.068	16.4
18.0	-----	---	-----	---	-----	---	1.072	17.5	1.069	16.8	1.067	16.2	1.064	15.6
17.5	-----	---	-----	---	-----	---	1.069	16.7	1.066	16.0	1.063	15.4	1.061	14.8
17.0	-----	---	-----	---	1.068	16.5	1.065	15.9	1.062	15.2	1.060	14.6	1.057	14.0
16.5	-----	---	-----	---	1.064	15.7	1.062	15.1	1.059	14.4	1.056	13.8	1.054	13.2
16.0	-----	---	1.063	15.5	1.061	14.9	1.058	14.2	1.056	13.6	1.053	13.0	1.050	12.4
15.5	-----	---	1.060	14.7	1.057	14.1	1.055	13.4	1.052	12.8	1.049	12.2	1.047	11.6
15.0	1.059	14.5	1.057	13.9	1.054	13.3	1.051	12.6	1.049	12.0	1.046	11.4	1.043	10.8
14.5	1.056	13.7	1.053	13.1	1.051	12.5	1.048	11.8	1.045	11.2	1.043	10.6	1.040	9.9
14.0	1.052	12.9	1.050	12.3	1.047	11.7	1.045	11.0	1.042	10.4	1.039	9.8	1.037	9.1
13.5	1.049	12.1	1.046	11.5	1.044	10.9	1.041	10.2	1.039	9.6	1.036	9.0	1.033	8.3
13.0	1.046	11.3	1.043	10.7	1.040	10.1	1.038	9.4	1.035	8.8	1.033	8.2	1.030	7.5
12.5	1.042	10.5	1.040	9.9	1.037	9.3	1.035	8.6	1.032	8.0	1.029	7.3	1.027	6.7
12.0	1.039	9.7	1.036	9.1	1.034	8.5	1.031	7.8	1.029	7.2	1.026	6.5	1.023	5.9
11.5	1.036	8.9	1.033	8.3	1.031	7.7	1.028	7.0	1.025	6.4	1.023	5.7	1.020	5.1
11.0	1.033	8.1	1.030	7.5	1.027	6.9	1.025	6.2	1.022	5.6	1.019	4.9	1.017	4.2
10.5	1.029	7.3	1.027	6.7	1.024	6.1	1.021	5.4	1.019	4.8	1.016	4.1	1.013	3.4
10.0	1.026	6.6	1.023	5.9	1.021	5.3	1.018	4.6	1.016	4.0	1.013	3.3	1.010	2.6
9.5	1.023	5.8	1.020	5.1	1.018	4.5	1.015	3.8	1.012	3.2	1.010	2.5	1.007	1.8
9.0	1.020	5.0	1.017	4.3	1.014	3.7	1.012	3.0	1.009	2.3	1.007	1.7	1.004	1.0
8.5	1.016	4.2	1.014	3.5	1.011	2.9	1.009	2.2	1.006	1.5	1.003	0.9	1.001	0.2
8.0	1.013	3.4	1.011	2.7	1.008	2.1	1.005	1.4	1.003	0.7	1.000	0.1	0.998	-0.6
7.5	1.010	2.6	1.008	1.9	1.005	1.3	1.002	0.6	1.000	-0.1	0.997	-0.8	0.994	-1.5
7.0	1.007	1.8	1.004	1.1	1.002	0.5	0.999	-0.2	0.997	-0.9	0.994	-1.6	0.991	-2.3
6.5	1.004	1.0	1.001	0.4	0.999	-0.3	0.996	-1.0	0.993	-1.7	0.991	-2.4	0.988	-3.1
6.0	1.001	0.2	0.998	-0.4	0.996	-1.1	0.993	-1.8	0.990	-2.5	0.988	-3.2	0.985	-3.9
5.5	0.998	-0.6	0.995	-1.2	0.993	-1.9	0.990	-2.6	0.987	-3.3	0.985	-4.0	0.982	-4.7
5.0	0.995	-1.4	0.992	-2.0	0.990	-2.7	0.987	-3.4	0.984	-4.1	0.982	-4.8	0.979	-5.5
4.5	0.992	-2.2	0.989	-2.8	0.987	-3.5	0.984	-4.2	0.981	-4.9	0.979	-5.6	0.976	-6.3
4.0	0.989	-2.9	0.986	-3.6	0.984	-4.3	0.981	-5.0	0.978	-5.7	0.976	-6.4	0.973	-7.2
3.5	0.986	-3.7	0.983	-4.4	0.981	-5.1	0.978	-5.8	0.975	-6.5	0.973	-7.2	0.970	-8.0
3.0	0.983	-4.5	0.980	-5.2	0.978	-5.9	0.975	-6.6	0.972	-7.3	0.970	-8.0	0.967	-8.8
2.5	0.980	-5.3	0.977	-6.0	0.975	-6.7	0.972	-7.4	0.969	-8.1	0.967	-8.9	0.964	-9.6

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Original Brix

	22		23		24		25		26		27		28	
RBRIX	SG	BRIX	SG	BRIX	SG	BRIX	SG	BRIX	SG	BRIX	SG	BRIX	SG	BRIX
28.0	-----	---	-----	---	-----	---	-----	---	-----	---	-----	---	1.119	27.7
27.5	-----	---	-----	---	-----	---	-----	---	-----	---	-----	---	1.115	26.9
27.0	-----	---	-----	---	-----	---	-----	---	-----	---	1.114	26.7	1.111	26.1
26.5	-----	---	-----	---	-----	---	-----	---	-----	---	1.110	25.9	1.107	25.3
26.0	-----	---	-----	---	-----	---	-----	---	1.109	25.6	1.106	25.0	1.103	24.4
25.5	-----	---	-----	---	-----	---	-----	---	1.105	24.8	1.102	24.2	1.100	23.6
25.0	-----	---	-----	---	-----	---	1.104	24.6	1.101	24.0	1.099	23.4	1.096	22.8
24.5	-----	---	-----	---	-----	---	1.100	23.8	1.098	23.2	1.095	22.6	1.092	21.9
24.0	-----	---	-----	---	1.099	23.6	1.097	23.0	1.094	22.3	1.091	21.7	1.088	21.1
23.5	-----	---	-----	---	1.096	22.7	1.093	22.1	1.090	21.5	1.087	20.9	1.085	20.3
23.0	-----	---	1.095	22.5	1.092	21.9	1.089	21.3	1.086	20.7	1.084	20.1	1.081	19.4
22.5	-----	---	1.091	21.7	1.088	21.1	1.086	20.5	1.083	19.9	1.080	19.2	1.077	18.6
22.0	1.090	21.5	1.087	20.9	1.085	20.3	1.082	19.7	1.079	19.0	1.076	18.4	1.073	17.8
21.5	1.086	20.7	1.084	20.1	1.081	19.5	1.078	18.8	1.075	18.2	1.073	17.6	1.070	16.9
21.0	1.083	19.9	1.080	19.3	1.077	18.7	1.075	18.0	1.072	17.4	1.069	16.8	1.066	16.1
20.5	1.079	19.1	1.076	18.5	1.074	17.8	1.071	17.2	1.068	16.6	1.065	15.9	1.063	15.3
20.0	1.076	18.3	1.073	17.6	1.070	17.0	1.067	16.4	1.065	15.7	1.062	15.1	1.059	14.4
19.5	1.072	17.4	1.069	16.8	1.067	16.2	1.064	15.6	1.061	14.9	1.058	14.3	1.055	13.6
19.0	1.068	16.6	1.066	16.0	1.063	15.4	1.060	14.7	1.057	14.1	1.055	13.4	1.052	12.8
18.5	1.065	15.8	1.062	15.2	1.059	14.5	1.057	13.9	1.054	13.3	1.051	12.6	1.048	11.9
18.0	1.061	15.0	1.059	14.4	1.056	13.7	1.053	13.1	1.050	12.4	1.048	11.8	1.045	11.1
17.5	1.058	14.2	1.055	13.5	1.052	12.9	1.050	12.3	1.047	11.6	1.044	10.9	1.041	10.3
17.0	1.054	13.4	1.052	12.7	1.049	12.1	1.046	11.4	1.043	10.8	1.041	10.1	1.038	9.4
16.5	1.051	12.6	1.048	11.9	1.045	11.3	1.043	10.6	1.040	9.9	1.037	9.3	1.034	8.6
16.0	1.047	11.7	1.045	11.1	1.042	10.4	1.039	9.8	1.036	9.1	1.034	8.4	1.031	7.7
15.5	1.044	10.9	1.041	10.3	1.039	9.6	1.036	8.9	1.033	8.3	1.030	7.6	1.027	6.9
15.0	1.041	10.1	1.038	9.4	1.035	8.8	1.032	8.1	1.030	7.4	1.027	6.8	1.024	6.1
14.5	1.037	9.3	1.035	8.6	1.032	8.0	1.029	7.3	1.026	6.6	1.023	5.9	1.021	5.2
14.0	1.034	8.5	1.031	7.8	1.028	7.1	1.026	6.5	1.023	5.8	1.020	5.1	1.017	4.4
13.5	1.031	7.7	1.028	7.0	1.025	6.3	1.022	5.6	1.020	4.9	1.017	4.2	1.014	3.5
13.0	1.027	6.8	1.024	6.2	1.022	5.5	1.019	4.8	1.016	4.1	1.013	3.4	1.011	2.7
12.5	1.024	6.0	1.021	5.3	1.018	4.7	1.016	4.0	1.013	3.3	1.010	2.6	1.007	1.9
12.0	1.021	5.2	1.018	4.5	1.015	3.8	1.012	3.1	1.010	2.4	1.007	1.7	1.004	1.0
11.5	1.017	4.4	1.015	3.7	1.012	3.0	1.009	2.3	1.006	1.6	1.003	0.9	1.001	0.2
11.0	1.014	3.6	1.011	2.9	1.009	2.2	1.006	1.5	1.003	0.8	1.000	0.1	0.997	-0.7
10.5	1.011	2.7	1.008	2.1	1.005	1.4	1.003	0.7	1.000	-0.1	0.997	-0.8	0.994	-1.5
10.0	1.008	1.9	1.005	1.2	1.002	0.5	0.999	-0.2	0.997	-0.9	0.994	-1.6	0.991	-2.4
9.5	1.004	1.1	1.002	0.4	0.999	-0.3	0.996	-1.0	0.993	-1.7	0.991	-2.5	0.988	-3.2
9.0	1.001	0.3	0.998	-0.4	0.996	-1.1	0.993	-1.8	0.990	-2.6	0.987	-3.3	0.985	-4.0
8.5	0.998	-0.5	0.995	-1.2	0.993	-1.9	0.990	-2.7	0.987	-3.4	0.984	-4.1	0.981	-4.9
8.0	0.995	-1.3	0.992	-2.1	0.989	-2.8	0.987	-3.5	0.984	-4.2	0.981	-5.0	0.978	-5.7
7.5	0.992	-2.2	0.989	-2.9	0.986	-3.6	0.983	-4.3	0.981	-5.1	0.978	-5.8	0.975	-6.6
7.0	0.989	-3.0	0.986	-3.7	0.983	-4.4	0.980	-5.2	0.978	-5.9	0.975	-6.7	0.972	-7.4
6.5	0.985	-3.8	0.983	-4.5	0.980	-5.2	0.977	-6.0	0.974	-6.7	0.972	-7.5	0.969	-8.3
6.0	0.982	-4.6	0.980	-5.3	0.977	-6.1	0.974	-6.8	0.971	-7.6	0.969	-8.3	0.966	-9.1
5.5	0.979	-5.4	0.977	-6.2	0.974	-6.9	0.971	-7.6	0.968	-8.4	0.966	-9.2	0.963	-9.9