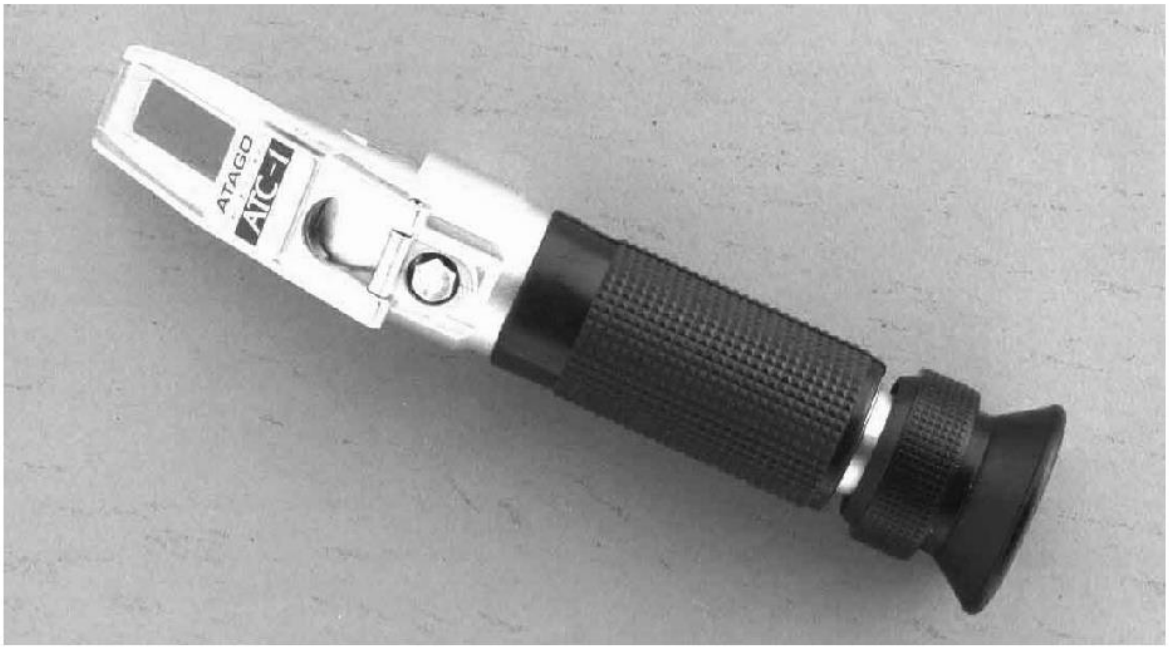
Refractometer



Manual

STEP Systems GmbH
Soil Testing Equipment - Professional Systems

Duisburger Str. 44
Tel: ++49 (0) 911 96 26 05-0
Fax: ++49 (0) 911 96 26 05-9
D-90451 Nürnberg
e-mail: info@stepsystems.de
www.stepsystems.de

Refractometer

The **refractometer** is a measuring device for determining of refractive index of optical media by means of refraction or the total reflection of light.

Other devices determining ripeness of wine, original extract of beer, water content of honey, frost protection of coolant or the specific gravity of the electrolyte of a battery, for example, operate on the same principle. Refractometer can also be used to measure proportion of dissolved substances, eg. sea water salinity, or to determine correction lenses for a human eye.

Refraction refers to the change in direction of a wave due to a local change in its propagation speed caused by - in contrast to diffraction - a change in the absorbance (optical density) of the propagation medium.

Brix Degree (°Brix, Brix, % Brix) is a measurement value for specific density of liquids.

It is mainly used in the fruit industry, in English-speaking countries however, also for determining the must weight in winemaking. So for fruit juices, drinks and generally for sugary products. Since in addition to water they mainly contain various sugars (eg, glucose, fructose, sucrose), its density gives rough estimate of its sugar content.

The value was named after the Austrian-German scientist Adolf F. Brix (1798-1870), who developed it in 1870.

A liquid has one Brix degree (= 1% Brix) if it has the same density as a solution of 1 g sucrose in 100 g water, it has 10 Brix (= 10% Brix) when its density corresponds to a solution of 10 g sucrose in 100 g water.

Sucrose solution here is only the reference substance, the liquid being examined need not necessarily contain sucrose.

1° Brix = 1° Balling = 4° Oe (approximate calculation)

Degrees Oechsle is a measurement value of the must weight of wine and is based on the must density. It is common, especially in Germany, Switzerland and Luxembourg; in Austria must weight is measured in Klosterneuburger sugar degrees.

The amount of must weight in °Oe can be obtained from the must density ρ, being measured at 20°C, by the formula $\rho - 1000\ \mathrm{g/l}$. Therefore, a must with the density of 1083 g/l has 83° Oechsle. The Oechsle scale is named after its inventor Ferdinand Oechsle, mechanic from Pforzheim.

Must weight is measured by a special wine scale, which is a calibrated in °Oechsle hydrometer. Alternatively, sugar concentration of the must can also be measured visually by a refractometer.

With the help of the must weight one can determine an estimated alcohol content of the wine (when the wine is fermented, which means all the sugar in wine has been converted into alcohol).

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Refractometer

A quality statement about the finished wine arises only partly from the Oechsle value: a higher sugar content in the must suggests a better ripening of the grapes, the decisive factor however is what the vineyard or cellar master makes of it. A must with 80° Oechsle yields 84 grams of pure alcohol per liter, which corresponds to an alcohol content of 10.6% by volume. Sweet late vintages can reach over 300° Oechsle. In general, the must weight of an average vintage in Germany is between 70 and 80° Oechsle.

Klosterneuburger Sugar Degree

The **Klosterneuburger Sugar Degree (°KMW)** shows sugar content of grape must in percent by weight. The name comes from the wine scale (**M**ost**w**aage), developed in 1861 by Baron August Wilhelm von Babo at the Wine School of Klosterneuburg.

The Klosterneuburger sugar degrees are applied especially in Austria.

1° KMW corresponds to about 5° Oechsle. The exact conversion is done by the formula (0.022 x ° KMW + 4.54) x °KMW = °Oechsle

Must weight describes the specific weight (density) of grape must, ie. the mass of the must in proportion to its volume. It serves as an indicator of the expected alcohol content of the wine after complete fermentation of sugar. Hence, the *must weight* is also commonly referred to as *gradation* or *alcoholic potency*.

Must weight is thus a measure of the proportion of all solved substances in grape must. These are also known as the *extract*. This extract consists mainly of sugar (dextrose and fructose), acids, glycerin and in small quantities of phenols, pectins, proteins and minerals. Due to the high sugar content, the mass of must is always higher than that of water, ie. the specific weight of grape must is always higher than 1.

The must density can be determined by various physical methods. These include:

- buoyancy of a hydrometer or a hydrostatic balance (hydrometer)
- weighing of mass based on the volume by pycnometer
- measurement of light refraction by refractometer

In addition to different measuring methods, there are also various measurement scales and thus various units used in different countries. In Germany, Luxembourg and Switzerland, for example, the must weight is measured in degrees Oechsle. In Italy, Austria, Hungary, Slovakia and the states of former Yugoslavia measurement in *KMW*, or *degrees Babo*, is widely spread.

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Refractometer

Degrees Baumé are used in France and Spain. *Brix*, or the almost identical unit *Balling*, are mainly applied in English-speaking countries. These units can be mutually converted only by rather complicated formulas, since their relationships to each other are not linear. For this reason, tables are usually used, from which the values can be read accurately enough (see table below).

As a general rule, one can say that 10 grams of sugar per 1000 grams of fermented must yield 0.66% vol. alcohol.

Must weight is an important factor for determining the time of grape harvest. In Germany, Austria and Switzerland the must weight, over the wine law, forms the basis for the classification of wines in quality classes. For each of these classes a so-called *minimum must weight* is provided, which has to be exceeded. However, especially in warm wine regions the must weight alone means very little. Based only on the must weight, simple French country wines would already belong to the best in Germany. Italian Amarone from Valpolicella (wine) would then be considered as a vintage wine of selected grapes (Beerenauslese). Therefore, in warm wine regions also the acid, the pH and the physiological maturity are used for classification of wine into quality classes.

Density	**Oechsle**	**KMW/Babo**	**Brix/Balling**	**Baumé**	**pot. alcohol content**
g/l	*Oe*	*KMW*	*Bx*	*Bé*	*vol-%*
1060	60	12	14,7	8,1	8,1
1065	65	13	15,9	8,8	8,8
1070	70	14	17,1	9,4	9,4
1075	75	15	18,2	10,1	10,1
1080	80	16	19,2	10,7	10,7
1085	85	17	20,3	11,3	11,3
1090	90	18	21,4	11,9	11,9
1095	95	19	22,4	12,5	12,5
1100	100	20	23,6	13,1	13,1
1105	105	21	24,7	13,7	13,7
1110	110	22	25,7	14,3	14,3
1115	115	23	26,8	14,9	14,9
1120	120	24	27,8	15,5	15,5
1125	125	25	28,9	16,9	16,9

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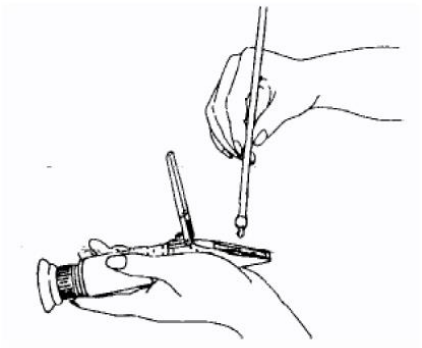
Refractometer

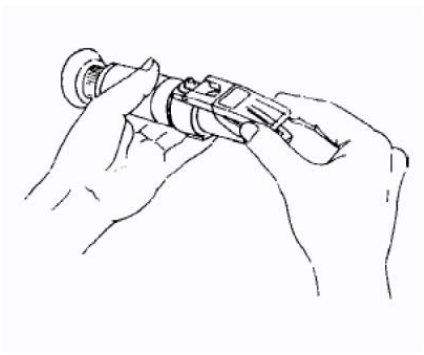
Using a refractometer for determination of sugar content

1.



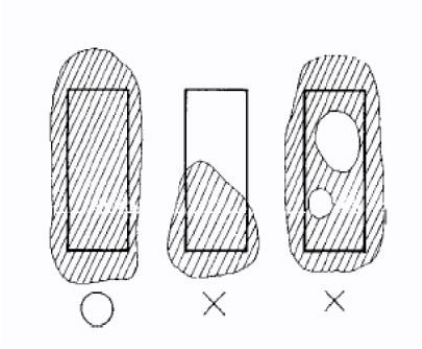
Apply two or three drops of sample fluid

2.



Close the prism cap

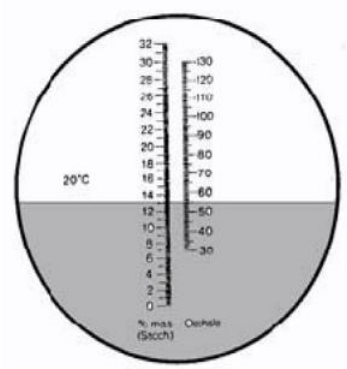
3.



The sample must be evenly distributed
over the prism surface.
Uneven distribution causes measuring error!

4.

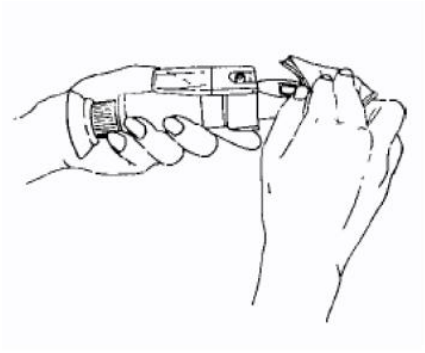
5.



Look through the eyepiece, focus if necessary.
Read position of the white/blue border as
measuring result.

Atago Co.,Ltd.,Japan, Instruction Manual Refractometer ATC-1

6.



After each measurement clean the prism flap
and the prism first with a damp and then with a dry
cloth. Immediate cleaning prevents that the sample
acts on the measuring prism longer time and
attacks the mirror polish.

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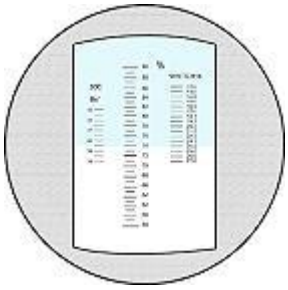
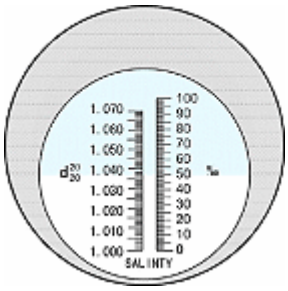
Refractometer

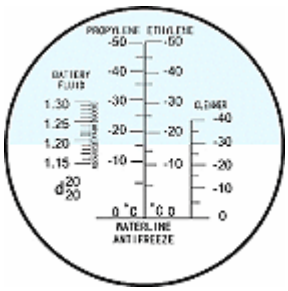
Below you will find scales of various refractometers. If you require any of these models, please feel free to contact us.



Refractometer for beekeeper



Refractometer for salinity



Refractometer for frost protection

It is no problem to determine concentrations of other suspensions or aqueous solutions (eg color suspension) by means of the refractometer. You need to measure a sample from the liquid using a refractometer only once. The result is 12.9% Brix, for example. Then you make a dry sample of the same substance in a drying oven or a chemical analysis in the laboratory. The result is here 8.2% solids content, for example. Now divide both results, the factor is 1.57. Now you have the correlation of the refractometer to the laboratory result. Now, if you measure with a refractometer in the process or in the field, you only need the values to be divided by 1.57 and you get the actual laboratory value.

The measure of the soluble solids in a liquid (and therefore approximately the sugar content) is usually given in "degrees Brix" (°Brix). Indirectly the measure shows thereby an objective value of the fruit ripeness degree. In the meantime, some EC marketing standards (eg for kiwis and melons) define, that "sufficiently ripe" fruits in terms of the standard must display certain Brix values. The EC marketing standards for kiwis, melons and watermelons acquire explicitly refractometer measurement of Brix value as a base for determination of the harvest maturity of the fruit.

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Refractometer

Table of recommended values (in % Brix) for maturity determination (approximate figures)

Quality	Bad	Medium	Good	Excellent
		Fruits		
Strawberry	8	12	16	18
Apple	6	10	14	18
Blueberry	4	8	16	22
Blackberry	6	8	12	14
Cantaloupe	8	12	14	18
Honeydew melon	8	10	14	16
Water melon	8	12	16	18
Grape	8	12	18	22
Raspberry	6	8	12	14
Cherry	6	8	14	16
Pear	6	10	14	16
Orange	6	10	16	20
		Vegetables		
Potatoe	3	5	7	10
Endives	4	6	10	12
Asparagus	4	6	8	10
Beans	4	8	10	12
Broccoli	6	8	10	12
Field peas	4	6	10	12
Marrow peas	8	10	12	14
Cualiflower	4	6	8	10
Cabbage	6	10	12	14
Turnip	4	6	8	10
Kohlrabi	6	8	10	12
Red beet	6	8	12	14
Maize	6	10	18	24
Sweetcorn	6	10	18	24
Paprika	4	6	8	12
Hot pepper	4	6	8	10
Parsley	4	6	8	10
Celery	4	6	10	12
Salad	4	6	8	10
Tomatoe	4	6	10	14
Onion	4	6	10	12
Carrot	4	8	14	18

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Refractometer

Refractometrical calculation of the alcohol content in the must.

With the refractometer you can indirectly determine the potential alcoholic strength by determining the sugar content of the must.

The higher the sugar content of the must, the higher its density. This means that the light beam has low speed and deviation. This deviation depends on the sugar concentration and other soluble agents, so that the higher the concentration is, the larger the deviation of the incident light beam and vice versa. The refractometer allows the examination of the relationship between the refraction degree and the sugar concentration in various units through the proper application of graduated scale.

Normally, temperature has an influence on the measuring result; our refractometers however have automatic temperature compensation. Thus, no corrections of the results are necessary. Note please that the sample to be measured should be in the temperature range around 20 °C. Avoid measurements of samples with the temperature of more than 30 ° C.

The alcohol content can be calculated by the following formula (valid for the range 15 ... 25 Brix.):

% vol = (0.6757 x ° Brix) – 2.0839

See table on page 4 of this manual.

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Fax: ++49 (0) 911 96 26 05-9
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