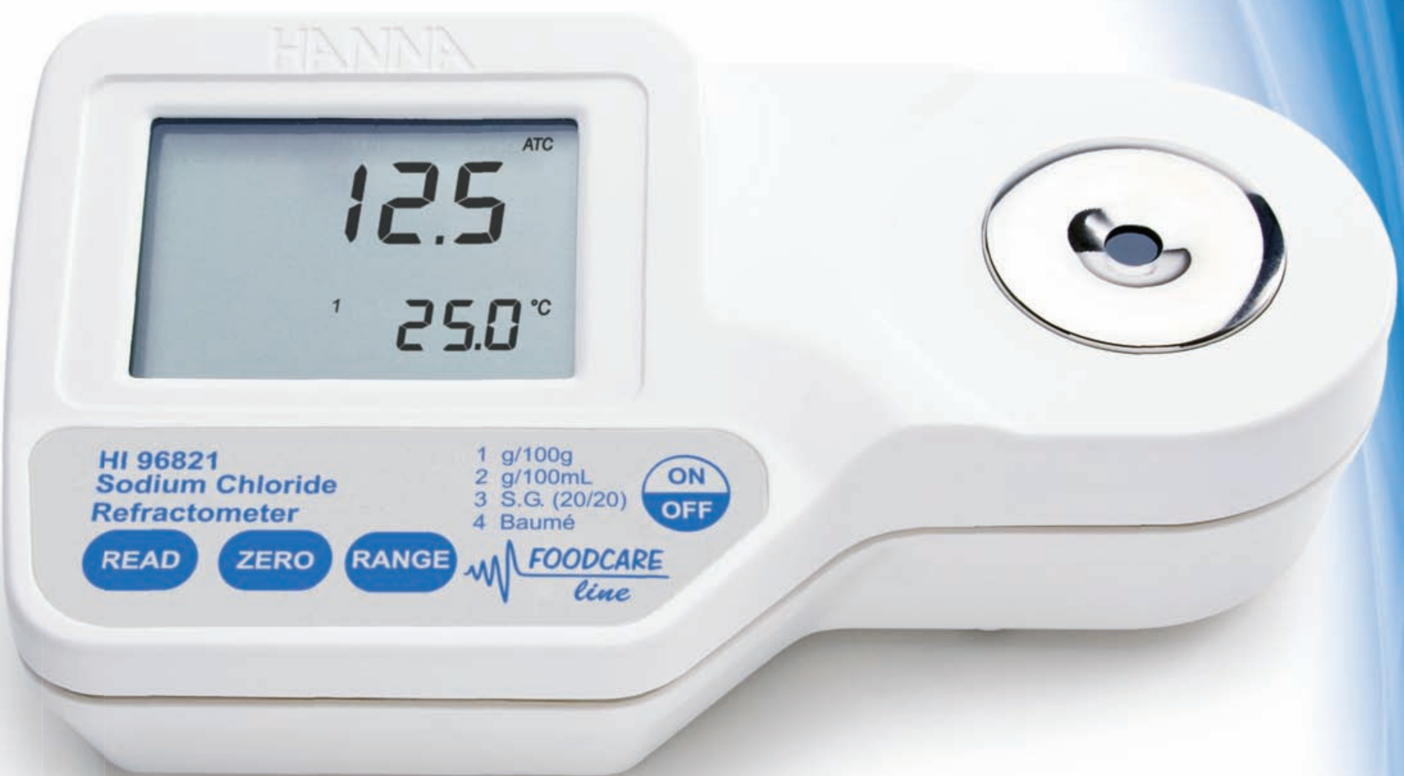

Digital Refractometers

Sugar Content • Sodium Chloride • Seawater Analysis • Glycol Content

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HANNA Digital Refractometers

Refractometry

Refractometry is the method of measuring a substances refractive index (one of their fundamental physical properties) in order to assess their composition or purity.

The refractive index of a substance is strongly influenced by temperature and the wavelength of light used to measure it, therefore, care must be taken to control or compensate for temperature differences and wavelength. The refractive index measurements are usually reported at a reference temperature of 20 degrees Celsius, which is equal to 68 degrees Fahrenheit, and considered to be room temperature.

A digital refractometer is an instrument used to measure the refractive index and to convert/compensate this information in specific units (depending by model).

Refractive Index

Determinations are made by measuring the refractive index of a solution. Refractive Index is an optical characteristic of a substance and the number of dissolved particles in it.

Refractive Index is defined as the ratio of the speed of light in empty space to the speed of light in the substance. A result of this property is that light will “bend”, or change direction, when it travels through a substance of different refractive index. This is called refraction.

When passing from a material with a higher to lower refractive index, there is a critical angle at which an incoming beam of light can no longer refract, but will instead be reflected off the interface.

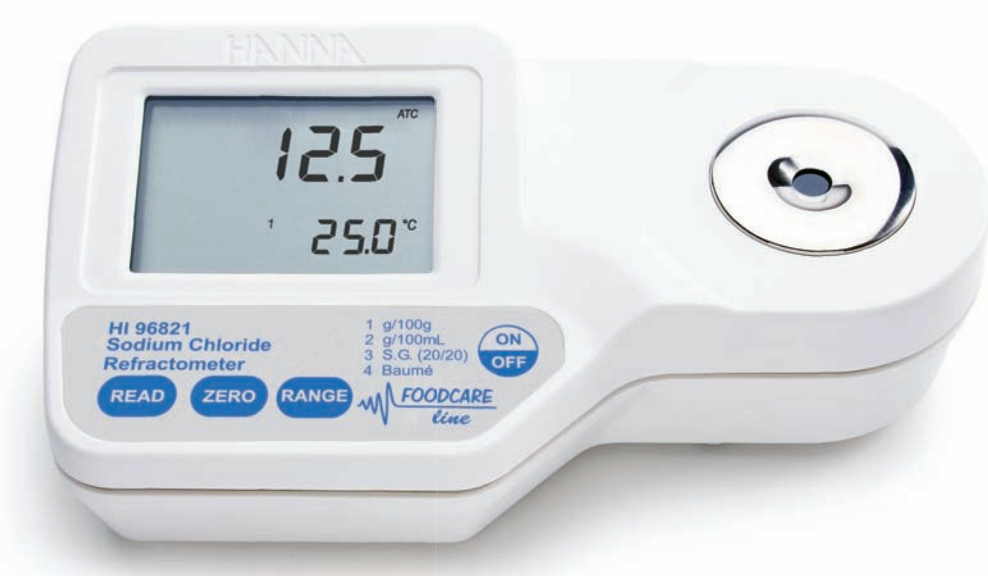
The critical angle can be used to easily calculate the refractive index according to the equation:

$$\sin (q_{critical}) = n_2 / n_1$$

Where n_2 is the refractive index of the lower-density medium; n_1 is the refractive index of the higher-density medium.

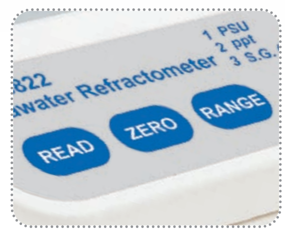
Light from an LED passes through a prism in contact with the sample.

An image sensor determines the critical angle at which the light is no longer refracted through the sample. Specialized algorithms then apply temperature compensation to the measurement and convert the refractive index to the specified parameter.



Battery life on display

Easy to clean stainless steel sample well



Easy measurement

- **Automatic Temperature Compensation**
  For exceptionally accurate measurements
- **Easy measurement**
  Place a few drops of the sample in the well and press the READ key
- **BEPS**
  (Battery Error Prevention System) alerts the user in the event that low battery power could adversely affect readings.
- **IP65 water protection**
  Built to perform under harsh laboratory and field conditions.
- **Single point calibration**
  Calibrate with distilled or deionized water
- **Stainless steel sample well**
  Easy to clean and corrosion resistant
- **ABS thermoplastic casing**
- **Start-up**
  When powered on the meter displays battery life and the set measurement units.
- **Unit selection**
  Pressing the RANGE key quickly cycles through the units of measurement (if applicable).
- **Calibration**
  Perform a quick and easy calibration after start-up with distilled or deionized water.

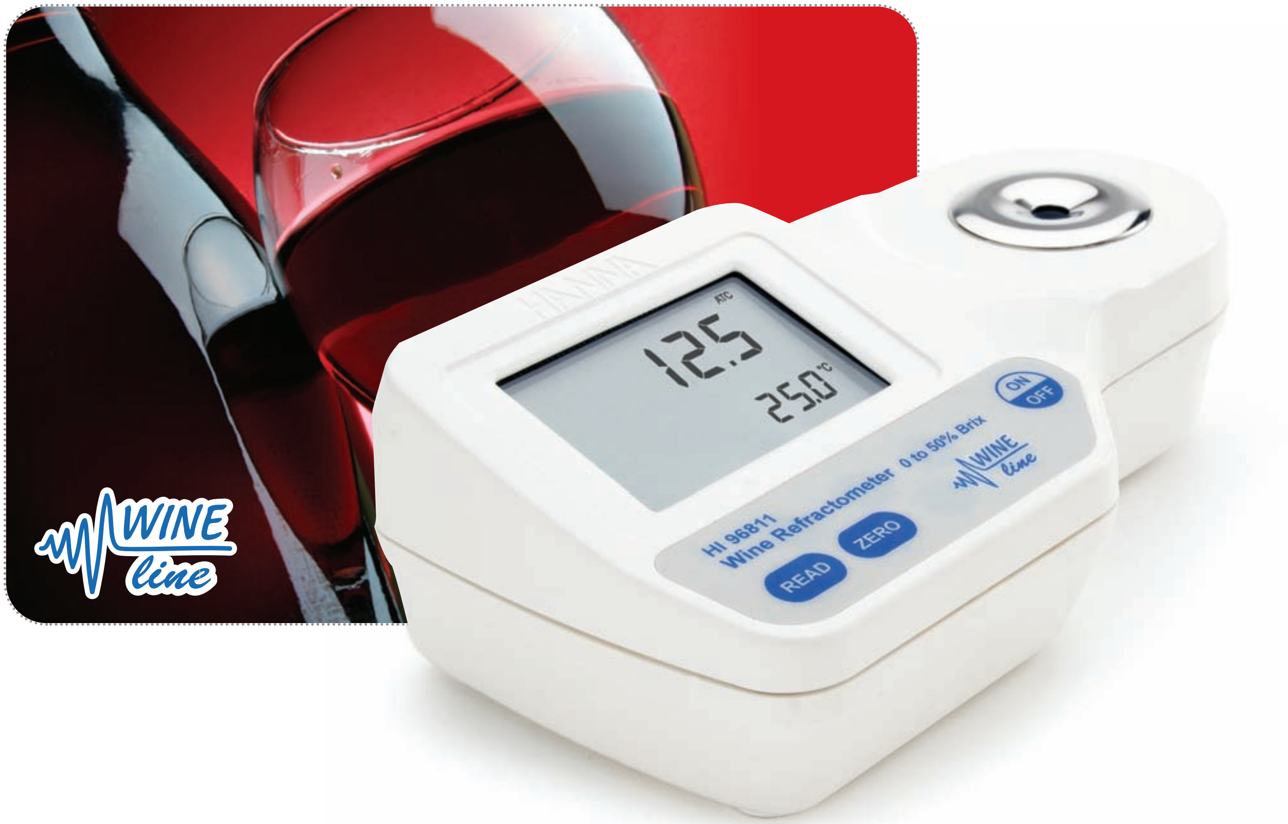
GENERAL SPECIFICATIONS	
Temperature Compensation	automatic between 0 and 40°C (32 to 104°F)
Measurement Time	approximately 1.5 seconds
Minimum Sample Volume	100 μL (to cover prism totally)
Light Source	yellow LED
Sample Cell	stainless steel ring and flint glass prism
Auto-off	after three minutes of non-use
Enclosure Rating	IP65
Battery Type / Battery Life	9V / approximately 5000 readings
Dimensions / Weight	192 x 104 x 69 mm (7.6 x 4.1 x 2.7”) / 420 g (14.8 oz.)

ORDERING INFORMATION

All Digital Refractometers are supplied with battery and instruction manual.

HI 96811 • HI 96812 • HI 96813 • HI 96814 • HI 96816

Digital Refractometers for Measurement of Sugar in Wine



HI 96811, **HI 96813** and **HI 96814** convert the refractive index of the sample to sucrose concentration in units of percent by weight, %Brix (also referred to as °Brix). The conversion used is based on the ICUMSA Methods Book (International Commission for Uniform Methods of Sugar Analysis). Since the majority of sugar in grape juice is fructose and glucose and not sucrose, the reading is sometimes referred to as “Apparent Brix”.

HI 96812 has units of °Baumé. The °Baumé scale is based on density and was originally designed to measure the mass of sodium chloride in water. °Baumé is used in wine making to measure the sugar in must. The HI 96812 converts the %Brix reading to °Baumé based on the table found in the Official Methods of Analysis of AOAC International, 18th Edition. 1 °Baumé is approximately equal to 1.8 %Brix, and 1 °Baumé is roughly equivalent to 1 % alcohol when the wine is fully fermented.

In addition to %Brix, HI 96814 includes two other scales used in the wine industry: °Oechsle and °KMW.

The **HI 96813** allows the user to tailor the instrument to their specific needs based on their experience, since no fixed conversion factor is universally applicable. The first conversion is based on the %Brix value and an adjustable conversion factor between 0.50 and 0.70 (0.55 is a common value).

Potential alcohol (% v/v) = (0.50 to 0.70) x % Brix

One drawback of the above equation is that it does not take into account the nonfermentable sugars and extract.

A second equation was also added that takes these factors into account and can give a more accurate estimate of the alcohol content in the finished wine. This conversion is named “C1” on the meter, and uses the following equation:

Potential Alcohol (%v/v) = 0.059 x [(2.66 x °Oe) - 30] (C1)

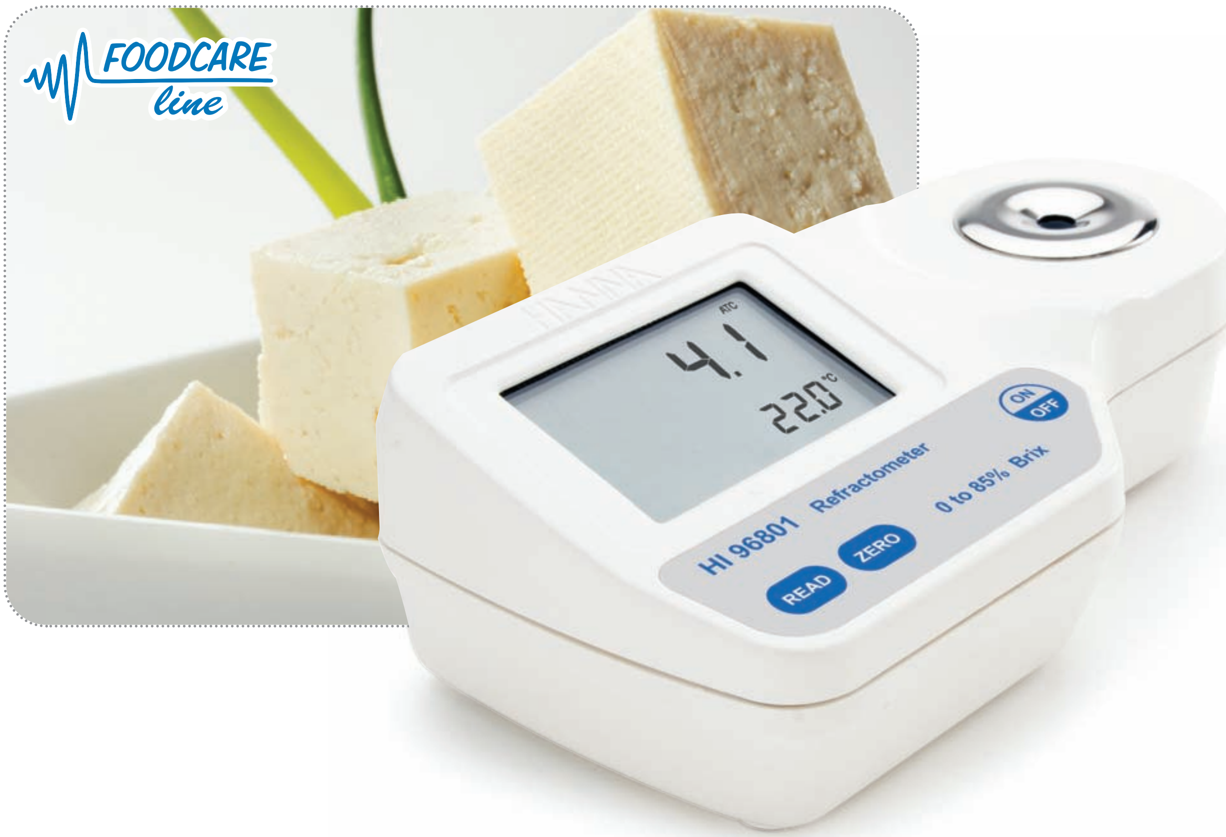
The **HI 96816** potential alcohol curve is based on the tables found in the European Economic Community Commission Regulation No 2676/90 of September 17, 1990, Determining Community Methods for the Analysis of Wine and International Organization of Vine and Wine (OIV). The potential alcohol curve is based on the following equation:

Potential alcohol (%v/v) = g/L of Sugar / 16.83

SPECIFICATIONS		HI 96811	HI 96812	HI 96813	HI 96814	HI 96816
Range	Sugar Content	0 to 50 % Brix	0 to 27 °Baumé	0 to 50 % Brix; 0.0-25.0 % V/V Potential Alcohol	0 to 50 % Brix; 0-230° Oechsle; 0-42° KMW	4.9 to 56.8 %v/v Potential Alcohol (10 to 75 %Brix)
	Temperature			0 to 80°C (32 to 176°F)		
Resolution	Sugar Content	0.1 % Brix	0.1 °Baumé	0.1 % Brix; 0.1 % V/V Potential Alcohol	0.1 % Brix; 1° Oechsle 0.1° KMW	0.1 %v/v
	Temperature			±0.1°C (0.1°F)		
Accuracy (@20°C/68°F)	Sugar Content	±0.2 % Brix	±0.1 °Baumé	±0.1 °Baumé; ±0.2 V/V Potential Alcohol	±0.2 % Brix; ±1° Oechsle ±0.1° KMW	±0.2 %v/v
	Temperature			±0.3°C (0.5°F)		

HI 96801 • HI 96802 • HI 96803 • HI 96804

Digital Refractometers for Sugar Analysis Throughout the Food Industry



HANNA offers four sugar refractometers to meet the requirements of the food industry. The HI 96801 Sucrose, HI 96802 Fructose, HI 96803 Glucose and HI 96804 Invert Sugar digital refractometers are rugged, portable and water resistant for measurements in the lab or field. Each instrument offers a specific analysis to determine accurate sugar concentration.

These optical instruments employ the measurement of the refractive index to determine parameters pertinent for sugar concentration analysis.

The actual measurement of refractive index is simple and quick and provides the operator a standard accepted method for sugar content analysis. Samples are measured after a simple user calibration with deionized or distilled water. Within seconds these instruments measure the refractive index of the sample and convert it to percent by weight concentration units (or %Brix for HI 96801). These digital refractometers eliminate the uncertainty associated with mechanical refractometers and are easily portable for measurements in the field.

These four instruments utilize internationally recognized references for unit conversion and temperature compensation and employ methodology recommended in the ICUMSA Methods Book (internationally recognized body for sugar analysis).

Temperature (in °C or °F) is displayed simultaneously with the measurement on the large dual level display along with icons for low power and other helpful messages.

Making a standard % Brix solution

To make a Brix Solution, follow the procedure below:

- Place container (such as a glass vial or dropper bottle that has a cover) on an analytical balance.
- Tare the balance.
- To make an X BRIX solution weigh out X grams of high purity sucrose (CAS #: 57-50-1) directly into the container.
- Add distilled or deionized water to the container so the total weight of the solution is 100 g.

Note: Solutions above 60 %Brix need to be vigorously stirred or shaken and heated in a water bath. Remove solution from bath when sucrose has dissolved. The total quantity can be scaled proportionally for smaller containers but accuracy may be sacrificed.

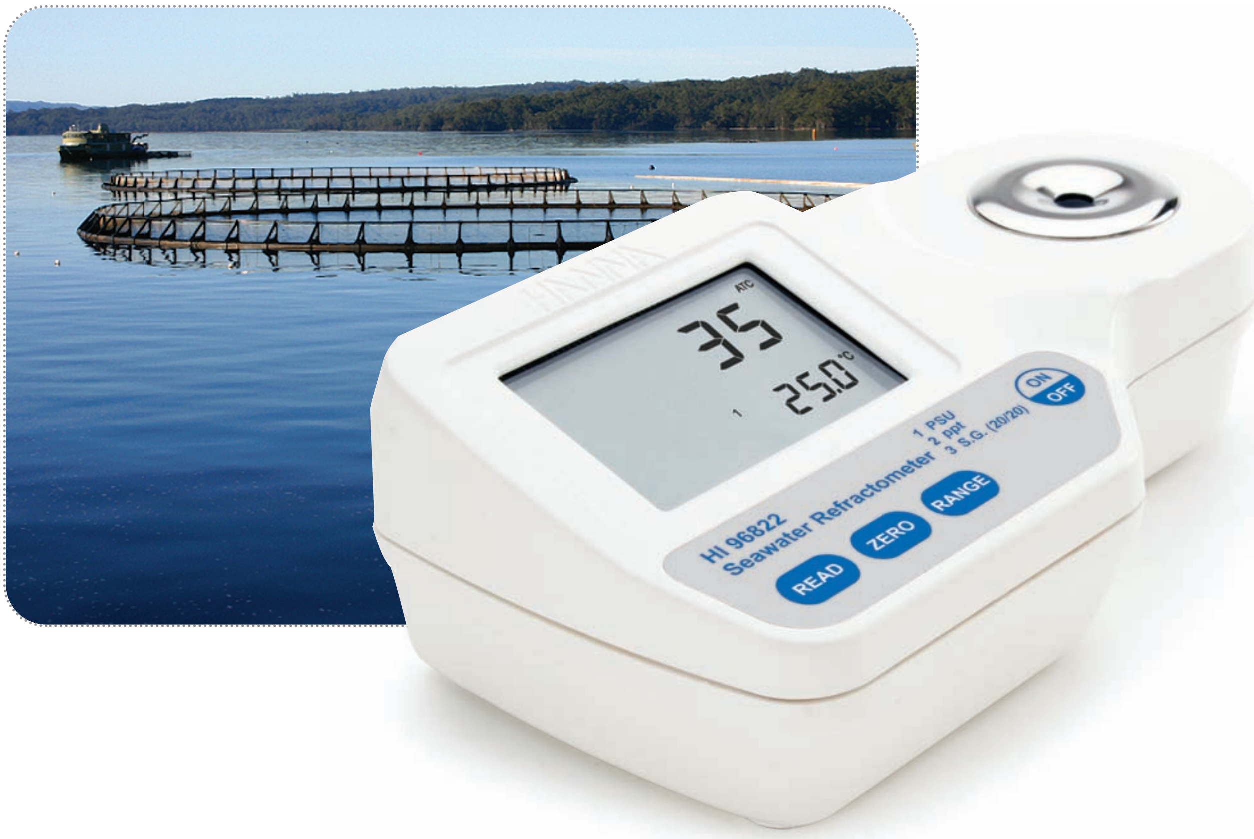
Example with 25 %Brix:

% Brix	25
g Sucrose	25.000
g Water	75.000
g Total	100.000

SPECIFICATIONS		HI 96801	HI 96802	HI 96803	HI 96804
Range	Sugar Content	0 to 85% Brix (% Brix)	0 to 85% (by weight) (% fructose)	0 to 85% (by weight) (% glucose)	0 to 85% (by weight) (% invert sugar)
	Temperature	0 to 80°C (32 to 176°F)			
Resolution	Sugar Content	0.1 % Brix	0.1	0.1	0.1
	Temperature	0.1°C (0.1°F)			
Accuracy (@20°C/68°F)	Sugar Content	±0.2% Brix	±0.2%	±0.2%	±0.2%
	Temperature	0.3°C (0.5°F)			

HI 96822

Digital Refractometer for Natural or Artificial Seawater Analysis



HANNA's HI 96822 Digital Refractometer is a rugged, portable, water resistant device that utilizes the measurement of the refractive index to determine the salinity of natural and artificial seawater, ocean water or brackish intermediates. The HI 96822 reflects HANNA's years of experience as a manufacturer of analytical instruments. This digital refractometer eliminates the uncertainty associated with mechanical refractometers and is durable and compact enough to be used at home, in the lab and out in the field.

The HI 96822 is an optical device that is quick and easy to use. After a simple user calibration with distilled or deionized water, a seawater sample can be introduced into the sample well.

Within seconds, the refractive index and temperature are measured and converted into one of 3 popular measurement units: Practical Salinity Units (PSU), salinity in parts per thousand (ppt), or specific gravity (S.G. (20/20)). All conversion algorithms are based upon respected scientific publications using the physical properties of seawater (not sodium chloride).

The Importance of Salinity Measurement Throughout a Variety of Applications

Salinity is a critical measurement in many applications, such as aquaculture, environmental monitoring, aquariums, desalination plants, well water, and many more. Until now, the available technology to measure salinity has relied on mechanical instruments, such as hydrometers and ocular refractometers, or on high-tech conductivity meters. While easy to use, ocular refractometers can be difficult to get a accurate reading from and are highly susceptible to changes in temperature. Hydrometers, though inexpensive, are clumsy and inaccurate. Conductivity meters that convert to salinity can be cost-prohibitive.

The HANNA HI 96822 is the solution to all these issues. It is lightweight, easy to use, cost-efficient, and is extremely accurate. With the ability to read in all the three of the most widely used salinity units (PSU, ppt, and specific gravity), it is the ideal instrument for any application.

Making a standard sodium chloride solution

Sodium Chloride solutions can be used to check the accuracy of the meter. The table below lists several Sodium Chloride solutions and there expected ppt Seawater value.

To make a Standard NaCl Solution (g/100 g), follow the procedure for the HI 96821.

	g of NaCl	g of Water	Total Weight	Expected ppt Seawater Value
5% NaCl	5.00	95.00	100.00	48
10% NaCl	10.00	90.00	100.00	96
15% NaCl	15.00	85.00	100.00	145

SPECIFICATIONS		HI 96822 Seawater
Range	**PSU**	0 to 50
	ppt	0 to 150
	Specific Gravity (20/20)	1.000 to 1.114
	Temperature	0 to 80°C (32 to 176°F)
Resolution	**PSU**	1
	ppt	1
	Specific Gravity (20/20)	0.001
	Temperature	0.1°C (0.1°F)
Accuracy (@20°C/68°F)	**PSU**	±2
	ppt	±2
	Specific Gravity (20/20)	±0.002
	Temperature	±0.3°C (0.5°F)

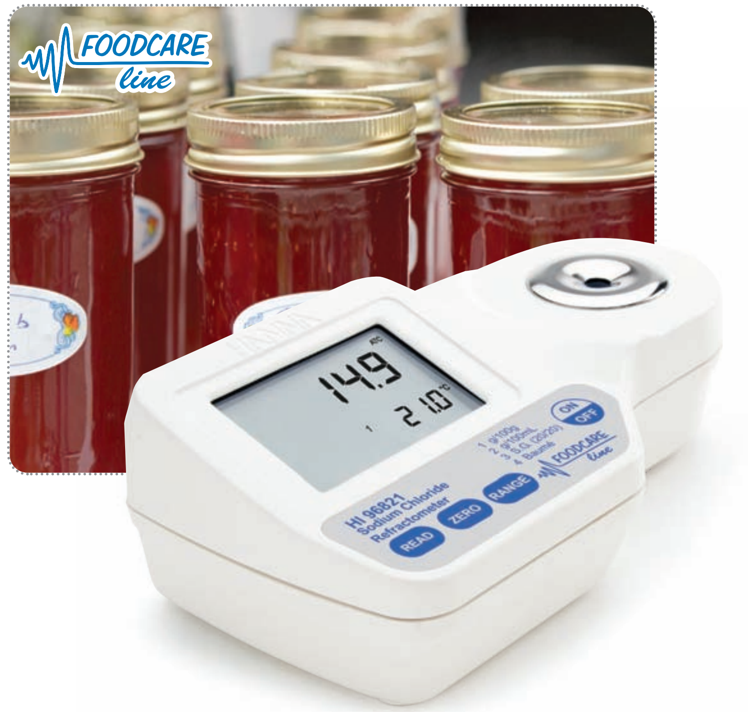
HI 96821

Digital Refractometer for Sodium Chloride Measurement for the Food Industry

HANNA offers the HI 96821 digital sodium chloride refractometer to meet the requirements of the food industry. This optical instrument employs the measurement of the refractive index to determine sodium chloride concentration in aqueous solutions used in food preparation. It is not intended for sea water salinity measurements.

Samples are measured after a simple user calibration with deionized or distilled water. Within seconds the instrument measures the refractive index of the solution. The digital refractometer eliminates the uncertainty associated with mechanical refractometers and is portable for measurements where you need them.

The instrument utilizes internationally recognized references for unit conversion and temperature compensation. It can display the measurement of NaCl concentration 4 different ways: g/100 g, g/100 mL, specific gravity, and °Baumé.



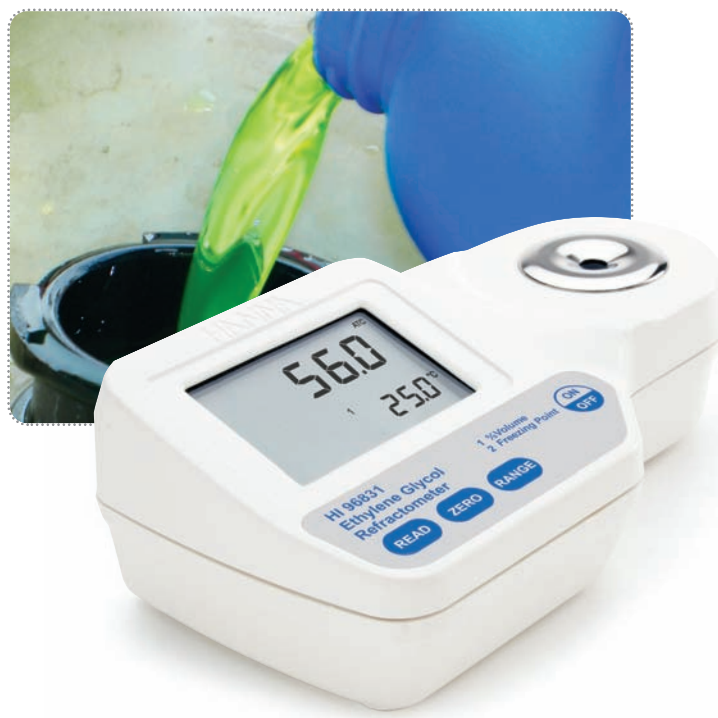
SPECIFICATIONS		HI 96831 Ethylene Glycol	HI 96832 Propylene Glycol
Range	% Volume	0 to 100 %	
	Freezing Point	0 to -50 °C (32 to -58 °F)	0 to -51 °C (32 to -59.8 °F)
	Temperature	0 to 80 °C (32 to 176 °F)	
Resolution	% Volume	0.1 %	
	Freezing Point	0.1 °C (0.1 °F)	
	Temperature	0.1 °C (0.1 °F)	
Accuracy (@20°C/68°F)	% Volume	±0.2 %	
	Freezing Point	±0.5 °C (±1.0 °F)	
	Temperature	±0.3 °C (±0.5 °F)	

HI 96831 • HI 96832

Digital Refractometer for Ethylene and Propylene Glycol Analysis

The HI 96831 Ethylene Glycol and HI 96832 Propylene Glycol Digital Refractometers are rugged, portable, water resistant devices that utilize the measurement of refractive index to determine the percent volume and freezing point of ethylene or propylene glycol based solutions.

These digital refractometers eliminate the uncertainty associated with mechanical refractometers. HI 96831 and HI 96832 samples are measured after a simple user calibration with distilled or deionized water. Within seconds, the refractive index and temperature are measured and converted into one of two measurement units; % volume or freezing point. These meters use internationally recognized references for unit conversion and temperature compensation for glycol solutions (e.g. CRC Handbook of Chemistry and Physics, 87th Edition).



SPECIFICATIONS		HI 96821 Sodium Chloride
Range	g/100 g	0 to 28
	g/100 mL	0 to 34
	Specific Gravity	1.000 to 1.216
	°Baumé	0 to 26
	Temperature	0 to 80°C (32 to 176°F)
Resolution	g/100 g	0.1
	g/100 mL	0.1
	Specific Gravity	0.001
	°Baumé	0.1
	Temperature	0.1°C (0.1°F)
Accuracy (@20°C/68°F)	g/100 g	±0.2
	g/100 mL	±0.2
	Specific Gravity	±0.002
	°Baumé	±0.2
	Temperature	±0.3°C (0.5°F)

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