

# Refractometers

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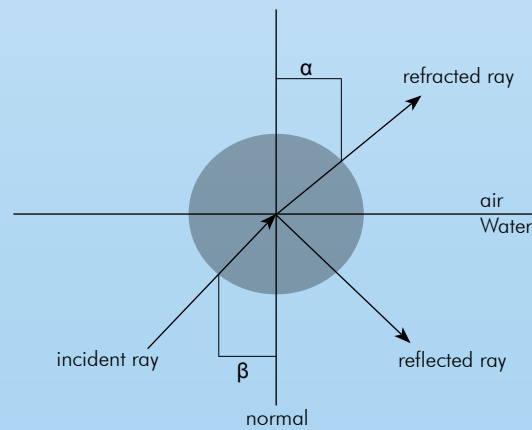
## What is Refractometry?

You've lost the key to your locker in the swimming pool. You spot it lying on the bottom of the shallow part of the pool, reach in to take it – and your hand misses. The refraction of light at the boundary of two different materials can be explained as easily as that. If the swimming pool was filled with salt water, the image of the key would have been shifted even more.

Light moves at different speeds in materials of different densities. In a vacuum, it reaches 299 792 458 m/s, however in water "only" 225 000 000 m/s. If a ray of light with a defined wavelength strikes a boundary between one medium to another at a fixed angle, the angle of the ray will change according to the refractive indices of the media. Snell's law describes this phenomenon:

$$n_1 \cdot \sin \delta_1 = n_2 \cdot \sin \delta_2,$$

where  $\delta_1$  is angle  $\alpha$  and  $\delta_2$  is angle  $\beta$



Under constant conditions with known material properties, the formula can be manipulated to calculate the refractive index of an unknown second medium. The angle of incidence and angle of refraction can be measured, the refractive index of one of the materials (the prism of the refractometer) is known, and so, after adjusting the formula, the refractive index of the unknown material is a matter of simple mathematics.

Measurement of the refractive index depends on the temperature and wavelength of the light. Determination of the refractive index can provide information on the purity of a substance, but not its exact composition.

The refractive index of water at 20 °C is 1.33 nD. Ice has a refractive index of 1.31 nD.

Adding sugar to pure water changes the refractive index, depending on the amount added. Adding salt changes the refractive index as well, but in relation to the concentration.

This means that if pure water at 20 °C does not have a refractive index of 1.33, it has been "polluted" with some other material. As a rule, determining the refractive index of a substance is a quick and reliable check of its purity.

Sun flower oil diluted with cheaper oil can be detected just as easily as the sugar content of marmalade during the production process.

Another example: cyclohexane at 20 °C has the same refractive index as a 52.9 % sugar solution. This shows that no statements on the composition or possible admixture of a substance can be made without knowing exactly what it is.

Temperature is one of the greatest factors which can influence the refractive index. Each substance reacts differently and specifically to temperature.

**40 % Brix Sugar Solution**  $\Delta nD = 0.00015/^\circ C$

Temperature	Refractive Index
20.0 °C	1.39986 nD
20.1 °C	1.39985 nD
21.0 °C	1.39971 nD

**Paraffine Oil**  $\Delta nD = 0.00036/^\circ C$

Temperature	Refractive Index
20.0 °C	1.48001 nD
20.1 °C	1.47997 nD
21.0 °C	1.47965 nD

A temperature corrected scale in a refractometer must always be specific to a substance, and can never be considered to be universal.

## A.KRÜSS Optronic Refractometers

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### Precision Instruments „made in Germany“

For over 200 years A.KRÜSS Optronic has been famous worldwide for innovative optic-electronic measuring instruments of the highest precision.

As the oldest company in this field, our target is to develop instruments which set new standards. With our products we aim to simplify testing and inspection tasks in laboratories or production facilities. For this reason all instruments are user-friendly and can be operated intuitively.

# DR6000 Series | Digital Refractometers

## Versatile and powerful!

Digital laboratory refractometers from A. Krüss Optronic are setting new benchmarks on many counts. An intuitive touchscreen presents a clear overview of all data and functions and the integrated SQL database stores all data and allows external access via a network or standalone PC.

The refractive index is a parameter in quantitative or qualitative analysis and quality assurance. Degrees of polymerisation can also often be monitored frequently, quickly and cost-efficiently without turbidity or the colour of the sample affecting measurement precision. There is no longer any elaborate preparation of samples necessary. The sample is simply placed on the measuring prism and the measurement process is started.

The flat stainless steel plate is easy to clean and is highly resistant to aggressive substances. As the refractive index depends on the temperature of the sample, the refractometer should be tempered. The DR6000 series is thus available with integrated electronic temperature control by means of a Peltier element. This type of temperature control is faster and more reliable than water bath thermostats. For continuous measurements or series of measurements with many samples and high volumes of samples, devices with flow measurement cells are available. A sample can thus displace the previous one, nonetheless achieving an accurate measurement result without cleaning the measuring prism after every measurement.

The DR6000 series of refractometers are robust, low-maintenance and also very quiet - an often underestimated quality for equipment used continuously in a laboratory.

An integrated SQL database stores up to 99 user-defined measurement methods and the last 999 measurement values with all associated data. You can select the stored results by means of various filters and export data in

## Fields of application

Determination of mixing ratios, quality and quantity inspection in the following industries:

- Beverages
- Food
- Sugar / sweeteners
- Chemicals
- Flavours
- Petrochemicals
- Cosmetics / hygiene
- Metalworking
- Pharmaceuticals
- Water / effluent
- Education / research
- Purity control
- Quality control

XLS- or CSV-format on a USB flash drive, print directly or convert to a PDF document for printing from a PC. By connecting a printer to the RS-232 interface, results can be printed out as soon as they are measured.

The refractometer can be connected to a PC or linked to a network via an Ethernet interface. If there is access to the Internet, remote maintenance and fault diagnosis are also possible.

Optional user management functionality with three authorisation levels protects the settings from being changed unintentionally. The DR6000 series thus meets all GLP requirements and is best suited for use in FDA-regulated situations.

Special KrüssLab software also enables the instrument to be controlled from a PC. This exactly replicates the intuitive touchscreen of your Krüss unit, allowing you to "operate" it directly from the PC. Measured values are copied from the device into the KrüssLab database. You then have permanent access to more than the last 999 results. This data can be accessed even when the Krüss unit is switched off.

The refractometers in this series meet the guidelines of ASTM D1218 and D1747.

## Special features

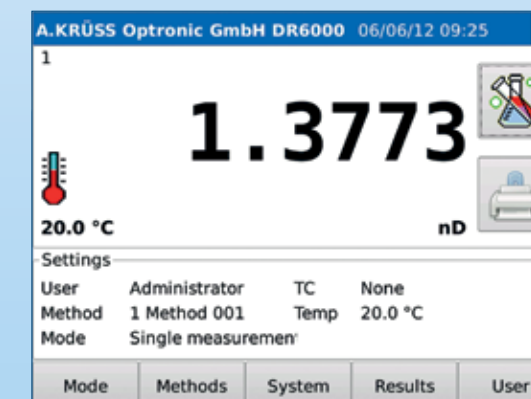
- Bright touchscreen display with intuitive operation in 6 languages
- Very efficient integrated Peltier temperature regulation with high precision (T-Models)
- Fast and easy cleaning of the probe
- High resolution LED with 100.000 hour service life
- Very quiet operation
- Compact powder-coated metal housing
- 99 different methods and customer tables (individual tables can be set)
- Data display of all important settings and measurements
- User management functionality (password-protected) can be activated
- Integral SQL database for data storage
- USB interface for data export and firmware updates and for connecting keyboard or barcode scanner
- RS-232 interface for serial printer
- Ethernet interface for direct connection to a PC (with possibility of remote maintenance via internet)
- PDF-export
- Direct printing possible on a PostScript-enabled network printer
- Full cGMP/GLP capability: password protection, data backup, automatic printout or data output in CSV-format
- Meets the relevant international standards such as Pharmacopoeia, OIML, ASTM
- NIST-compliant calibration certificate
- IQ/OQ/PQ-commissioning possible
- Extremely low maintenance and long life
- 3 year warranty with registration



## Main measuring display

This is where the measurement is carried out and the results as well as the important parameters are displayed.

- Measured value: refractive index, %Brix, user-defined unit
- Target and actual temperature
- User
- Method
- Temperature compensation
- Status information



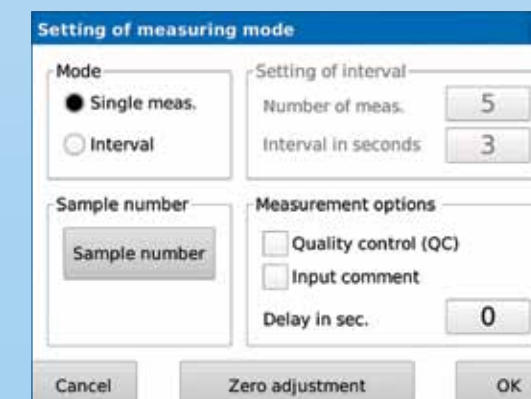
## Mode and method menu

In the mode menu any user can adjust settings.

- Single or interval measurements
- Mark measurements as QC measurements
- Define sample numbers

Where the user administration function has been activated, only administrators can make changes in the method menu.

- Name of method
- Unit
- Target temperature
- Temperature compensation (ICUMSA or user-defined)



## Results menu

The last 999 measurements are stored in the results menu along with all associated settings and parameters. Columns can be displayed or hidden and the results filtered, printed or exported.

- Date and time
- Method
- User
- Sample number
- Target and actual temperature
- Measured value
- Unit
- etc.

Date+Time	Method	No.	Value	Unit	Set
06/06/12 09:14:19	Method 001	3	1.3733	nD	20.0
06/06/12 09:14:21	Method 001	4	1.4019	nD	20.0
06/06/12 09:14:22	Method 001	5	1.4156	nD	20.0
06/06/12 09:14:23	Method 001	6	1.3589	nD	20.0
06/06/12 09:15:10	Method 002	6	45.0	% Brix Saccharose	0.0
06/06/12 09:15:17	Method 002	7	3.1	% Brix Saccharose	0.0
06/06/12 09:15:25	Method 002	8	54.6	% Brix Saccharose	0.0
06/06/12 09:17:17	Method 001	7	1.3450	nD	20.0
06/06/12 09:17:19	Method 001	8	1.4186	nD	20.0
06/06/12 09:17:36	Method 001	1	1.3334	nD	20.0



## Specifications

Model / Article-No.	Range 1.3200 – 1.5800 nD 0-95 %Brix	Range 1.3200 – 1.7000 nD 0-95 %Brix	Resolution 0.0001 nD 0.1 %Brix	Resolution 0.00001 nD 0.01 %Brix	Accuracy 0.0001 nD 0.1 %Brix	Accuracy 0.00002 nD 0.01 %Brix
DR6000	•		•		•	
DR6100		•	•		•	
DR6200	•			•		•
DR6300		•		•		•

## Common Specifications

Measurement modes	Single, Interval	Interface	RS-232 (printer) USB (data export, firmware updates) Ethernet (LIMS, remote monitoring)
Scales	Preset standard scales: Refractive Index [nD], %Brix saccharose, inverted sugar, glucose, fructose, Temperature compensated [nD], Temperature compensated [%Brix]. User defined scales can be initialised.	Working voltage	90–250 V 50/60 HzW
Calibration	Automatic (menu-driven), manufacturer's calibration with up to 30 sampling points, user defined 1-point-calibration	Protection class	IP65 for analysis basin
Measurement time	~4 s	Temperature measurement	5–90 °C
Prism	Sapphire	Temperature resolution	0.1 °C
Illumination	LED 590 nm (est. life: >100.000 hours)	Temperature measurement accuracy	±0.05 °C
Housing	Cast aluminium, powder-coated	Temperature compensation	ICUMSA, User defined 3-Point
Analysis basin	Stainless steel,	Temperature sensor	PT100 Sensor
Display	LCD TFT 5.7", 640x480 pixel color display (VGA)	Sample temperature	10–80 °C
Operation	Touchscreen	Ambient temperature	15–35 °C
Measured data storage	999 measurements	Temperature control (except T-Models)	Thermostat connections
		Dimensions in cm	21.5 x 15 x 34.5
		Weight	5 kg

All models are also available in the following versions:

### T Model: with built-in electronic Peltier thermostat

Model / Article-No.	Temperature control range	Temperature accuracy	Temperature stability
DR6000-T DR6100-T DR6200-T DR6300-T	10–80 °C (optional)	±0.1 °C	0.05 °C

### F-Model: with flow cell

The flow cell is a variation of the DR6000 series and is indicated by the suffix "F" (e.g. -F, -TF). It consists of a measuring cell cover fixed with robust stainless steel brackets over the prism, with two tubes for inflow and outflow. All parts that come into contact with the sample (tubes and measuring cell cover) are made of PTFE (Teflon). Combined with the sapphire prism equipped with a Peltier thermostat, precise and stable temperature control is assured. The UNF-thread hose coupling is made of PEEK.

The flow cell allows the unit to run in automated mode using a peristaltic pump or autosampler. It can also be filled by means of injection if required. Thanks to its special geometry (forced venting), no air bubbles can become trapped.

As a result of the small size of the micro-measuring cell, this version is particularly suitable for applications in which it is important for samples to be in small volumes (e.g. in the flavourings industry).

The measuring cell can be removed easily and the sample thus placed directly on to the prism.



### TF-Model: with integrated electronic Peltier thermostat AND flowcell

TF models are a combination of T- and F-models

## DR6000 Series | Accessories

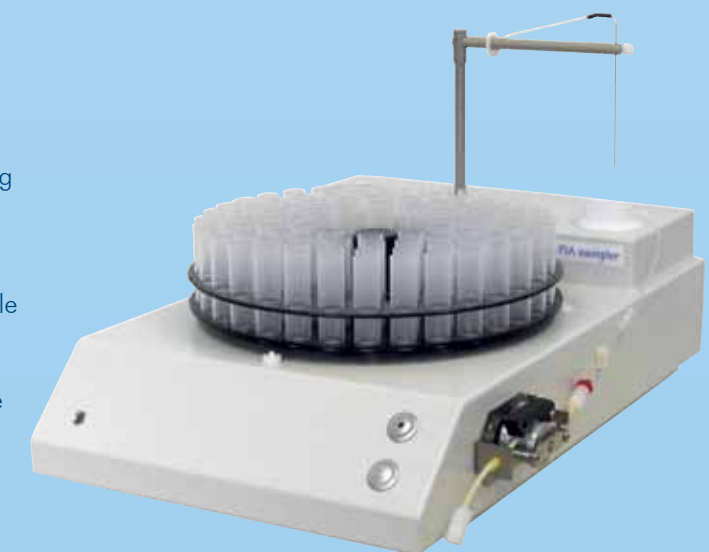
### Automated sample injector - Autosampler

#### AS80

The refractometer, fitted with a flow-through cuvette, and the density meter can be completed by means of an automated sample injector system.

This consists of a rotor sampler, a peristaltic pump and a constriction-tube valve as toggle switch. The sampler uses a plate with 89 positions for sample tubes in polystyrene with dimensions Ø 16 x 100 mm. These can accept sample volumes of 8 ml. Peristaltic pump and valve are integrated into the sampler and are controlled via this by the measuring device. The heads of the two assemblies are situated on the right-hand side of the unit.

The sample is transported into the measurement system by means of the peristaltic pump. If the measured value is stable and is recorded, the valve toggles from Sample to Standby and the system is rinsed. This minimises spreading and measurement errors. To take the following measurement the rotor is moved to the next sampling position and the valve set back to sample mode.



## AR | Abbe Refractometers

### The modern classic!

The Abbe refractometer was developed in 1869 by Ernst Abbe and is used to determine the refractive index otherwise known as the index of refraction.

It is based on the principle of total reflection which occurs at the boundary between the prism and the sample. The refractive index of the prism determines the upper limit of the measurement range, as it always has to be greater than that of the sample.

With the AR Series, Krüss has two models of the Abbe refractometer in its range. These are easy to use and require only a small sample volume. These devices allow samples in the form of solids or pastes to be measured just as easily as liquids. Furthermore, colouration or clouding scarcely affect the measurement result. Besides the refractive index, the solid content can be determined in %Brix. To determine the refractive index of solids, a contact liquid with an average refractive index is required.

The refractive index of a sample is dependent on the wavelength of the light used for the measurement and on the temperature. As the temperature increases, the refractive index drops. That is why our Abbe refractometers have thermostat connections on both the illumination prism as well as the measurement prism.

### Fields of application

**Determination of mixing ratios, quality and quantity inspection in the following industries:**

- Beverages
- Food
- Sugar / sweeteners
- Chemicals
- Flavours
- Petrochemicals
- Cosmetics / hygiene
- Metalworking
- Pharmaceuticals
- Water / effluent
- Education / research



AR2008



AR4

## AR2008 | Digital Abbe Refractometer

### Specifications

Measurement range	1.3000–1.7200 nD 0–95 %Brix
Accuracy	±0.0002 nD ±0.1 %Brix
Resolution	0.0001 nD 0.1 %Brix
Temperature Range	0–99 °C
Temperature resolution	0.1 °C
Autom. Temperature compensation	0–90 °C
Interfaces	serial RS-232 9600 Baud serial RS-422 9600 Baud
Power supply	110/230 V, 50/60 Hz, 40 W
Dimensions in cm	12.0 x 29.0 x 25.0
Weight	5 kg

The digital Abbe refractometer AR2008 has an electronic data processing system. The refractive index or Brix value is shown on an LCD display together with the temperature.

A serial interface allows measured values with date and time to be transferred directly to the PC or printer.

An automatic temperature compensation feature is optionally selectable.

The AR2008 has a thermostat connection for prisms and a built-in light source (589 nm) for the measuring prism. The AR2008 is extremely sturdy and is ideally suited for use in a harsh environment.

It is supplied with a glass calibration plate, contact fluid and a screwdriver as well as a dust hood.

## AR4 | Analogue Abbe Refractometer

### Specifications

Measurement range	1.3000–1.7000 nD 0–95 %Brix
Accuracy	±0.0002 nD ±0.1 %Brix
Scale division	0.0005 nD 0.25 %Brix
Thermometer	Digital thermometer: -40–120 °C
Illumination	Scale illumination, LED-illumination (590 nm) for prism
Display	Readings via ocular
Power supply	110/220 V, switchable
Dimensions in cm	10.0 x 27.0 x 19.0
Weight	2.5 kg
Special features	Adjustable scale, prisms can be temperature-controlled, thermostat connections for prisms

The AR4 offers readings via ocular. It has an adjustable scale, temperature controlled prisms, and thermostat connections for prisms.

The refractive index of a sample depends on the wavelength of the light used in measurement.

That is why we supply our AR4 with LED illumination for the measuring prism. This has the standard wavelength of 589 nm and has a very long service life (> 100.000 h). Refractometers also have scale illumination.

Since the refractive index is also temperature-dependent, our Abbe refractometers feature thermostat points on both the lighting and the measurement prisms.

A digital thermometer is supplied. Other wavelengths are available on request.

Our Abbe refractometers can easily be checked and calibrated with the calibration plates provided and comply with all requirements of ASTM D1218.

## PR | Process Refractometer

### Complete quality control!

Process refractometers are built directly into pipework and boilers or operated in the bypass. They are ideal for process monitoring, control and product separation in a variety of industries (chemicals, beverages, food and sugar).

#### Why use Refractometers in pipelines?

The monitoring of refractive index is a popular method of inline quality control in many process industries, including pulp and paper, food and beverage, chemical and pharmaceutical, and wastewater. It provides real-time data for quality control and Good Manufacturing Practice (GMP), and can be used to monitor qualities such as concentration of a solution, density of a fluid, or % Brix. An inline process refractometer is installed directly into pipework or a boiler, with standard connections for easy assembly. The alternative bypass process refractometer analyses a stream of fluid drawn off the main process run.

### Fields of application

#### Determination of mixing ratios, quality and quantity inspection in the following industries:

- Beverages
- Food
- Sugar/sweeteners
- Chemicals
- Flavours
- Petrochemicals
- Cosmetics / hygiene
- Metalworking
- Pharmaceuticals
- Water / effluent
- Education / research

### Special Features

- Excellent value for money
- Wide measurement range from 1.3300 –1.5600 nD; 0–95 %Brix
- Adjustable measurement interval (min. 3 s)
- Password-protected
- Prism in the sample chamber is easy to clean
- User-friendly interfaces for direct connection to a PLC
- Very easy to install, no special requirements

## PR21 Series | Process Refractometer

As no bypass is necessary, it is much simpler to install the process refractometer in a pipeline or tank. Standard connections enable the process refractometer to be assembled quickly and easily. Depending on diameter, a T-piece is inserted into the pipeline or an adapter welded on, as with the tank. Three interfaces are available for this unit: Analogue 0/4-20 mA, Ethernet, or PROFIBUS.



PR21

### Model overview

	Measurement accuracy	Resolution	Product temperature	Ambient temperature
PR21S	±0.0002 nD	0.0001 nD	< 60 °C	< 40 °C
PR21S-T	±0.2 %Brix	0.1 %Brix	< 160 °C	< 60 °C
PR21H	±0.00002 nD	0.00001 nD	< 60 °C	< 40 °C
PR21H-T	±0.02 %Brix	0.01 %Brix	< 160 °C	< 60 °C

### Specifications

Measurement mode	Refractive index [nD], Sugar content [%Brix], User defined [%]	Prism	Sapphire
Measurement interval	3–60 s	Illumination	LED 590 nm (est. life: > 100.000 h)
Temp. sensor	PT100	Housing	Stainless steel, Cast aluminium, powder-coated
Temp. measurement	-10–200 °C	Interfaces	Analogue 0/4-20 mA, Ethernet, PROFIBUS (optional)
Temp. resolution	0.1 °C	Protection class	IP65
Temp. measurement accuracy	± 0.2 °C	Working voltage	24 V
Temp. compensation	ICUMSA, arbitrary	Dimensions in cm	18.0 x 19.0 x 18.0
Process temperature	-5–160 °C	Weight	3.5 kg
Ambient temperature	0–60 °C		

## PRB21 | Bypass Process Refractometer

The bypass process refractometer PRB21 fills the gap between the DR6000 series of digital laboratory refractometers and the process refractometer PR21. The sample is fed into the measurement chamber through a stainless steel bypass. The prism is made of particularly scratch-resistant sapphire. The PRB21 is generally connected to a PLC and provides continuous process control. Small sample volumes suffice for this. The measurement interval is adjustable (>3 s) and the measurement result is not affected by either the colour or the turbidity of the sample.

The PRB21 has various interfaces and can also be supplied with PROFIBUS on request. A display is also available for visual monitoring. Automatic temperature compensation can be obtained by means of the internal temperature sensor and the measured temperature fed to the PLC.



PRB21

### Specifications

Measurement range	1.3200 nD–1.5600 nD 0–95 %Brix	Temperature resolution	0.1 °C
Accuracy	PR-H: ±0.00002 nD; ± 0.02 %Brix	Temperature accuracy	±0.2 °C
	PR-S: ±0.0002 nD; ± 0.2 %Brix	Temperature compensation	ICUMSA, arbitrary
Resolution	PRB-H: 0.00001 nD; 0.01 %Brix	Ambient temperature	0–40 °C
	PRB-S: 0.0001 nD; 0.1 %Brix	Prism	Sapphire
Measurement units	Refractive Index [nD] Saccharose [%Brix] Invert Sugar [%Brix] Glucose [%Brix] Fructose [%Brix]	Illumination	LED 590 nm (est. life: > 100.000 h)
Measurement interval	3–60 s	Housing	Cast aluminium, powdercoated
Temperature sensor	PT100	Interfaces	RS-232, analogue 0/4–20 mA
Temperature measurement	-10–99.9 °C	Protection class	IP65
		Working voltage	24 V
		Display (optional)	LCD 120 x 32 Pixel
		Dimensions in cm	18.0 x 10.0 x 18.0
		Weight	3 kg



## DR301-95, DR201-95, DR101-60 | Digital Hand-held Refractometers

### For mobile use - with a large measurement range!

Quick, precise measurement results simplify incoming goods inspection, optimise quality assurance and reduce work processes. The devices can easily be carried on inspection rounds, as they are lightweight and fit into any lab coat pocket.



### Fields of application

Determination of mixing ratios, quality and quantity inspection in the following industries:

- Beverages
- Food
- Sugar / sweeteners
- Chemicals
- Flavours
- Petrochemicals
- Cosmetics / hygiene
- Metalworking
- Pharmaceuticals
- Water / effluent
- Education / research

### Special features

- Large measuring range
- High precision
- Calibrated with water
- Display of measurement results in various units
- Automatic temperature compensation
- Robust casing
- Little weight

	DR301-95	DR201-95	DR201-95-OE	DR101-60	DR101-60-OE
<b>Measurement range</b>	1.3330–1.5318 nD 0–95 %Brix	1.3330–1.5318 nD 0–95 %Brix	0–250 °Oechsle 0–95 %Brix	1.3330–1.4419 nD 0–60 %Brix	0–150 °Oechsle 0–60 %Brix
<b>Accuracy</b>	±0.00015 nD ±0.1 %Brix	±0.0003 nD ±0.2 %Brix	±1 °Oechsle ±0.2 %Brix	±0.0005 nD ±0.25 %Brix	±1 °Oechsle ±0.2 %Brix
<b>Resolution</b>	0.0001nD 0.1 %Brix	0.0001nD 0.1 %Brix	1 °Oechsle 0.1 %Brix	0.0001nD 0.1 %Brix	1 °Oechsle 0.1 %Brix
<b>Temperature measurement</b>	5–40 °C 41–104 °F	0–40 °C	0–40 °C	0–40 °C	0–40 °C
<b>Temperature accuracy</b>	±0.5 °C	±0.5 °C	±0.5 °C	±0.5 °C	±0.5 °C
<b>Temperature compensation</b>	5–40 °C	10–40 °C	10–40 °C	10–40 °C	10–40 °C
<b>Prism</b>	optical glass				
<b>Housing</b>	Plastic				
<b>Dimensions in cm</b>	18.0 x 10.0 x 6.0	13.0 x 8.0 x 4.0		11.0 x 6.2 x 3.2	11.0 x 6.2 x 3.2
<b>Weight</b>	500 g	200 g		160 g	160 g
<b>Power supply</b>	9 V Battery, (Adaptor available separately)	1.5 V Battery		1.5 V Battery	1.5 V Battery

### DR301-95

The digital handheld refractometer DR301-95 has more functions than a simple handheld refractometer and at the same time is more cost-effective than a desktop unit. Besides the refractive index, sugar and salt scales, up to two other user-defined scales can be programmed. To do this, the handheld refractometer can be connected to a PC via a serial interface. The software supplied with it allows results to be managed and printed out. While the instrument can be operated as a mobile unit with a 9 V block battery, the optionally available power supply unit turns the DR301-95 into a small laboratory refractometer. The sample plate is made of stainless steel and is so flat that it can be cleaned quickly and easily. The instrument is calibrated simply with distilled water and has an optional temperature compensation feature. For incoming goods control applications, an upper and lower tolerance alarm can be entered.



DR301-95



DR201-95

### DR201-95 and DR201-95OE

The DR201-95 is a compact digital handheld refractometer which eliminates any user-related reading errors of manual handheld refractometers. Specially developed for fast and easy quality control and process control, it has a wide measuring range for a refractive index scale and a sugar scale. One DR201-95 can thus often replace several existing instruments. For wine-growing, a special model is available with an Oechsle scale instead of a sugar scale. Both instruments are low-maintenance and are calibrated simply with distilled water. The 1.5 V battery lasts for over 1000 measurements.

### DR101-60 und DR101-60-OE

As an entry-level model in digital refractometry, the DR101-60 covers many areas of application where the wide measurement range of the DR201-95 is not required. It offers excellent value for money, in terms of both procurement and operation. Calibration is also with distilled water. The waterproof case allows the DR101-60 to be rinsed under running water. This digital handheld refractometer also has an automatic temperature compensation feature, of course.



DR101-60

# HR Series | Manual Hand-held Refractometers

## Quick on-site measurements!

Manual handheld refractometers are for fast everyday use. They are particularly easy to use and very sturdy. Various scales and additional functions ensure that there is exactly the right handheld refractometer for many application areas. This makes for reliability when reading, as the measured value does not first have to be converted.

Some models have an automatic temperature compensation feature which increases measurement precision for measurements which are performed at 10–40 °C instead of 20 °C. For calibration, distilled water is required, or else a small calibration plate is provided.

## Fields of application

Determination of mixing ratios, quality and quantity inspection in the following industries:

- Beverages
- Food
- Sugar / sweeteners
- Chemicals
- Flavours
- Petrochemicals
- Cosmetics / hygiene
- Metalworking
- Pharmaceuticals
- Water / effluent
- Education / research

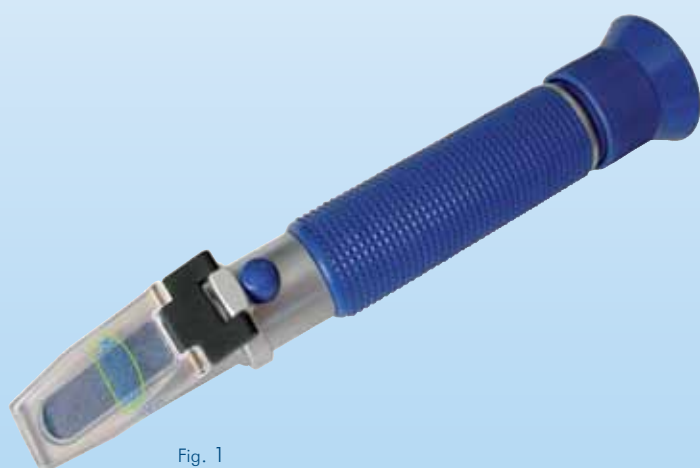


Fig. 1



Fig. 2

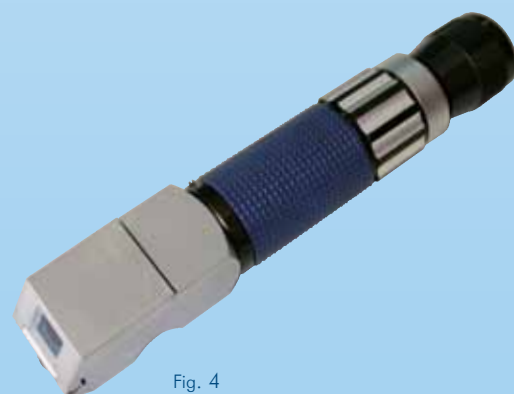


Fig. 4

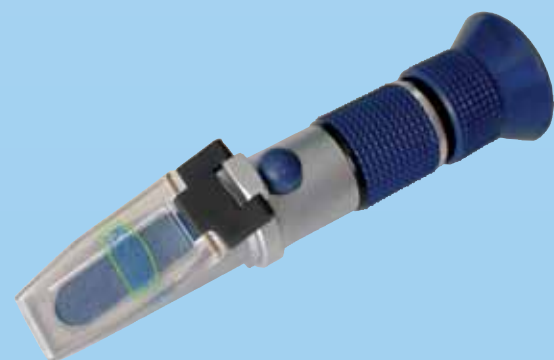


Fig. 3



Fig. 5

Model	Fig. Nr.	Measurement range	Accuracy	scale division	Temperature compensation	Thermo-meter	Field of application
HR10	Fig. 1	0–10 %Brix	0.1 %Brix	0.1 %Brix	-	-	For sugar concentration in fruit juices, soft drinks, vegetables, foods and cooling lubricants
HR18-01	Fig. 1	0–18 %Brix	0.1 %Brix	0.1 %Brix	-	-	For sugar concentration in fruit juices, soft drinks, vegetables, foods and cooling lubricants
HRKL32	Fig. 2	0–32 %Brix 0–140 °Oechsle 0–27° KMW BaBo	0.2 %Brix 1 °Oechsle 0.2° KMW BaBo	0.2 %Brix 1 °Oechsle 0.2° KMW BaBo	-	-	For the measurement of Brix and alcohol content in must by either oechsle and Klosterneuburg scale
HRN20	Fig. 2	0–20 %Brix	0.2 %Brix	0.2 %Brix	-	-	For sugar concentration in fruit juices, soft drinks, vegetables, foods and cooling lubricants
HRN32	Fig. 2	0–32 %Brix	0.2 %Brix	0.2 %Brix	-	-	For sugar concentration in fruit juices, soft drinks, vegetables, foods and cooling lubricants
HRT32	Fig. 3	0–32 %Brix	0.2 %Brix	0.2 %Brix	automatically	-	For sugar concentration in fruit juices, soft drinks, vegetables, foods and cooling lubricants
HRN62	Fig. 3	28–62 %Brix	0.2 %Brix	0.2 %Brix	-	-	For analysing chemical and technical liquids, such as oils, fats, coolants, lubricants
HRT62	Fig. 3	28–62 %Brix	0.2 %Brix	0.2 %Brix	automatically	-	For analysing chemical and technical liquids, such as oils, fats, coolants, lubricants
HRN82	Fig. 3	45–82 %Brix	0.2 %Brix	0.2 %Brix	-	-	For analysing chemical and technical liquids, such as oils, fats, coolants, lubricants
HR92	Fig. 3	58–90 %Brix 38–43 °Baume 12–27 % Water	1 %Brix 0.5 °Baume 1 % Water	1 %Brix 0.5 °Baume 1 % Water	-	-	For examination of highly concentrated sugars, determination of water content in honey and analysing fats, lubricants and cooking oil
HRH30	Fig. 2	12–30 % Water content in honey	0.1 % Water content in honey	0.1 % Water content in honey	-	-	For examination of highly concentrated sugars, determination of water content in honey and analysing fats, lubricants and cooking oil
HR900	Fig. 5	0–90 %Brix	0.2 %Brix	0.2 %Brix	-	6–36 °C	Universal hand refractometer with stage switch for all ranges. Adjustable prisms for sharp contours, direct and indirect light guidance for measurement of clear and opaque substances. With thermometer
HR901	Fig. 5	1.333–1.517 nD	0.0005 nD	0.0005 nD	-	6–36 °C	Universal hand refractometer with stage switch for all ranges. Adjustable prisms for sharp contours, direct and indirect light guidance for measurement of clear and opaque substances. With thermometer
HR27-100	Fig. 2	1.000–1.070 d <sub>20</sub> <sup>20</sup> 0–100 ‰ Salinity	0.001 d <sub>20</sub> <sup>20</sup> 1 ‰ Salinity	0.001 d <sub>20</sub> <sup>20</sup> 1 ‰ Salinity	-	-	For salinity analysis
HRS16	Fig. 1	1,333–1,373 nD 0–160 ‰ Salinity	0.001 nD 2 ‰ Salinity	0.001 nD 2 ‰ Salinity	-	-	For salinity analysis
HR146	Fig. 2	1,3330–1,3834 nD 0-28 % Salinity	0.001 nD 0.2 % Salinity	0.001 nD 0.1 % Salinity	-	-	For salinity analysis
HRM18	Fig. 2	0–12 g/dl 1.333–1.360 nD 1.000–1.050 UG	0.2 g/dl 0.0005 nD 0.002 UG	0.2 g/dl 0.0005 nD 0.002 UG	-	-	For the measurement of serum protein and specific urine weight
HRMT18	Fig. 2	0–12 g/dl 1.333–1.360 nD 1.000–1.050 UG	0.2 g/dl 0.0005 nD 0.002 UG	0.2 g/dl 0.0005 nD 0.002 UG	automatically	-	For the measurement of serum protein and specific urine weight
HRO32	Fig. 2	0–32 %Brix 30–130 °Oe 4.4–19 % Alcohol	0.2 %Brix 1 °Oe 0.1 % Alcohol	0.2 %Brix 1 °Oe 0.1 % Alcohol	-	-	For the measurement of Oechsle, Brix and alcohol content in must
HROT32	Fig. 3	0–32 %Brix 30–130 °Oe 4.4–19 % Alcohol	0.2 %Brix 1 °Oe 0.1 % Alcohol	0.2 %Brix 1 °Oe 0.1 % Alcohol	automatically	-	For the measurement of Oechsle, Brix and alcohol content in must
HRKFZ1	Fig. 3	Anti freeze: 50–0 °C Battery acid: 1.10–1.30 g/cm <sup>3</sup>	Ethylene-Propylene: 5 °C Battery acid: 0.01 g/cm <sup>3</sup>	Ethylene-Propylene: 5 °C Battery acid: 0.01 g/cm <sup>3</sup>	-	-	Anti freeze and battery fluid tester
HR25-800	Fig. 4	0–80 %Brix	0.5 %Brix	0.5 %Brix	-	-	Universal hand refractometer with stage switch for all ranges. Adjustable prisms for sharp contours, direct and indirect light guidance for measurement of clear and opaque substances



## ER60 Series | Gem Refractometers

### Real or not?!

Gemstone refractometers are used for the classification and quality control of gemstones. The gemstone to be examined is simply placed on the prism with a drop of contact fluid. The refractive index of the gemstone is read through the ocular of the refractometer. The refractive index is an important parameter in classifying a mineral or gemstone. Each mineral has its typical refractive index, due to its chemical composition and crystalline structure. Our gemstone refractometers are characterised by their particularly sharp image and good readability. With the sodium filter that only lets through light with a wavelength of 589 nm, the refractometer can be used as a mobile unit with an ordinary light source or with sufficient ambient lighting. LED illumination is also available with a wavelength of 589 nm.



ER601  
Illumination not figured



ER604  
Illumination not figured

### Model overview

	Standard Gem Refractometer		Professional Gem Refractometer	
	ER604	ER604-LED	ER601-NA	ER601-LED
Measurement range	1.33–1.81 nD	1.33–1.81 nD	1.33–1.83 nD	1.33–1.83 nD
Resolution	0.01 nD	0.01 nD	0.01 nD	0.01 nD
Monochromator	Na-Filter 589 nm	Na-Filter 589 nm	Na-Filter 589 nm	–
Illumination	–	LED 589 nm	–	LED 589 nm
Power supply	–	100–240 V	–	100–240 V
Prism	Optical glass			
Housing	Cast aluminium			

## Refractometer accessories

### Peltier thermostat

#### PT31

This electronic water-bath thermostat with Peltier element is a versatile, high-performance instrument. In one application, for example, it can be used to set the correct refractometer temperature. It is extremely robust, compact and easy to operate. Because it is so small it does not take up valuable space in the laboratory.

Resolution	0.1 °C
Heating power	30 W
Cooling power	15 W
Power supply	115–230 V
Pump pressure	2000 Pa
Pump performance	20 l/h
Temperature	8–40 °C (continuously adjustable)
Temperature accuracy	±0.2 °C
Bath volume	ca. 100 ml
Dimensions in cm	8.0 x 21.0 x 14.0
Weight	1.5 kg



### Printer

#### CBM910

24 characters plain paper dot matrix printer for:

- Digital Refractometers from the DR6000 series
- Digital Abbe-Refractometer AR2008
- Digital Polarimeter from the P8000 Series
- Density Meters from the DS7000 Series



### Optical archiving unit

#### AR42

This camera enables results to be archived with ease. The optical unit also detects the limit of wavelengths that are not visible to the human eye (infrared).

- High quality glass lens
- 30 images per second
- Snapshot function (1.3 MP)
- Detects the limit of invisible wavelengths (infrared)
- Includes inserter / adapter for eyepiece

Connector	USB
Image frequency	30 images/s
Photo resolution	1366 x 768 Pixel
Video resolution	640 x 480 Pixel



### Flow-through cell with funnel

#### AR15

Flow-through cell with funnel  
upgrade for AR4 and AR2008.



### Flow-through cell

#### AR16

Flow-through cell upgrade for continuous measurement  
with AR4 and AR2008.



### Refractometer calibration solutions

- **RI34** calibration solution 1.3400 nD ( 5 %Brix)
- **RI39** calibration solution 1.3900 nD (35 %Brix)
- **RI43** calibration solution 1.4300 nD (55 %Brix)
- **RI48** calibration solution 1.4800 nD (76 %Brix)
- **RI65** calibration solution 1.6500 nD

All bottles contain 30 cc and are supplied with a certificate.



## Further Products available from A.KRÜSS Optronic GmbH

- Polarimeters
- Density Meters
- Microscopes
- Melting Point Meters
- Peltier Thermostat
- Cold Light Sources
- Spectroscopes
- Spectral Measuring Instruments
- UV Lamps
- Software
- Gemmological Instruments