Density Meter
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KRÜSS
A.KRÜSS OPTRONIC
GERMANY

Density Meter

DS7800

2 + 1 year
WARRANTY EXTENSION
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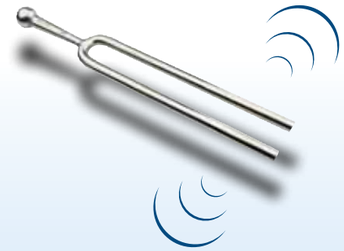
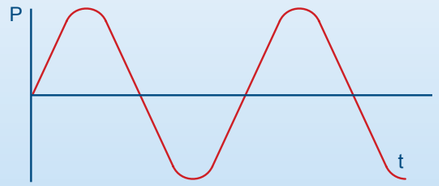
innovation since 1796

What is digital density measurement using the oscillating U-tube principle?





The example of a tuning fork shows that by applying a mechanical impulse one can generate a sound with a characteristic pitch. This sound is the result of the oscillation created by deflecting the prongs of the tuning fork. A determining factor in the pitch of the note obtained, and thus of the oscillating frequency, is the mass of the tuning fork.
Digital density measurement puts this relationship to use by means of the U-tube oscillation principle. The extremely fine capillaries are made to oscillate by a piezoelectric or magnetic transducer with a characteristic frequency.
The resulting resonant frequency of the U-tube will depend on the mass of the filled sample. This frequency can be measured very accurately and used to calculate the density of the sample.
The physical relationship of oscillation frequency (the reciprocal of the period of oscillation) to density is very simple and linear. Accordingly, calibration is only possible with two standards as a rule - air and water.

What is density?

Density ρ is a characteristic property of materials and indicates the relationship of mass **m** to volume **V**.

$$\rho = \frac{m}{V}$$

It is measured in g/cm³ or kg/m³.

For high-precision measurements, the most significant influencing factor is the temperature of the sample. It is essential therefore that modern density meters are equipped with efficient temperature control of the measurement room.

Temperature [°C]	Ultra-pure water [kg/m³]	Air [kg/m³]
4	999.972	1.270
20	998.203	1.205
60	983.191	1.060

Relationship of density to temperature

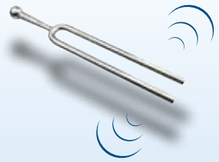
A temperature change of 0.1 °C consequently has an influence on density of between 0.1 and 0.3 kg/m3, depending on the substance.

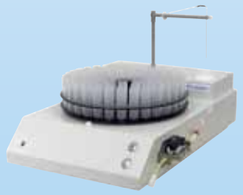
Density measurement is often also used for determining the concentrations of mixtures of fluids. Strictly speaking, this applies to mixtures of two substances, also known as binary systems. Extensive concentration tables can be created in DS7800 for our customers to facilitate everyday measurements. However, digital density measurement can also be of significant benefit in analysing complex solutions such as beer or fruit juices.

What are the advantages of digital density measurement?

Today there are still two alternative procedures for measuring density commonly in use.
The **areometer**, better known as a hydrometer, works on the Archimedean principle of buoyancy in proportion to mass. An areometer is low-cost but difficult to read, particularly in highly viscose or dark samples.
Additionally, large sample volumes of at least 100 ml are required. A high degree of precision (max. 0.001 g/cm3) requires precise temperature regulation.
The **pycnometer** provides a gravimetric determination of density. This can achieve higher degrees of precision than the hydrometer. Owing to complex weighing procedures, however, measurement by this method can take hours and requires trained personnel.
The advantages of density measurement using the **oscillating U-tube** include both good repeatability and high precision. These devices are easy to use and enable measurements to be made simply in a matter of minutes at a defined, regulated temperature.

Index





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.

DS7800 | Density Meter

User-friendly measurement using oscillating U-tube technology

Digital density meters with up to five decimal places for measuring density, relative density and concentration of aqueous solutions in a range of 0.0000 – 1.9999 g/cm³. Measuring method is based on established oscillating U-tube technology. The U-tube made of glass is monitored through the window to ensure that no gas bubble falsifies measurement results.

The device has a high-precision recirculation air-temperature control based on a Peltier element. Calibration is performed with pure water and dry air. A dry-air unit and a peristaltic pump for sample handling are included.
Tubing material is also optionally available in a chemical resistant design. Injection filling, e.g. for higher viscosity specimens, is also possible.

An integrated SQL database stores up to 99 user-defined measurement methods and the last 999 measurement values with all relevant data, such as date, time and user. You can select the stored results by means of various filters and export data in 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 density meter 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 DS7800 thus meets all GLP requirements and is ideal 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. And you can access this data even when the Krüss unit is switched off.
The DS7800 density meter functions in accordance with the guidelines of ASTM D4052 and D5002.

Fields of application:

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

Drinks industry:
Beer, flavourings, fruit juice, syrups, sugar, soft drinks, spirits, milk drinks.

Chemical industry:
Acids, alkalis, salts, solvents, goods inward and final inspections, inspections of raw ingredients, monitoring of mixing ratios.

Food industry:
Jams, preserves, honey, glucose or fructose syrups, jelly, mustard, ketchup, sauces, soups, convenience products, mayonnaise, ice cream, baby food, confectionery production, milk products.

Automotive industry:
Oils, lubricants, battery acid, antifreeze.

Metalworking:
Cooling lubricants and their emulsion solutions with water.

Petrochemicals:
Oils, lubricants, quality control of fuels and additives.

Cosmetics and pharmaceuticals:
Creams, ointments, pastes, emulsions, lotions, beauty products, perfumes, aromas, solvents, cleaners, shampoos, soaps, infusion solutions, urine, quality control of liquid medications and agents.

Wine-growing:
Grape juice, cider, wine, champagne, liqueur.

Sugar industry:
%Brix, purity of sugar and the products from which it is derived, syrup concentrations.

Includes the following accessories:

- Desiccation cartridge
- Rinsing and filling pump
- Tube set - standard:
  4 pc. adapter connection, Specimen tube, Pump tubing, 10 pc. syringe 5 ml Luer, 1 T-piece
- Waste vessel
- Operating manual
- Test report and calibration certificate in accordance with N.I.S.T.

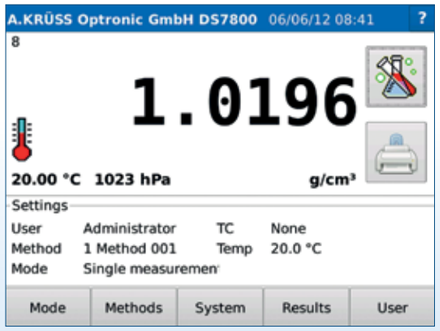
Features at a glance

- Density measurement based on the oscillating U-tube principle
- Bright touchscreen display with intuitive operation in 6 languages
- Fast, efficient measuring in minutes (typically 1-3 min) plus temperature regulation.
- Very efficient integrated Peltier temperature regulation (10-40 °C) with high precision
- Desiccation unit and peristaltic pump included
- Can be filled using the integrated peristaltic pump or by injection
- Resistance to samples: all parts that come into contact with samples are made of glass or PTFE
- LUER or UNF couplings
- Compact powder-coated metal casing
- Includes built-in air pressure sensor
- Low consumables costs
- Output of all important measurement data
- 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 Pharmacopoe, OIML, ASTM
- Calibration certificate in accordance with N.I.S.T.
- IQ/OQ/PQ-start-ups possible
- Extremely low-maintenance and long life
- 3-year warranty on registration

Main measurement display

This is where measurements are taken and the result and other parameters are displayed.

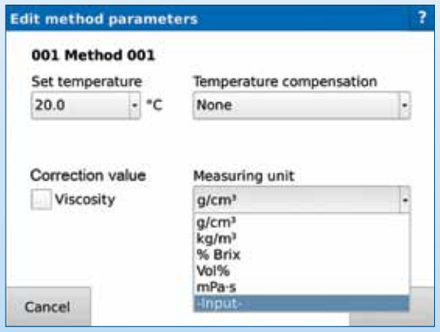
- Measurement value and unit
- Sample temperature
- Air pressure
- Method selected
- Status information



Method parameters

In this menu the measurement parameters are set.

- Target temperature
- Temperature compensation
- Measurement unit
- User-defined units

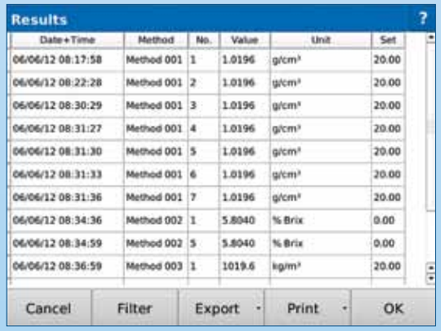


Results menu

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.



Specifications

Measurement range	0.0000–1.9999 g/cm³
Accuracy	0.0001 g/cm³
Repeatability	0.0001 g/cm³
Sample volume by manual injection	0.9 ml
Temperature range	10–40 °C
Temperature stability	±0.02 °C
Measurement time	approx. 5 min
Ambient temperature	10–40 °C
Calibration	Automatic menu-driven calibration with dried air and distilled water
Manufacturer's calibration	4–10 sampling points for air, water with 9 temperatures
Case	Cast aluminium, powder-coated
Display	LCD TFT 5.7 ", 640x480 pixel colour display (VGA)
Interfaces	RS-232 (printer) USB (data export, firmware updates) Ethernet (LIMS, remote monitoring)
Power supply	90–264 V, 50/60 Hz
Power consumption (measuring mode)	25 W
Power consumption (max.)	100 W
Methods	99 freely definable methods
Result storage	999 last measurements
Printer port	serial
User administration	activatable
Password protection	activatable
LIMS access	possible
Dimensions in cm	22.0 x 22.0 x 43.0
Weight	5.3 kg

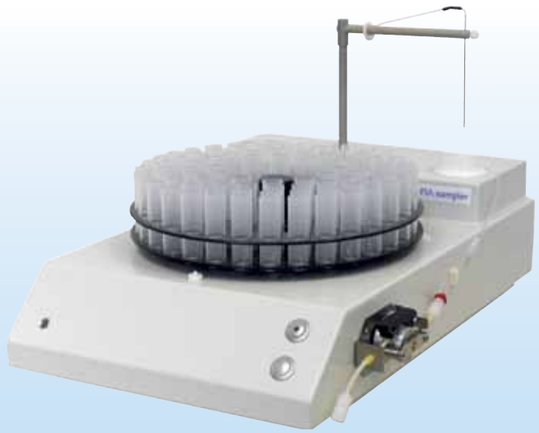
Parts that come into contact with sample:

The following materials come into contact with samples and with cleaning fluid:

	Part description	Material
DS7800	Measuring cell	Borosilicate glass
	Filling nozzle - Luer	PTFE
Standard accessories	Tube adapter	PP
	Syringe 5 ml Luer	PE/PP
	Sample tube	Tygon
	Pump tube	Silicone
	T-piece	PA
Acid-resistant accessories (optional)	Filling nozzle-UNF	PTFE
	Sample tube	Viton
	Pump tube	PTFE
	UNF-tube connection	PTFE
	UNF-T-piece	PTFE
	UNF - M5 – adapter connection (without specimen contact)	PEEK
	UNF female screw connection (without specimen contact)	PEEK

DS7800 | Accessories

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 ∅ 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.

Chemical-resistant tube set

DS7001
- 2x filling nozzle - UNF (PTFE)
- 2x UNF-tube connection (PTFE)
- 1x UNF-T-piece (PTFE)
- Specimen tube (PTFE)
- Pump tubing (Viton)

Corresponding connecting parts without specimen contact:
- 1x UNF-M5 adapter (PEEK)
- 8x UNF-female screw (PEEK)

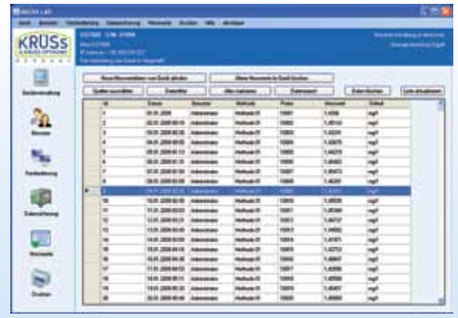
Replacement tube pump

DS7070
- Time controlled start/stop mode
- Variable rotation speed mode
- Pump head for tubes up to 5 mm external diameter included

Matrix printer

CBM910
24 characters plain paper dot matrix printer for:
- Density meters DS7000 series
- Digital refractometers from the DR6000 series
- Digital Abbe refractometer AR2008
- Digital polarimeters from the P8000 series

Software KrüssLab



The custom LIMS for your KRÜSS instruments.
For convenient remote control of refractometer, polarimeter and density meter.

- Simple installation with Windows Explorer
- Device management, remote control and measurement administration
- Uses the same intuitive layout as the touchscreen on your Krüss instrument, for direct PC control
- The PC stores measurement results as a local copy in the database
- Central control of an unlimited number of KRÜSS instruments

Calibration fluids

available on request

DS7800 | Services

- On-site maintenance
- Calibration using traceable standards (Federal Physical-Technical Institute (PTB))
- IQ/OQ/PQ start-up

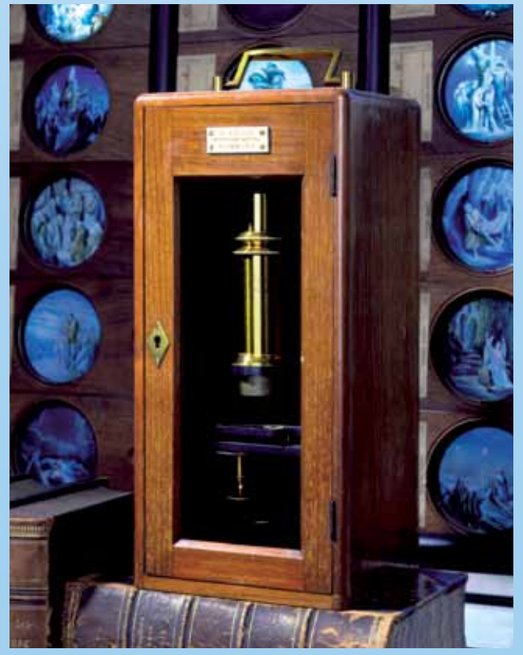
The History of A. Krüss Optronic

Trichina microscope from 1862

200 years of history is a long time for any company. The family enterprise of A. Krüss has spent this long keeping up with, and ahead of, some breathtaking developments in science, technology, optics and precision engineering.

An amazing number of high-precision optical and other quite different products have been shipped worldwide from the company's Hamburg laboratories.
Although some have long since been forgotten, many are known throughout the world. But let us return to the origins, to 1796 and the Hamburg workshop of Edmund Gabory, "Mechanicus Opticus".

Gabory was trained in London by none other than Jesse Ramsden, the world famous optician, at a time when precision engineering was flourishing. On finishing his training in 1790, Edmund set up a workshop of his own in London's Holborn. In 1796 he moved with his family to Hamburg, the international port and trading city.
This is where the talented optical engineer established his career and saw his business prosper.
In 1813 Gabory died, and the company was taken over by his widow Mary and their son Edmund Nicolas.
In 1823 Gabory's daughter Mary Ann married Andres Krüss.



Laboratory Microscope from 1885

The combination of scientific skill and Hanseatic business acumen, tradition and perspective proved to be a successful formula. Together with his wife and her brother, Andres Krüss led the company to further success, adding nautical instruments and charts to their product range. Brisk trade with the neighbouring Scandinavian and other foreign countries developed.
In 1844 Andres Krüss established a company of his own named Optical Institute A. Krüss. Four years later he fell victim to one of the cholera epidemics.
After his death, the company was first run by his widow who then handed it over to her sons Edmund and William in 1851.

In 1859 Edmund set up the company's own lens-grinding facility. In addition to camera lenses, they later manufactured projectors for dissolving views.
In order to demonstrate the quality of his photographic lenses, he opened his own photographic studio. He was awarded first prize for his lenses at the World Exhibition in London in 1862. In 1865, Krüss patented his famous Magic Lantern, forerunner of the cinema projector.

Still in existence, the original company of Edmund Gabory was merged with Optical Institute A. Krüss in 1886. After completing his training with distinction at Steinheil and his university studies in Munich, Edmund's son returned to take over the management of the company in 1888. In a period of many new inventions and scientific developments, Dr. Hugo Krüss established himself as a pioneer in theoretical and applied photometry. His Manual of Electromechanical Photometry became a standard work. In his capacity as chairman of the German Society for Precision Engineering and Optics, Dr. Krüss was appointed by the German government as an expert for customs and excise in 1892; while in office, he convinced the government to establish a tariff-heading specifically for 'scientific instruments'. In 1917, the Hamburg Senate awarded Dr. Krüss a professorship in recognition of his achievements in the scientific world and his engagement in public affairs.

In 1904 Hugo's son, Dr. Paul Krüss, had joined the family company at the age of only 24. The so-called 'master craftsman with a doctorate' managed the company from 1920 during the troubled times of crisis and World War, as well as during the later restructuring of the German economy. Using his international connections in the world of science, he developed a range of scientific instruments including laboratory equipment for schools.

Andres Krüss, Paul's son, was an engineer and became a partner in 1946 in the 6th generation.
Due to his hard work during the 'German Economic Miracle', Andres secured new customers and new markets. Dr. Paul Krüss died in 1976 at the age of 96. No one else had ever run the company so long.

Today the company is run in a seventh generation by Martina Krüss-Leibrock, who took over A. Krüss Optronic in 1980. Martina is the daughter of Andres, who died in 1992. In 2005, Martina's daughter Karin Leibrock joined the management of the company as 8th generation, and today the company remains famous for high-precision, state-of-the-art measuring instruments. The traditional craftsman's art of precision engineering has been perfectly combined with innovative electronic technology.

Astronomical direct vision spectroscope in front of the portrait of professor Hugo Krüss.

Martina Krüss-Leibrock and Karin Leibrock

Further Products available from A.KRÜSS Optronic GmbH

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

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Version 2.0 | State: August 2013 | subject to technical modification without notice / errors and omissions excepted