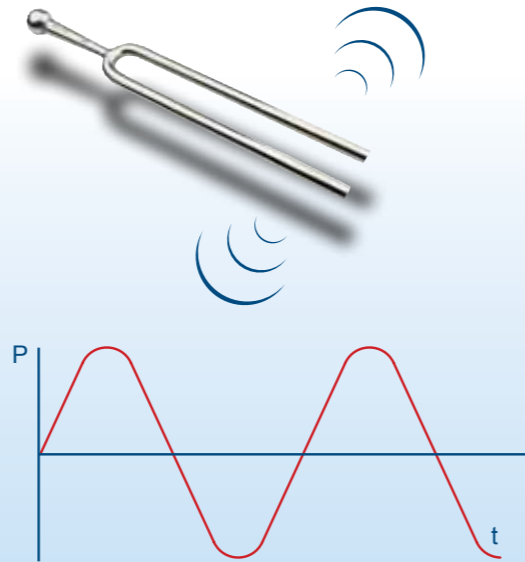


What is digital density measurement using the oscillating U-tube principle?

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 .

$$\rho = \frac{m}{V} \quad \text{It is measured in g/cm}^3 \text{ or kg/m}^3.$$

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/m ³]	Air [kg/m ³]
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.

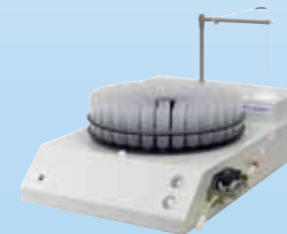
What are the advantages of digital density measurement?

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 viscous 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.



What is digital density measurement using the oscillating U-tube principle? 2

What is density? 2

What are the advantages of digital density measurement? 2

DS7800 | Density Meter 4

DS7800 | Accessories 8

DS7800 | Services 9

The History of A. KRÜSS Optronic 10

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.

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

Includes the following accessories:

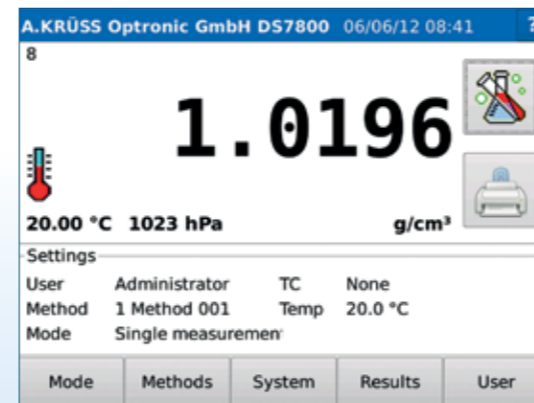
- Desiccation cartridge
- Rinsing and filling pump
- Tube set - standard:
 - 4 pc. adapter connection, Specimen tube,
 - Pump tubing, 10 pc. syringe 5 ml Luer, 1 T-piece
- Waste vessel
- Operating manual
- Test report and calibration certificate in accordance with N.I.S.T.



Main measurement display

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

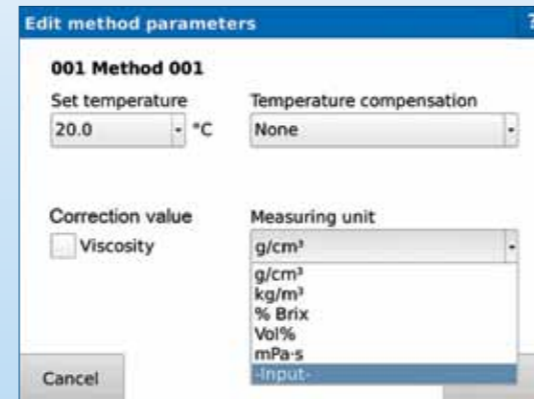
- Measurement value and unit
- Sample temperature
- Air pressure
- Method selected
- Status information



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.

Date+Time	Method	No.	Value	Unit	Set
06/06/12 08:17:58	Method 001	1	1.0196	g/cm³	20.00
06/06/12 08:22:28	Method 001	2	1.0196	g/cm³	20.00
06/06/12 08:30:29	Method 001	3	1.0196	g/cm³	20.00
06/06/12 08:31:27	Method 001	4	1.0196	g/cm³	20.00
06/06/12 08:31:30	Method 001	5	1.0196	g/cm³	20.00
06/06/12 08:31:33	Method 001	6	1.0196	g/cm³	20.00
06/06/12 08:31:36	Method 001	7	1.0196	g/cm³	20.00
06/06/12 08:34:36	Method 002	1	5.8040	% Brix	0.00
06/06/12 08:34:59	Method 002	5	5.8040	% Brix	0.00
06/06/12 08:36:59	Method 003	1	1019.6	kg/m³	20.00

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	