Anton Paar

Reference Guide

DMA 6002 CK
DMA 6002
DMA 5002 CK
DMA 5002
DMA 4002 CK
DMA 4002

Density Meter

Instrument software version: from 6.5

Find out more

www.anton-paar.com

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Date: June 2025
Document number: D98IB009EN-A
Original instructions

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1 Safety instructions

Read the documentation

- Read the documentation before using the product.
- Follow all hints and instructions in the documentation to ensure the correct use and safe functioning of the product.

1.1 General safety instructions

General

- The documentation is a part of the product. Keep it for the complete working life of the product and make it easily accessible to all persons involved with the product. If you receive any additions or revisions from Anton Paar, these must be treated as part of the documentation.

Liability

- This document does not claim to address all safety issues associated with the use of the product and samples. It is your responsibility to establish health and safety practices and to determine the applicability of regulatory limitations.
- Anton Paar only warrants the safe and proper functioning of the product if no modifications are made to mechanics, electronics, or software.
- Use the product only for the purpose described in the documentation. Anton Paar is not liable for damages caused by incorrect use of the product.
- The results delivered by the product depend on the correct function of the product and various other factors. We recommend that you have experts check the results (i.e., perform plausibility testing) before taking consequential actions based on the results.

General precautions

- Observe and adhere to your national safety regulations regarding the handling of all substances associated with your measurements (e.g. use safety goggles, gloves, respiratory protection, etc.).
- Substances used must be labeled. The corresponding material safety data sheets must be observed and made available near the measuring setup.
- Samples and cleaning liquids that have been used in the measuring system are not suited for human consumption after use.
- Check the wetted parts of the product for chemical resistance to all samples and cleaning liquids.
- Take care that samples, cleaning liquids and gases are chemically compatible when they come into contact with each other. They must not react exothermally or produce hazardous substances.

For products directly connected to electrical supply

- Install the product so that you can easily separate it from the electrical supply (pull the power plug) at any time.

Installation

- The installation procedure shall only be carried out by authorized personnel who are familiar with the installation instructions.
- Never use the product outside the specified ambient conditions and specifications.
- Use only accessories, consumables, or spare parts supplied or approved by Anton Paar.

Using the product

- Ensure that all operators have been trained beforehand to use the product safely and correctly.
- Before you start a measurement or cleaning procedure, take care that all parts of the measurement system are properly connected and in good condition.
- Before you start a measurement or cleaning procedure, check the injection adapters for leak tightness.
- Ensure that the product is sufficiently supervised during operation.
- In case of damage or malfunction, stop operating the product. Do not operate the product under conditions that could result in damage to goods or injuries or loss of life.
- If hazardous substances have been spilled on the product, immediately decontaminate it in an appropriate way.
- If you suspect that spilled substances got into the product, disconnect the product from the electrical supply and have it checked for electrical safety by a service technician authorized by Anton Paar.

Precautions for flammable samples and cleaning agents

- Keep potential sources of ignition, like sparks or open flames, at a safe distance from the product.
- Place the instrument on a laboratory bench made of fireproof material, preferably bricks, ceramics, or stoneware.
- Store only the minimum required amount of sample, cleaning liquids, and other hazardous materials near the product.
- Do not spill sample/cleaning liquids or leave their containers uncovered. Immediately remove spilled sample/cleaning liquids.
- Ensure that the setup location is sufficiently ventilated. The environment of the product must be kept free from flammable gases and vapors.
- Provide fire-extinguishing equipment.

Operation with explosive samples

– The product must not be used for the measurement of samples of explosion group IIC (such as carbon disulfide or acetylene).

Operation in areas with risk of explosion

– The product is **not** explosion-proof and therefore must not be operated in areas with risk of explosion.

Service and repairs

– Service and repair procedures may be carried out only by authorized persons or by Anton Paar.

Disposal

– Concerning the disposal of the product, observe the legal requirements in your country.

1.2 Conventions of safety messages and typography

Conventions for safety messages

The following conventions for safety messages are used in this document:

WARNING

Description of risk

Warning indicates a hazardous situation which, if not avoided, **could** result in death or serious injury.

CAUTION

Description of risk

Caution indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Description of risk

Notice indicates a situation which, if not avoided, could result in damage to property.

TIP: *Tip gives extra information about the situation at hand.*

Typographical conventions

The following typographical conventions are used in this instruction manual:

Convention	Description
Names for physical buttons *Labels for tabs, buttons etc. in the software*	The names and labels are written in *italic*.
Menu Level 1 > Menu Level 2	Menu paths are written in *italic*. The menu levels are connected using a closing angle bracket.

2 Overview

DMA 4002/5002/6002 measures the density by use of the oscillating U-tube method, which was first introduced on the market by Anton Paar in 1967. This cutting-edge digital density and concentration meter combines high precision with easy operation and robust design.

The instrument can be combined with a variety of modules for the measurement of additional parameters and with various sample changers for automatic sample filling.

Inside the instrument

– Your instrument is equipped with the world's most advanced digital density measurement technology, the patented Pulsed Excitation Method (AT 516420 (B1)).

– The oscillation periods of the U-tube and the reference oscillator are measured by optical pickups.

– Two integrated Pt 100 platinum thermometers together with Peltier elements provide an extremely precise temperature control of the sample.

– ThermoBalance™: The additional reference oscillator provides long-term stability and enables precise measurements over the whole temperature range of the instrument, with only one adjustment at 20 °C (68 °F).

– Viscosity-related errors are automatically corrected over the full viscosity range by measuring the damping effect caused by the viscous property of a sample. The result is subsequently used for the calculation of the viscosity-corrected density value.

Condition monitoring

– The built-in sensor for the atmospheric pressure enables the automatic calculation of the current air density required for adjustments and checks of the instrument as the air density is dependent on the atmospheric pressure.

– FillingCheck™: A major source of measuring errors with density meters are gas bubbles in the measuring cell. The instrument automatically detects inhomogeneities by an advanced analysis (e.g. of the density measuring cell's oscillation pat-

tern). Where necessary, a warning message is generated in real time for every single measurement.

– U-View™: Real-time images by a camera with zoom function enable you to visually inspect the density measuring cell.
– Condensation in the density measuring cell or the measuring cell block causes various problems. A built-in sensor determines the air humidity near the measuring cell and gives a warning if the temperature of the measuring cell block lies below the dew point.
– The Pulsed Excitation Method even improves operational safety as the condition of the density measuring cell can be monitored in detail.

User interface

– The touchscreen user interface guides you in an intuitive way through routine applications as well as demanding scientific research work.
– Freely define your favorites on the home screen and have quick access to the instrument functions that you need every day.
– Define your own products (in addition to the predefined product measurement settings), your own measurement parameters (derived from the parameters coming with the instrument), or the contents of output reports.
– Industry profiles allow you to turn the instrument into a measuring tool specific for your industry by activating additional predefined products, dashboards, and quantities.
– Export all measured data as a PDF or CSV file onto any connected storage device or a network share. Data can be printed via USB, network, or serial port.
– If you prefer, you can optionally connect an external keyboard or mouse and a barcode reader.

Compact and robust design

The instrument is ready for reliable measurements also in demanding environments due to:

– compact design
– sealed housing that withstands shocks, dirt, and spillages
– robust housing materials

2.1 Measuring principle

Definition of density and specific gravity

The density ρ of a sample is defined as mass m divided by volume V:

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

The specific gravity SG is calculated by dividing the density of a sample by the density of pure water at a defined temperature:

$$SG = \frac{\rho_{sample}}{\rho_{water}}$$

Density and specific gravity are highly temperature-dependent.

U-Pulse method

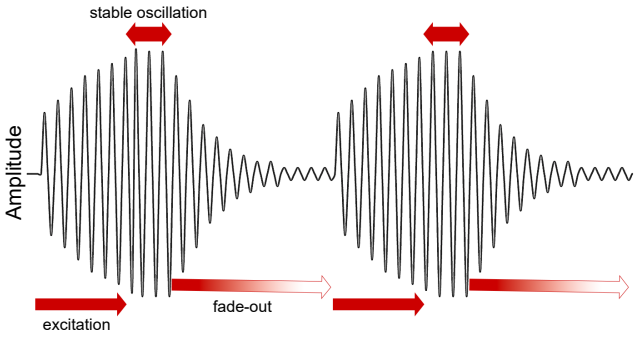


Fig. 1: *Outline of the U-Pulse (pulsed excitation) method*

The sample is introduced into a U-shaped tube made of borosilicate glass that is being excited to oscillate at its characteristic frequency, which changes with temperature and density of the filled sample. After having reached a stable oscillation, the excitation is switched off, and the oscillation fades out. The excitation and fade-out sequence is repeated continuously. This patented U-Pulse method (AT 516420 (B1)) allows the instrument to determine the quality factor of the oscillating U-tube in a sophisticated way that provides deeper insights into the sample's characteristics compared to any other oscillating U-tube method. U-Pulse provides a viscosity correction two times better than any other measuring principle, a better repeatability of the density result, and detection of gas bubbles in the sample.

Through precise and continuous monitoring of the oscillation pattern during excitation and fade-out, followed by a mathematical conversion, the density of the filled sample can be determined.

The density ρ is calculated from the quotient of oscillation periods of the U-tube and the reference oscillator.

$$\rho = A \cdot PQ^2 \cdot f_1 - B \cdot f_2$$

A, B *instrument-specific constants*
PQ *oscillation period of the U-tube divided by the oscillation period of the reference oscillator*
f_1, f_2 *correction factors for temperature, viscosity and non-linearity*

Concentration measurement

In binary mixtures, the density of the mixture is a function of its composition. Thus, the density value of a binary mixture can be used to calculate its composition with the aid of density/concentration tables.

This is also possible with so-called quasi-binary mixtures. These are mixtures containing two major components and some additional components present in

very small concentrations compared to the two main components. Many decarbonated soft drinks, for example, can be considered to be quasi-binary solutions of sugar in water because the concentration of flavors and acids are very small compared to sugar and water. Hence the sugar concentration can be measured with a density meter.

Note that the accuracy of the concentration measurement depends not only on the accuracy of the density measurement, but also on the slope of the correlation between density and concentration. For example, a density measurement with an accuracy in the order of ±0.00001 g/cm³ yields an ethanol value with an accuracy in the order of only ±0.02 % w/w (at 20 °C/68 °F).

2.2 Intended use of the instrument

Your instrument is capable of measuring liquids in a wide viscosity range. Concentrations can be determined in binary and quasi-binary mixtures.

Some samples need a special treatment before measurement, like degassing (samples with a tendency to bubble formation), or they need a special filling technique.

Restrictions

– Do not leave bases longer than necessary in the density measuring cell because the glass of the measuring cell is susceptible to attack by alkaline liquids.

Exclusions

– The instrument cannot measure solids.
– Do not measure hydrofluoric acid as it attacks the glass of the density measuring cell.
– Do not fill substances that may harden inside the measuring cell.
– Do not mix substances inside the measuring cell if these substances may react chemically.
– Do not use mechanical action for cleaning the measuring cell.
– Diet measurements are not available on DMA 4002.

IMPORTANT: *Always check if recommendations of the instrument (e.g. from the instrument's intelligent condition monitoring) are reasonable.*

2.3 Functional components

Fig. 2: *Front and right side of the instrument*

1 Touchscreen
2 Power LED
3 Status light
4 Air pump outlet (5 mm barbed)
5 Socket for U-Dry
6 Sample inlet and outlet
7 Extension slot cover plate
8 Recessed grip for transportation

Table 1: Status light

Color & behavior	Status
White constant	Instrument ready / also during checks or adjustments
White pulsed slowly	Instrument busy (ongoing measurement / drying procedure)
Green constant	Measurement finished without error/warning
Yellow constant	Warning during measurement
Red constant	Error during measurement

CAUTION

Prolonged direct viewing of the LED lights may cause eye discomfort or potential damage

Do not stare continuously into the LED-lights.

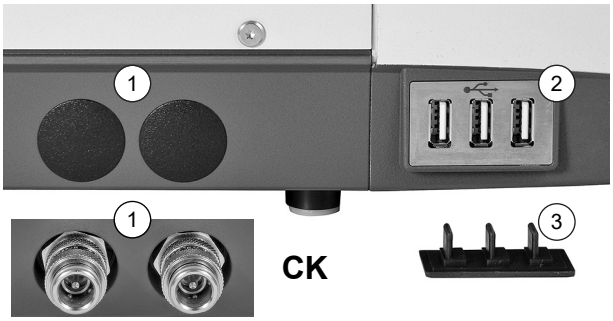


Fig. 3: *Left side of the instrument*

1 Standard models: Blind covers | CK models: Inlet and outlet connectors for the cooling kit
2 USB 2.0 sockets (type A), 3x
3 Protection cover for the USB sockets

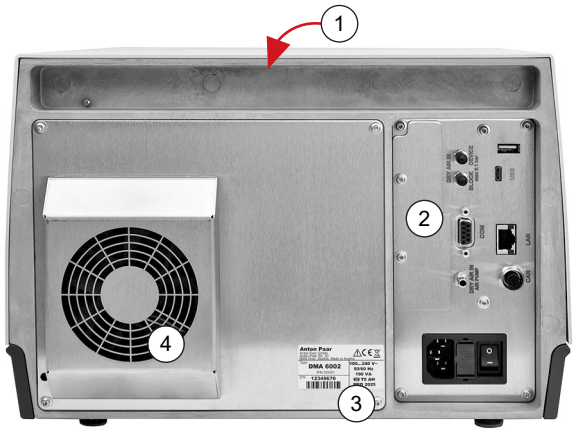


Fig. 4: *Rear of the instrument*

1 Ledge handle for transportation
2 Connectors on the rear
3 Type plate with serial number (P/N = mat. no.)
4 Fan

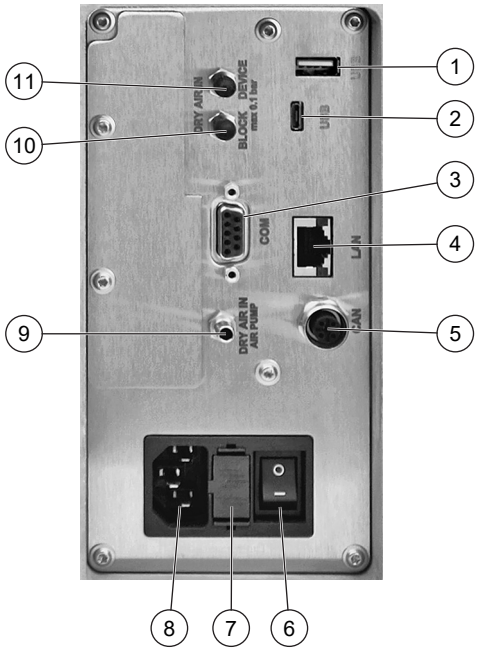


Fig. 5: *Rear connectors of the instrument*

1 USB 2.0 socket (type A)
2 USB OTG socket (Micro-A)
3 COM / RS-232 serial port (DE-9F connector)
4 Ethernet terminal (RJ45 connector)
5 CAN interface (for the connection of further measuring modules)
6 Power on/off switch
7 Fuse holder
8 AC power jack
9 “DRY AIR IN AIR PUMP” connector (5 mm barbed): air pump inlet
10 “DRY AIR IN BLOCK” connector (3.5 mm barbed), max. 0.1 bar (1.5 psi) rel.: drying of measuring cell block / camera view
11 “DRY AIR IN DEVICE” connector (3.5 mm barbed), max. 0.1 bar (1.5 psi) rel.: drying of instrument’s interior

3 Supplied parts

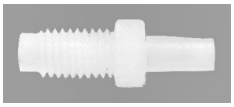
The product was tested and packed carefully before shipment. However, damage may occur during transport.

– Keep the packaging material (box, foam piece, transport protection) for possible returns and further questions from the transport and insurance company.
– Check the delivery for completeness by comparing the supplied parts to those noted in the table(s) below.
– If a part is missing, contact your Anton Paar representative.
– If a part is damaged, contact the transport company and your Anton Paar representative.

Table 2: Supplied parts

	Qty.	Description	Mat. No.
	1	DMA 4002 or DMA 5002 or DMA 6002	325153 325159 325201
		or CK model with cooling kit DMA 4002 CK or DMA 5002 CK or DMA 6002 CK	 325590 325628 325729
	1	Power cable	
	1	Instruction Manual and Safety Information English	388442
	1	Waste vessel 500 mL	6210
	1	Density standard ultra-pure water 5x10 mL with works certificate	96044

Table 3: Supplied accessory kit DMA HR02 series

	Qty.	Description	Mat. No.
	1	Accessory kit DMA HR02 series	387989
		containing:	
	1	U-Dry complete	385485
	2	U-Dry Luer cone	385650
	1	Syringe holder 02	387520
	1 m	Hose 4x6 mm silicone *only for pressures up to 0.4 bar rel.*	57024

	Qty.	Description	Mat. No.
	1	Hose 300x3x2 PTFE “AA”	3443
	1	Hose 140x3x2 PTFE 2x¼”–28 UNF	187223
	1	Hose 85x3x2 PTFE 2x¼”–28 UNF	387864
	3	Syringe 2 mL Luer	51974
	2	Injection adapter UNF ¼” black	159025
	1	Male Luer plug PTFE	63865
	1	Adapter Luer cone PTFE black	384626
	2	Adapter Luer ¼” UNF	64792
	3	Hose clamp Dmin 5.8 Dmax 6.5	21531
	2	Pan head screws M3x16	66750
	3	Pan head screws M2x6	68028
	1	Phillips screwdriver PH-0x40	75030

Table 4: Optional accessories and consumables

Description	Mat. No.
Data I/O	
Keyboard USA USB	80807
Keyboard German USB	80809
Barcode scanner 2D with USB cable	189615
Printer Epson TM-U220	93362
Network	
Wi-Fi/Bluetooth dongle	194727
Protection	
Protecting cover for keyboard	13350
Interface caps DMA HR01 series	232006
Special funnel protection	82448
Special application accessories	
Aerosol adapter	74650
Drying cartridge	65085
Heating attachment	83161
Syringes	
Syringe 2 mL Luer (1 pc.)	51974
Syringes 2 mL Luer (10 pcs.)	58802
Syringes 2 mL Luer (1000 pcs.)	66399
Syringes 5 mL Luer (100 pcs.)	6772
Calibrations	
ISO 17025 calibration density/temp G2	219479
ISO 17025 calibration density G2	157100
ISO 17025 calibration temperature G2	219481
ISO 17025 extra calibration density	157102
ISO 17025 extra calibration temperature	219483

4 Installation

If you install the instrument in a measurement system, proceed as described in the documentation of the measurement system.

Table 5: Installation procedure

	Step	refer to
1	**Place** the instrument on a bench in an appropriate environment.	Section 4.1 [▶ 15]
2	Mount the **injection adapters** and check for **leak tightness**.	Section 4.2 [▶ 15] Section 4.3 [▶ 16]
3	Mount **U-Dry** and the **hoses,** and connect the **waste vessel**.	Section 4.4 [▶ 16]
4	*CK models only:* Connect the **cooling**.	Section 4.6 [▶ 17]
5	Connect the instrument to the **power supply** and **switch** it **on**.	Section 4.7 [▶ 18] Section 4.8 [▶ 18]
6	Define basic **instrument settings** and perform **first checks**.	Section 4.9 [▶ 18]

Installation of modules, sample changers, and other optional parts

NOTICE

Risk of damaging the instrument

Never plug or unplug CAN cables while the instrument is switched on.

For the installation of optional parts, refer to the particular instructions coming with the part or to the corresponding section in this manual.

WARNING

Risk of electric shock

Connect only voltages that comply with PELV (protective extra-low voltage) according to EN 61140 or with SELV (safety extra-low voltage) according to EN IEC 62368-1 to the interface connectors (except the power inlet) of the instrument.

IMPORTANT: *Connect only Anton Paar equipment with a maximum power consumption of 40 W to the CAN interface. Otherwise the instrument will not work. The CAN power supply, mat. no. 100655, enables you to increase the maximum load.*

4.1 Installation requirements

Read the Safety Instructions in Section 1 [▶ 7].

Find all Technical Data in Appendix A [▶ 71].

Allow the equipment to reach ambient temperature before installation. This is very important if the equipment has been stored or transported at lower temperatures.

IMPORTANT: *High humidity or a measuring temperature that is significantly below the ambient temperature may lead to condensation in the density measuring cell. In this case take measures to avoid condensation – consider using a drying cartridge.*

The right place

The instrument is designed for operation under typical laboratory benchtop conditions.

The setup location and surroundings must meet the minimum requirements specified under “Operating conditions” in the Technical Data (Appendix A [▶ 71]).

NOTICE

No spray water protection

Consider that the instrument is not protected against spray water.

Place the instrument on a stable, flat bench which is free of vibrations and away from vibrating equipment.

To ensure temperature stability and trouble-free measurement, do **not** position your instrument:

- next to a heating facility
- in a drafty place (e.g., near an air conditioning, ventilation system, or an open window)
- in direct sunlight

NOTICE

Do not inhibit heat dissipation

A strong built-in cooling fan dissipates heat through the bottom and rear of the instrument. Ensure that the air flow is not blocked and provide for a minimal distance of 10 cm (4 in) to walls behind and beside the instrument.

The instrument requires an electrical outlet nearby:

- 100–240 V~, 50/60 Hz, fluctuation ±10 %

4.2 Mounting the injection adapters

Fig. 6: *Injection adapters mounted, front view (left) and top view (right)*

1. Take two injection adapters, mat. no. 159025, with screws from the accessory kit.

2. Pull the black plastic transport plugs out of the injection adapters' tips.

TIP: *Keep the transport plugs for later use. In case of leaks, you can widen the tips of the adapters with the transport plugs.*

3. Carefully insert the injection adapters into the sample inlet and outlet openings. Push the adapters in with moderate force.
4. Fix the adapters with the screws:

   Slide the screws through the bore holes of the adapters and tighten them cautiously until some resistance against further turning can be felt.

CAUTION

Possible leakage of dangerous liquids

If the fixing screw for the adapter is overtightened, the density measuring cell may get damaged. Dangerous liquids leaking from the instrument may cause injuries or risk of fire.

– Tighten the screw until some resistance against further turning can be felt, then stop to tighten the screw.
  The gap left between the holding plate and the adapter, where the thread of the screw can be seen, is approx. 3–8 mm (0.12–0.31 in).

4.3 Leak tightness test

CAUTION

Possible leakage of dangerous liquids

Dangerous liquids leaking from the instrument may cause injuries or risk of fire.

– Check the connections for leak tightness before you fill dangerous liquids.

1. Screw the adapters Luer ¼" UNF, mat. no. 64792 (from the standard accessory kit), into the openings of the injection adapters.
2. Close one adapter tightly with a male Luer plug, mat. no. 63865 (from the standard accessory kit).
3. Draw up air into a plastic syringe (from the standard accessory kit) and attach the syringe to the other adapter.
4. Inject, with moderate pressure, the air in the syringe into the instrument.
5. Wait a few seconds, then release the plunger of the syringe.
   – If the connections are tight, the plunger of the syringe will be slowly pushed back by the pressure in the measuring cell.
   – If the connections are leaky, the plunger of the syringe will not move.
     In this case remount the adapters and repeat the leak tightness test.

TIP: *In case of leaks, you can widen the tips of the adapters with the transport plugs of the adapters.*

4.4 Mounting U-Dry, all hoses, and waste vessel

For syringe filling, install U-Dry.

All parts required for this installation come with the standard accessory kit, mat. no. 387989.

For all instructions refer to Fig. 7 [▶ 16].

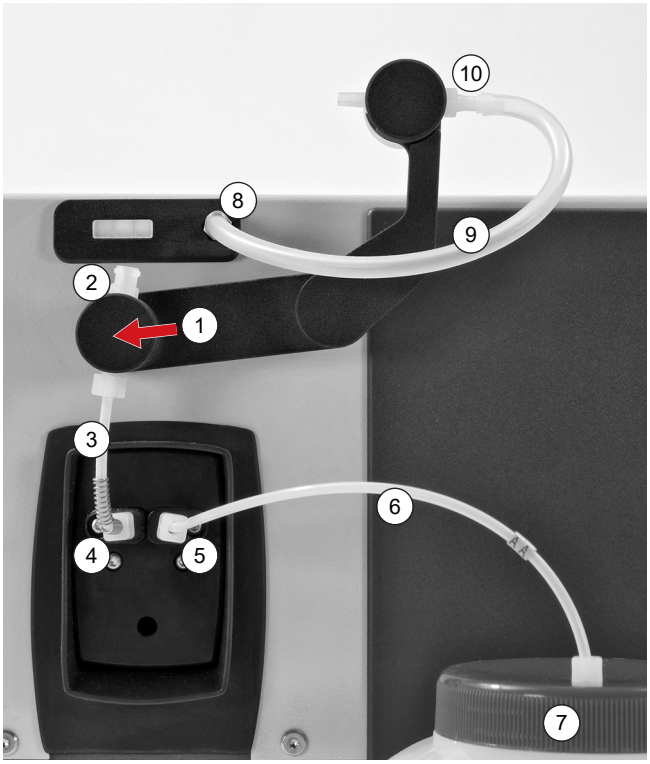


Fig. 7: *Mounting U-Dry, all hoses, and waste vessel*

1	*U-Dry / direction of insertion into socket (tapered dovetail on the back)*
2	*Adapter Luer ¼" UNF (locked by a fixing screw)*
3	*Hose 85x3x2 PTFE 2x¼"–28 UNF, mat. no. 387864*
4	*Sample inlet adapter*
5	*Sample outlet adapter*
6	*Hose 300x3x2 PTFE "AA", mat. no. 3443*
7	*Waste vessel*
8	*Air pump outlet*
9	*Air pump hose*
10	*U-Dry Luer cone*

U-Dry

1. Take U-Dry (1) from the accessory kit.
2. Insert the tapered dovetail of U-Dry into the socket on the instrument (figure below).

   It may be necessary to loosen the fixing screw first with the Phillips screwdriver from the accessory kit.

   Push U-Dry in firmly until you hear a clicking sound.

3. Tighten the fixing screw in the socket to secure U-Dry in place.

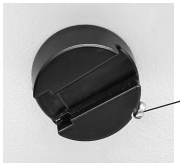


Fig. 8: *Socket and fixing screw*

To unmount U-Dry, loosen the fixing screw and pull U-Dry out of the socket. Do not push it from the opposite side.

CAUTION

Possible leakage of dangerous liquids

Dangerous liquids leaking from the instrument may cause injuries or risk of fire.

- Only use the supplied hoses and waste vessel if their materials are resistant to your samples and cleaning liquids.
- If the supplied parts are not suitable, use other parts made of an appropriate material.

Filling hose

1. Screw one end of the hose 85x3x2 PTFE, mat. no. 387864, into the lower screw hole of U-Dry (3).
2. Screw the other end of the hose into the injection adapter of the sample inlet (3+4).

   Choose any of the two injection adapters (4 or 5), whichever suits your needs better. The other one will be the sample outlet adapter.

Waste hose / waste vessel

You can use hose 140x3x2 PTFE, mat. no. 187223, or hose 300x3x2 PTFE, mat. no. 3443, as the waste hose, whichever suits you better.

1. Screw one end of the waste hose into the threaded hole in the cap of the waste vessel (6+7).
2. Screw the other end of the waste hose into the sample outlet adapter (5+6).

IMPORTANT: *Always keep the waste vessel closed with the lid during operation.*

Air pump hose

1. Cut a piece of approx. 18 cm (7 in) length from the supplied silicone hose 4x6, mat. no. 57024.
2. Connect one end of the hose piece to the air pump outlet (8+9).
3. Connect the other end of the hose piece to the Luer cone of U-Dry (9+10).

4.5 Mounting the syringe holder as an air hose dock

If you do not use syringe filling via U-Dry, install the syringe holder 02, mat. no. 387520, as a parking place for the air pump hose adapter.

1. Take the syringe holder from the accessory kit.
2. Insert the tapered dovetail of the syringe holder into the socket for U-Dry on the instrument.

   Depending on which side of the syringe holder you slide into the socket, you can switch between two parking positions. Choose the position that suits your needs better.

   Push the syringe holder in firmly until you hear a clicking sound to ensure it is securely in place.

Air pump hose for the syringe holder

1. Cut a piece from the supplied silicone hose, mat. no. 57024. Its length depends on your measurement setup. You should be able to reach all connectors that require air from the air pump.
2. Attach the supplied adapter Luer cone PTFE black, mat. no. 384626, to one end of the air pump hose.
3. Connect the other end of the air pump hose to the air pump outlet.
4. Stick the adapter on the air pump hose into the top hole of the syringe holder to keep the air pump hose from hanging loose while not used for drying.

4.6 Connecting the cooling

(Only for CK models of the instrument)

When you perform measurements at temperatures more than 15 °C (27 °F) below ambient temperature, connect the cooling to an external thermostat. If your tap water is cool enough, also connecting to a tap water supply will help. Operate the cooling with a moderate flow of water (1–3 liters per minute).

Table 6: Requirements for the cooling unit

Temperature range	5 °C to 30 °C (41 °F to 86 °F)
Maximal pressure	1 bar (14.5 psi) relative
Connector	self-locking coupling 8 mm, type Rectus 21KBTS08MVN, mat. no. 75090

Example

Your ambient temperature is 25 °C (77 °F), and you want to perform measurements at 0 °C (32 °F).

1. Connect the instrument to an external thermostat or a tap water line delivering water at a constant temperature between 5 °C (41 °F) and 15 °C (59 °F).
2. Set the measuring temperature to 0 °C (32 °F).

4.7 Power connection

WARNING

Risk of electric shock or fire

- Connect the instrument only to an electrical outlet with protective earthing.
- Never connect the instrument to the AC power supply with protective separation or protective insulation.
- Ensure that the non-fused earth conductor of the power cable is connected to earth.
- Ensure that the current rating of the power cable is at least 10 A.

NOTICE

Possible damage due to wrong voltage

- Before you switch on the instrument, make sure that the correct line voltage and line frequency are available (AC 100–240 V, 50/60 Hz).
- If large voltage fluctuations are to be expected, we recommend using a constant voltage source (UPS).

Use the supplied power cable to connect the AC power jack of the instrument with a suitable electrical outlet.

4.8 Switching the instrument on/off

Use the power switch on the rear of the instrument to switch the instrument on or off.

- When the instrument is switched on, the home screen will come up on the display.
- After power-on wait at least 15 minutes for the internal temperature to stabilize.

TIP: *Do not turn off the instrument during the night. This allows the measuring cell to achieve long term temperature stability.*

IMPORTANT: *After you have switched off the instrument, the electrical components stay live for a few seconds. If you have to restart the instrument, switch it off and wait approx. 15 seconds before switching it on again.*

4.9 Basic instrument settings and first checks

IMPORTANT: *Select the industry profile that suits your applications before changing other instrument settings (refer to Section 6.1 [▸ 26]).*

IMPORTANT: *Wait at least 15 minutes after a restart for the internal temperature to stabilize.*

1. After installation, set the instrument settings (refer to Section 6 [▸ 26]).
2. If you don't want to use the predefined products, you may define your own products or other measurement settings (refer to Section 7 [▸ 30]).

   If you want to use product settings already defined on another instrument, you can import them (refer to Section 7.1.1 [▸ 30]).
3. Conclude initial setup with an air check and a water check (refer to Section 9.2 [▸ 42]) to verify that your instrument is in perfect condition. Your instrument has been factory adjusted over the whole temperature and viscosity range, but during transport the density adjustment may have been compromised.
   - If both checks succeed, your instrument is ready for routine measurements.
   - If a check fails, clean the measuring cell thoroughly and repeat the check.
   - If the check still fails, perform an air/water density adjustment as described in Section 9.3 [▸ 44].
4. *For diet measurements with industry profile Beverages:*

   Perform initial diet adjustments for all your diet products as diet measurements will not be possible without them:
   - For each diet product create a measurement and start a process water adjustment and a concentration adjustment there (missing adjustments are preselected).

     A process water adjustment is only necessary for the first diet product. It will be automatically used for all other diet products.

TIP: *The process water adjustment and the concentration adjustment for the first diet product will be performed in one run.*

5 Operation

TIP: *If you do not see all functions described in this manual, if you cannot access certain settings, or if you cannot perform some procedures, this may be due to restricted user permissions. Refer to Section 13 [▸ 57] for a description of system security and user management.*

5.1 Basic operation and input devices

IMPORTANT: *All instructions in this manual relate to touchscreen operation.*

5.1.1 Touchscreen

Basically, you can operate your instrument like a smartphone. The touchscreen of the instrument accepts the following finger movements.

Tap

Tap on any functional element, and it will do whatever its purpose is: a button will initiate an action, a switch will change its state, a drop-down box will fold out a selection list, etc.

Tap on an item to select it.

Hold

Tap and hold your touch a little longer. Holding a screen element may pop up options depending on the context. For example, on the onscreen keyboard, holding some keys will open a box with more options to select from (if available).

Drag

Holding and dragging a screen element will move it up, down, left, right, if the operation is available.

Slide

Slide a finger on the screen in one direction. The operation is similar to dragging.

To access the dashboard, slide up the current screen (provided it is not modal). To return, slide down the dashboard.

To **scroll** information that does not fit on the screen, slide it up/down or left/right (if available). To scroll items in a list, slide up/down in the list. In these cases, a slider will appear (and after some time disappear again) beside (for up/down) or below (for left/right) the text.

TIP: *Sometimes it may not be clear whether portions of an information are out of screen. Simply try scrolling this part of the screen to make sure.*

5.1.2 Onscreen keyboard

If you tap on an input field, an onscreen keyboard will slide in so that you can type text or numbers.

You may see variants with a subset of characters, depending on reasonable options for the particular input field.

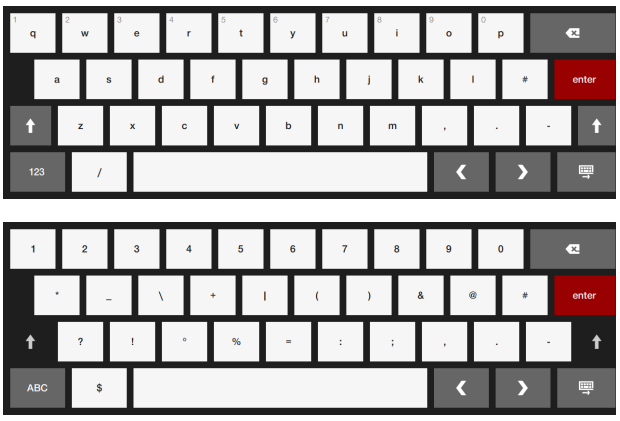


Fig. 9: *Example onscreen keyboards (English) – above: alphabetic | below: numerical*

– Tap on characters to enter them at the cursor position in the input field.
– Some keys of the onscreen keyboard (e.g., upper row on the alphabetic keyboard) provide multiple character options to select from:
  – Hold the key until a character selection box folds out (example below).

Fig. 10: *Example character selection box on "e" key*

  – Then tap on one of the keys in the selection box to enter it at the cursor position in the input field.

  Special characters on the alphabetic keyboard:

  – @: Hold “1” key (top row) and select.
  – ^{2}: Hold “2” key (top row) and select.
  – ^{3}: Hold “3” key (top row) and select.
  – $: Hold “4” key (top row) and select.
– Some keys have special functions. Refer to Table 7 [▶ 19] for their meaning.

Table 7: Function keys on the onscreen keyboard

	Hides the onscreen keyboard. (Tap on the input field to have it reappear.)
123	Switches alphabetic/numerical keyboard to numerical/alphabetic keyboard.
ABC	
	Shifts the next letter to upper case. (Disabled on the numerical keyboard.)
	Moves the cursor (entry point for the next character) left/right.
	
	Deletes the character left of the cursor.
enter	Finishes input and hides the onscreen keyboard.

5.1.3 USB mouse (optional)

If you connect a USB mouse to one of the instrument’s USB sockets, you can use it in addition to the touchscreen.

The mouse will be detected and installed automatically when plugged in.

Touchscreen operations translate to mouse operations as follows:

– A mouse **click** is equivalent to a touchscreen tap.
– A mouse **click and hold** is equivalent to a touchscreen hold.
– A mouse **drag** is equivalent to a touchscreen drag.

– There is no mouse equivalent for a touchscreen slide.

  However, you can also access the dashboard by a click operation.

  A mouse **scroll** (with a scroll wheel) is equivalent to a touchscreen scroll. You can also drag with the mouse to scroll.

5.1.4 USB keyboard (optional)

If you connect a USB keyboard to one of the instrument's USB sockets, you can use it in addition to the touchscreen for data input.

The keyboard will be detected and installed automatically when plugged in.

Set the keyboard layout according to your USB keyboard so that the correct characters will be entered, refer to Section 6.2 [▶ 27].

– Select any input field and type on the keyboard to enter text or numbers.

5.1.5 USB barcode reader (optional)

If you connect a USB barcode reader to one of the instrument's USB sockets, you can use it in addition to the touchscreen for data input.

IMPORTANT: *The barcode reader has to be configured as "USB Keyboard HID" (refer to the manual of the barcode reader).*
If you encounter reading problems, refer to the manual of the barcode reader, further settings may be necessary.

TIP: *If you get incorrect readings directly after starting the barcode reader or when reading in quick succession, try to increase the keystroke delay and the USB polling interval, or disable "USB Fast HID" (refer to the manual of the barcode reader).*

The barcode reader will be detected and installed automatically when plugged in.

– Select any input field and scan a barcode to enter text or numbers.

5.1.6 USB memory devices (optional)

IMPORTANT: *USB memory devices have to be formatted with FAT32 or exFAT file system.*

If you connect a USB memory device to one of the instrument's USB sockets, the icon in the header shows that it is ready for use.

– To safely remove the USB memory device, always tap beside the corresponding header icon.

5.2 Functional screen elements

Common screen elements

– The Home button on any screen brings you back to the home screen (where you basically start all operations).

– Tap to go back to the previous screen.

– Tap to open the menu.

– Tap to access the dashboard.

5.2.1 Header

The header at the top of the screen always keeps you concisely informed on crucial instrument settings including the instrument date/time.

– Tap on an element in the header to have a control panel slide in showing more details or associated operations or a selection of settings that you can change on the fly.

– Tap anywhere outside the control panel to close it.

5.2.2 System notifications

System notifications are collected in the header under . A number beside the symbol shows the number of collected notifications. Colors indicate the notification category.

Table 8: Notification categories

	Error: A severe problem has occurred, which needs to be solved before you continue with your measurements.
	Warning: A minor problem (may be temporary) or a reminder requires your attention.
	Information: Non-critical message from your instrument.

– Tap to view all notifications.

– Tap on a notification to see all available details.

5.2.3 Favorites button

The favorites button adds (☆) or removes (★) a link to the current spot on the home screen. It switches between the two states "already added" (★) and "not yet added" (☆).

Favorites on the home screen give you quick access to the instrument functions that you need every day.

5.2.4 Combined links

Lists and link collections may combine links to an element with an icon linking directly to a corresponding task.

Fig. 11: *Example of a product link combined with a shortcut to the measurement setup with this product*

1 Links to the product settings
2 Links to measurement setup

If you add the link to a product measurement as a favorite, the favorite will also show a link to the measurement setup (to facilitate quick modifications).

Fig. 12: *Example of a favorite combining a link to the measurement setup (for a product) with direct measurement start (with the product settings)*

1 Links to measurement setup
2 Directly starts a measurement

5.2.5 Action boxes

Action boxes contain tools suited for the context in which they appear. They are used in spots as **spot actions** or with lists as **list actions**.

– Tap ··· to fold out more details of an action box.

  Details include explanations of the icons or may even reveal more tools:

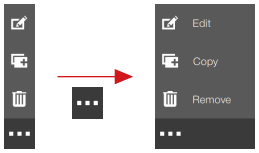


Fig. 13: *Example of a spot action without/with details*

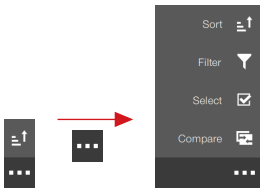


Fig. 14: *Example of a list action without/with details*

Action controls

Some actions open action controls. Multiple action controls can be open at the same time.

An action control consists of three parts:

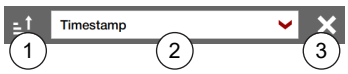


Fig. 15: *Example of an action control for sorting a list*

1 Icon identifying the action control
2 Control part defining the actual function
3 Close button of the action control

– Tap on the control part to configure the control function (further settings may fold out).

Some action controls look like this:

Fig. 16: *Example of an action control for selecting and then removing, exporting, comparing, or printing the selected items*

In this case even the identifying icon carries a function (select/deselect all items by tapping on the icon).

– Tap on one of the icons in the control part to start an activity controlled by the action.
– Tap ☒ to close an action control.

5.3 Screens – navigation, information, control

5.3.1 Home screen – your favorites

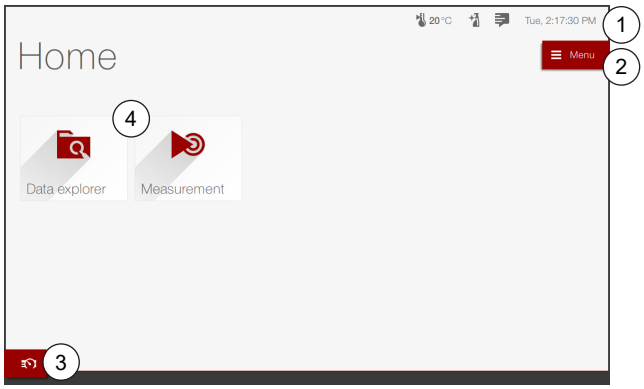


Fig. 17: *Example home screen*

1 Header
2 Menu button
3 Dashboard button
4 Currently added favorites

The home screen collects your favorites (4) giving you quick access to the instrument functions that you need every day.

It is the first screen that you see when the instrument has finished its initialization routines, and it is the place where you basically start all operations.

The Home button ⌂ always brings you back to the home screen. Alternatively tap ← (back) repeatedly.

The instrument comes with useful favorites already placed on the home screen. Of course, you can completely define and arrange the favorites on the home screen as you like:

– Hold a favorite on the home screen, then drag it to a different place.
– Hold a favorite on the home screen, then remove it (tap 🗑).
– To add new favorites, tap ☆ where available.

  New favorites are marked *New* on the home screen until you first use them.

5.3.2 Menu – all the functions

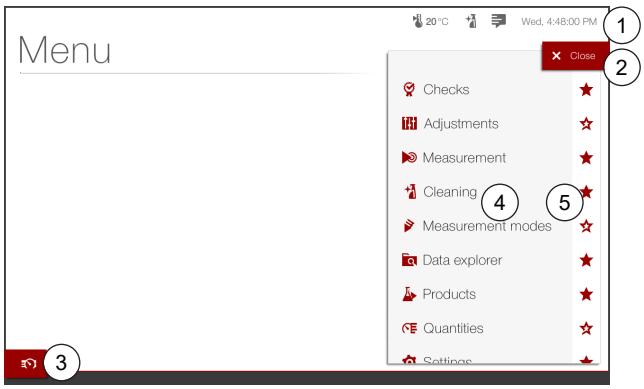


Fig. 18: *Example menu screen*

1 *Header*
2 *Close button (closes menu)*
3 *Dashboard button*
4 *List of functions*
5 *Select/deselect functions as favorites here*

The menu links to all functions available on your instrument.

When you tap ≡, it is superimposed on the current screen.

– If you tap on a function in the list (4), you will be taken directly to the spot (with maybe further selections, depending on the function).
– To add/remove functions as favorites on the home screen for quick access, select/deselect them in the column (5) on the right.

5.3.3 Spots

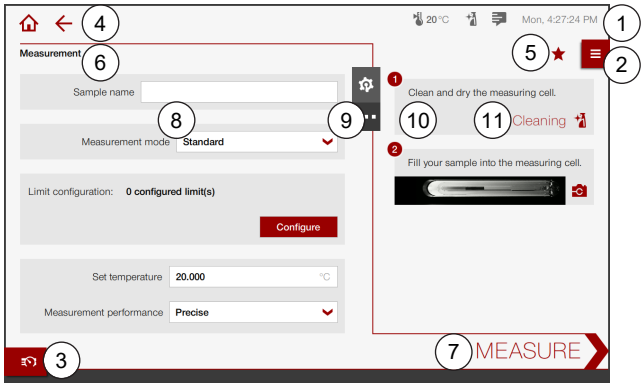


Fig. 19: *A typical spot screen*

1 *Header*
2 *Menu button*
3 *Dashboard button*
4 *Return to the previous screen or the home screen*
5 *Select/deselect the spot as a favorite here*
6 *Spot title: start here, follow the red line ...*
7 *... and end here (initiate a target action)*
8 *Settings for the task*
9 *Spot actions*
10 *Hints for the task / steps for the procedure*
11 *Link to a preparatory procedure*

A spot assembles all operations and settings for a specific task in one place. Spots can be quite diverse, but they share a common concept and a similar layout.

Work your way through a spot step by step, starting at top left (6) and finishing at bottom right (7).

Spot actions (9) provide tools to deal with the whole spot or with elements of it. Available actions depend on the spot.

The spot will give you useful hints for the task (10) and also guide you through preparatory or intermediate procedures, for example allowing you to start and stop components of the measurement system (11).

Usually, one side of the red line is reserved for settings pertaining to the spot (8). Before you start an operation, check if the settings are appropriate, and edit them if required. Spots will allow to edit modifiable settings either directly or via spot actions.

TIP: *Be sure to scroll down the settings area to see all available settings.*

You can always switch to the dashboard and back (3).

Spots can be added to your favorites on the home screen for quick access (5).

5.3.4 Wizards

Wizards are similar to spots except that they will not allow you to depart from the set course of a procedure. Wizards guide you through procedures when the correct sequence of steps is crucial.

Therefore, a wizard will only allow you to follow the procedure to the end – or to cancel the whole procedure. (Wizards are modal screens.)

5.3.5 Dashboards – the measurement stage

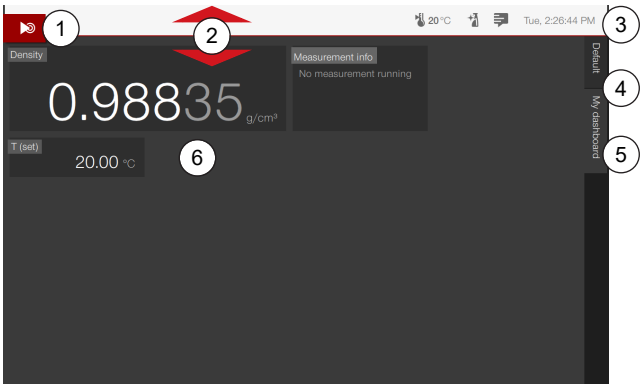


Fig. 20: *Example dashboard*

1 *Return to the current screen*
2 *Slide up to access dashboards / slide down to close dashboards (return to the current screen)*
3 *Header*
4 *List of dashboards*
5 *Current dashboard*
6 *Widgets on the dashboard*

A dashboard serves to monitor your measurements.

– Slide the bottom of the current screen up (unless it is a modal screen) to access the dashboards.

  Or tap .

– Slide the top of the dashboards down to return to the current screen (2).

  Or tap the button in the top left corner (1).

Managing dashboards

Holding the name of a dashboard in the list of dashboards (4) allows to **copy** the dashboard (), to **remove** it (), or to **edit** its name ().

Creating your own dashboard

The instrument comes with various predefined dashboards, however, you can create your own dashboard entirely according to your requirements.

– You may consider copying an existing dashboard, and then edit the copy.

– Or you can create an entirely new dashboard:

  – Hold any part (widget or background) of the current dashboard to switch it into edit mode.

  – Tap .

  – Enter a name and tap *Create*.

  – Start adding widgets to the empty dashboard.

5.3.6 Widgets on a dashboard

IMPORTANT: *To change the **output quantities** shown on the dashboard, or to change the **units** of an output quantity, edit the widget's properties.*

Holding any part (widget or background) of the dashboard switches the dashboard into **edit mode** (figure below). Note the grid lines used to arrange the widgets.

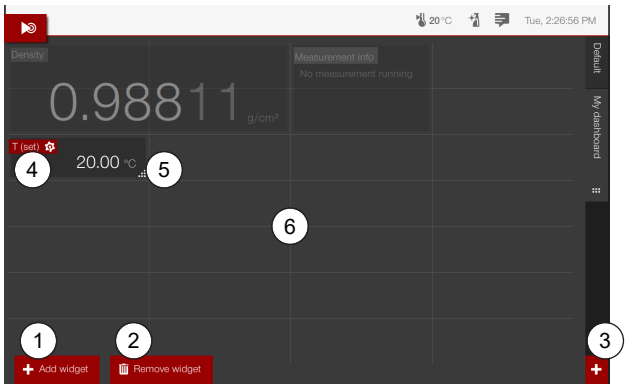


Fig. 21: *Dashboard in edit mode*

1 Add a new widget
2 Remove the selected widget
3 Add a new dashboard
4 Edit the properties of the selected widget
5 Handle to resize the selected widget
6 Grid lines for the arrangement of the widgets

– Tap on a widget to **select** it.

  – Drag it to any **position** on the dashboard (provided there is enough space for it). It will automatically snap to the grid (6).

  – Drag its handle (5) to **resize** it (the widget's content will be resized accordingly).

  – Tap (4) to **edit the properties** of the widget.

    In this way you can change output quantities or the units displayed for an output quantity or the number of digits displayed.
    Tap *Save* to save the changed properties.

  – Tap (2) to **remove** the selected widget.

IMPORTANT: *The operations take effect immediately, without request for confirmation.*

– Tap (1) to **add** a new widget.

  – Position the widget on the dashboard.

  – Adjust its size.

  – Edit its properties to suit your requirements.

Tap anywhere on the grid lines to leave the edit mode and to return to normal display.

5.3.7 Modal messages

Modal messages appear when the measurement system needs to present an important information or requires an immediate decision from you.

Modal messages will block your interaction with the measurement system until you have answered them.

5.4 The data explorer

The data explorer is your tool to access and manage all saved data, be it measurement data, checks, adjustments, or the products for which you have defined the measurement settings.

1. Select *Data explorer* in the menu to access data in the data memory.
2. Then tap on one of the available data categories, for example *Measurements* or *Products*.

   You will see a list of the available data sets in this data category.

   – You can sort and filter the list of data sets by various properties:

     Use the actions in the action box on the spot.

Sub-measurements are shown indented under the main measurement. The set of sub-measurements will always be treated as a whole.

Audit trail data

For detailed information on handling audit trail data, refer to Section 13.6 [▶ 60].

Electronic signature

For detailed information on signing measurement or check reports, refer to Section 13.7 [▶ 61].

Actions available in the data explorer

Depending on its context, an action box in the data explorer may include any of the following actions:

Table 9: Actions in the data explorer

	*Compare* Compares items in the list, which means that all data are shown side by side in a table. The data columns shown can be configured separately (refer to Section 5.4.1 [▶ 24]).
	*Create* Creates a new item.
	*Filter* Opens an action control where you can specify criteria which items shall be shown in the list.
	*Search* Opens an action control where you can enter a text string to be searched in the names of the list items. As a result, only items matching the search string are shown.
	*Select* Opens an action control and enables you to select items in the list. While the action control is present: – Tap on an item to select it. – Tap on an item again to deselect it. – Tap on the action control icon  to select all items. – Tap on the action control icon  to deselect all items.
	*Sort* Opens an action control where you can specify properties by which the items in the list shall be sorted.

5.4.1 Comparing data sets

Tap *Compare*  in the action box on the spot to generate a comparison list of the filtered data sets.

– Tap  in the action box to configure the data shown in the columns of the comparison list.

  The currently selected data are shown on the right, preceded by the column number.

  – To add further data, use the area on the left: First select a data category in the selection box on the top, then add data from the list below by tapping  .

  – Tap on any of the items in the list on the right to select it. You can then modify the displayed properties of the item, change its position in the list, or remove it from the list.

  – Tap on a selected item again to deselect it.

  – Finally tap *Save* to save the list configuration and return to the comparison list.

5.4.2 Exporting or printing single data sets

Tap on a data set in the list to access it.

The corresponding report will be shown (refer to Section 5.5 [▶ 24] for more information on reports and report configuration).

– Tap  in the action box to print the report on one of the registered printers (Section 11.4 [▶ 54]).

– Tap  in the action box to export the data set onto a connected USB memory device or one of the registered network shares (Section 11.2 [▶ 53]).

  You can export the data as a PDF file or a CSV file.

  – If you choose to export a CSV file, you can define the data format by tapping  .

5.4.3 Exporting or removing multiple data sets

TIP: *If your list of data sets is very long, filter the list before making your selections. In this way you get a conveniently short list.*

1. Select one or more data sets that you want to export or remove (Table 9 [▶ 24]).
2. In the action control of the *Select* action, select the desired activity:
   – Tap  to export the selected data sets.

     Define the data format of the CSV file by tapping  .

   – Tap  to remove the selected data sets.

The number of data sets exported is limited to 500.

When system security is activated, measurement, check, and adjustment data have to be exported before they can be removed.

5.5 Reports

Results shown in the data explorer are presented in the form of reports, which can also be printed or exported onto external storage.

5.5.1 Configuring report contents

Reports are always generated according to the current report configuration, which you can change at any time.

1. Access the measurement or product settings:

   For measurement reports:

   – Select  *Measurement* in the menu.

   – Tap  in the action box.

   For product measurement reports:

   – Select  *Products* in the menu.

   – Open the particular product.

   – Tap  in the action box.

2. Under *Report configuration* tap *Configure*.

The currently selected contents are shown in an ordered list on the right.

3. Configure the report contents:
   – To add further data, use the area on the left: First select a data group in the selection box on the top, then add data from the list below by tapping ✚.
   – Tap on any of the items in the list on the right to select it. You can then modify the displayed properties of the item, change its position in the list, or remove it from the list.
   – Tap on a selected item again to deselect it.
4. Tap *Save* to save the report configuration.
5. Tap *Save* to save the measurement or product settings.

TIP: *You can find measurement-specific parameters, like date of measurement or sample name, in the data group Measurement.*

5.5.2 Report templates

Report templates allow to include company information in reports and to configure reports so that they meet certain formal requirements.

Defining or editing a report template

IMPORTANT: *If you want to include images like a company logo or a background image, you have to add them first to the image repository on the instrument (refer to Section 5.6 [▸ 25]).*

1. Select *Settings* in the menu.
2. On the *Settings* screen, under *Reports* select *Report templates*.
3. Tap in the action box to add a **new** report template or tap on an existing report template to **edit** its settings.

   The configuration wizard shows a preview of your configuration on the right.
4. Specify a name for the report template.
5. Specify any of the available options according to your requirements.
   – Company information may include a company logo, which you can select from the list of available images. The image will be scaled proportionally to fit into the header of the report.
   – A background image may be selected from the list of available images. It will be scaled proportionally to fill the whole content area of the report.
   – Activate *GxP compliant* to include the specified number of signature lines.
   – Activate *Extended footer* to include the user who has generated the report in the footer.
6. Tap *Save* to save the report template.

Assigning a report template to a report category

You can assign different report templates to each of the results categories like measurements, checks, adjustments. The report template assigned to the results category *Measurements* is also used for audit trail reports.

1. Select *Data explorer* in the menu, then open the particular results category (for example *Measurements*).
2. Tap on one of the results.
3. Tap in the action box.
4. Select the appropriate report template from the list.
5. Tap *Save*.

   The selected report template will be assigned to the whole results category.

5.5.3 Instrument settings report

You can export a report collecting various instrument and measurement settings.

1. Select *System information* in the menu.
2. Tap *Export instrument settings* in the action box.
3. Select which settings shall be included in the report.
4. Select a report template (Section 5.5.2 [▸ 25]) and a location where the report shall be stored.
5. Tap *Save*.

5.6 Images

You can upload your own images onto the instrument for further use, for example to be included in reports.

Images qualify for upload if they meet the following conditions:

– image file format: .bmp, .jpg, .png
– image file size: < 300,000 bytes
– image size: longest side < 800 pixels

Adding or removing images

1. Select *Settings* in the menu, then under *System* select *Images*.

   You see thumbnails of the currently stored images.
2. To add or remove images:
   – Tap in the action box to **add** an image.
   – Tap below an image to **remove** it.

5.7 Data exports / MD5 checksum file

With some data exports, a checksum file is exported together with the exported data file. Its file name has ".md5" appended to the name of the data file.

The checksum file is a text file containing the MD5 hash value of the data file and the name of the corresponding data file.

Use any of the commonly available MD5 hash generators to verify the data integrity of the exported data file:

1. Generate the MD5 hash value of the data file with the MD5 hash generator.
2. Compare the generated MD5 hash value with the MD5 hash value in the checksum file. They should be equal.

6 Instrument settings

IMPORTANT: *Select the industry profile that suits your applications before changing other instrument settings.*

For the configuration of installed options, refer to the instructions that come with the option.

6.1 Industry profiles

Turn the instrument into a measuring tool specific for your industry with industry profiles.

Industry profiles show only predefined products, dashboards, and quantities relevant for your applications.

TIP: *All changes that you have made to dashboards and dashboards that you have created will be kept.*

1. Select *Industry profiles* in the menu.
2. Select an industry profile from the list.

   Select *None* to reset the filter.
3. Tap *Change*.

   After a reboot the instrument will show only the predefined products, dashboards, and quantity groups according to your industry profile.

Table 10: Industry profiles and available predefined products

Industry profile	Product name	Dashboard	Application / Measurement
None	*Generic liquids & gases*	*Density*	Density measurement with viscosity correction
	Acids and bases	*Chemicals*	Concentrations of acids and bases
	Cosmetics (homog.)	*Density*	Products like oil care baths
	Cosmetics (inhomog.)	*Density*	Products like peelings, etc.
	Distillates	*Distillates*	Ethanol measurement in distillates
	Non-alcoholic beverages	*Brix*	Brix measurement of non-alcoholic beverages
	Pharmaceuticals	*Density*	Products like infusion solutions
Beverages	*Generic liquids & gases*	*Density*	Density measurement with viscosity correction
	Diet soft drink	*Diet*	Diet concentration measurement
	Distillates	*Distillates*	Ethanol measurement in distillates
	Non-alcoholic beverages	*Brix*	Brix measurement of non-alcoholic beverages
Chemicals	*Generic liquids & gases*	*Density*	Density measurement with viscosity correction
	Acids and bases	*Chemicals*	Concentrations of acids and bases
Generic liquids and gases	*Generic liquids & gases*	*Density*	Density measurement with viscosity correction
Petroleum products	*Generic liquids & gases*	*Density*	Density measurement with viscosity correction
	Crude oil	*Crude oil*	API results for crude oils
	Custom API	*Custom API*	API results of a particular fluid using a specific thermal expansion factor
	Lubricants	*Lubricants*	API results for lubricants
	Refined products	*Refined products*	API results for refined products
Pharmaceuticals and cosmetics	*Generic liquids & gases*	*Density*	Density measurement with viscosity correction
	Cosmetics (homog.)	*Density*	Products like oil care baths
	Cosmetics (inhomog.)	*Density*	Products like peelings, etc.
	Pharmaceuticals	*Density*	Products like infusion solutions

Table 11: Industry profiles and available quantity groups

Quantity group	None	Beverages	Chemicals	Generic liquids and gases	Petroleum products	Pharmaceuticals and cosmetics
Acids / bases	●	●	●	●	●	●
Alcohols	●	●	●	●	●	●
API functions	–	–	–	–	●	–
Custom quantities	●	●	●	●	●	●
Density	●	●	●	●	●	●
Density expert	●	●	●	●	●	●
Diet[a]	–	●	–	–	–	–
Extract / sugar	●	●	●	●	●	●
Inorganic salts	–	–	●	–	–	–
Measurement	●	●	●	●	●	●
Other quantities	–	–	●	–	–	–
Special adjustment	●	●	●	●	●	●
System monitoring	●	●	●	●	●	●
Temperature	●	●	●	●	●	●
Viscosity	●	●	●	●	●	●

[a] *Only available on DMA 5002 and DMA 6002*

6.2 Language and regional settings

– Select *Settings* in the menu, then under *System* select *Time & language*.

First of all you will want to set the system **language** so that you feel comfortable on the instrument:

– Set *Language* to a language that you prefer.

On the occasion set the number format (decimal symbols etc.) and the date and time **formats**:

– Select *Format* according to your requirements.

Finally select the **keyboard layout** for the onscreen keyboard and the **keymap** for an optional USB keyboard:

– Set *Keyboard layout* and *HW keyboard keymap* appropriately.

6.3 Time settings

Set the system time correctly so that the time stamps of measurements and system events are correct and traceable:

1. Select *Settings* in the menu, then under *System* select *Time & language*.
2. Set *Region* and *City* to your time zone.

   Daylight saving time will be calculated automatically.

TIP: *The date and time formats are defined with the Format setting (refer to Section 6.2 [▸ 27]).*

*To set date and time **manually**:*

– Set *Date* to the current date.

– Set *Time* to the current time.

*Alternatively, set date and time via **time server**:*

1. Configure a network connection first.
2. Switch *Use time server* to *Yes*.

   The *Time servers* input field replaces the input fields *Date* and *Time*.
3. The *Time servers* setting depends on your network settings.
   – If you have set up an **automatic** network configuration, you can leave the *Time servers* input field empty.
   – If you have set up a **manual** network configuration, or if you want to specify a time server anyway:
   Specify the address(es) of your time server(s) in the *Time servers* input field.
   Put each time server in a new line. Do not separate addresses by commas or semicolons etc.
4. It depends on your time server when the system time will be synchronized. It may also be necessary to restart the instrument.

6.4 Display brightness

1. Select *Settings* in the menu, then under *Hardware* select *Instrument settings*.
2. To set the *Display brightness*, drag the slider to a convenient position.

6.5 Status light brightness

1. Select *Settings* in the menu, then under *Hardware* select *Instrument settings*.
2. To set the *Status light brightness*, drag the slider to a convenient position.

   Set the slider to 0 to deactivate the status light.

6.6 Camera settings

To set the properties of the camera image, select *Settings* in the menu, then under *Hardware* select *Camera*.

– Use the arrow buttons to browse through the camera settings.

– Tap to align the camera image with the density measuring cell:

  a. Drag the red frame representing the camera view and position it over the measuring cell.

  b. Tap ✔ to confirm the position.

6.7 Cell illumination

Illumination of the density measuring cell can be deactivated. This may be necessary if exposure to the particular light spectrum could lead to an undesirable change of sample properties.

1. Select *Settings* in the menu, then under *Hardware* select *Instrument settings*.
2. Switch *Cell illumination active* to *No* if you want to deactivate cell illumination.

   When you deactivate cell illumination, U-View™ is not available anymore. The camera image will not be included in reports.

   To suppress reflections of IR light (required for the measurement) in U-View™, lower the brightness in the camera settings (Section 6.6 [▶ 28]).
3. For light-sensitive samples, also consider deactivating the status light (Section 6.5 [▶ 28]).

6.8 Silent mode

The noise of the idle instrument can be greatly reduced by activating silent mode:

1. Select *Settings* in the menu, then under *Hardware* select *Instrument settings*.
2. Switch *Silent mode* to *Yes*.

   In silent mode, the instrument will reduce the amplitude of the oscillators when it has been idle for 20 minutes.

6.9 Speaker volume

You can set the volume of the sound signaling the end of a measurement:

1. Select *Settings* in the menu, then under *Hardware* select *Instrument settings*.
2. Set the volume with the slider *Speaker volume*.

   To silence the speaker, set the volume to 0.

6.10 Global units

Global units will be used as default units on the instrument:

1. Select *Settings* in the menu, then under *System* select *Global units*.
2. Set the global units that you prefer.

6.11 Automatic sample names

You can set the instrument so that it generates pattern-based automatic sample names.

1. Activate the function:

   a. Select *Settings* in the menu, then under *System* select *Sample naming*.

   b. Switch *Use automatic sample naming* to *Yes*.
2. After the function has been activated, define a pattern for the automatic sample names:

   – Tap *Configure*.

   The current elements of the name pattern are shown in an ordered list on the right, which shows their position in the pattern.
3. Assemble the name elements of the pattern:

   – To add a name element, select it from the list of available elements in the area on the left (tap ✚).

   – Tap on any of the elements in the name pattern on the right to select it. You can then change its position in the pattern or remove it from the pattern.

   – Tap on a selected element in the name pattern again to deselect it.

   – You can arrange name elements in any order and you can repeat elements in the pattern (for example a separator).

   – Special name elements:

   Separator is the character "_", which can be used to separate name elements.

   User input will be replaced with the sample name that you specify when you start a measurement.

   Text inserts a text string into the name. To define the text string, select the particular name element in the name pattern, then enter the text string in the input field *Text*.
4. Tap *Save* to save the name pattern.

6.12 Automatic printout or export of result reports

You can configure the instrument so that after a measurement, check, or adjustment, result reports are automatically printed or exported onto an external storage device in addition to the internal data memory (for example to process them in a LIMS).

1. Select *Settings* in the menu, then under *Reports* select *Automatic printout* or *Automatic export*.
2. Configure the automatic transfer:
   – *Automatic printout:*

     Set the switch to *Yes* for any data type to activate the function for the corresponding data.

     After you have activated the function, you can select a printer and configure the format of the printout.
   – *Automatic export:*

     Set the switch to *activated* for any data type to activate the function for the corresponding data.

     After you have activated the function, you can select and configure a file format, specify a location where the exported data shall be stored, and specify whether the measurement or check data shall be automatically removed from the instrument after export.

TIP: *Before you can use a network share, you have to register it on the instrument.*

IMPORTANT: *Adjustments of measuring modules are currently not included in the automatic printout and export.*

6.13 System security

System security includes user/role management, audit trail, and electronic signature, all of which can be activated and configured separately.

Your instrument comes with system security deactivated as a whole.

If you want to set up and maintain system security, refer to Section 13 [▸ 57] for details.

TIP: *System security settings are only visible/accessible after you have activated system security.*

6.13.1 Non-storage mode

You can operate the instrument as a mere measuring device without use of the data memory and related functions. To do so, activate the non-storage mode.

In this mode, all measuring results and check results are not stored. In order to keep them, you have to write down the results manually, print them, or export them directly after every single measurement.

TIP: *The non-storage mode is compliant to the United States Pharmacopeia 1058 CAT-B. So you may activate it to reduce the efforts for instrument qualification in lab environments.*

IMPORTANT: *This setting is only accessible when system security is activated (refer to Section 13.1 [▸ 57]).*

1. Select *Settings* in the menu, then under *System security* select *System settings*.
2. Switch *Non-storage mode* to *Activated*.

IMPORTANT: *Activating non-storage mode will remove all measurement and check data currently stored on the instrument. Electronic signature will be disabled.*

6.13.2 Restricted use of the USB interface

You can switch off the support of USB memory devices for data transfer.

IMPORTANT: *This setting is only accessible when system security is activated (refer to Section 13.1 [▸ 57]).*

1. Select *Settings* in the menu, then under *System security* select *System settings*.
2. Switch *Restricted USB usage* to *Yes*.

IMPORTANT: *Irrespective of this setting:*

– *Diagnostics packages can still be saved on a USB memory device.*
– *Software updates can still be performed with a USB memory device.*

6.13.3 Restricting the visibility of measurement values

By default, the instrument displays measurement values always (the current live values on the dashboard and the final measurement values on the results screen).

You can restrict the visibility of measurement values so that the instrument will only show values during the measurement process (including the results screen) or even on the results screen alone.

IMPORTANT: *This setting is only accessible when system security is activated (refer to Section 13.1 [▸ 57]).*

1. Select *Settings* in the menu, then under *System security* select *System settings*.
2. From the drop-down box *Value visibility*, select when measurement values shall be displayed.

TIP: *Temperature values will always be shown, their visibility cannot be restricted.*

7 Measurement settings – products

TIP: *Make sure that you have selected an industry profile that suits your applications.*

7.1 Products

You can individually define the measurement settings for each of your products or sample varieties and save them for repeated use:

1. Select *Products* in the menu.
2. Tap *Create product*.
3. Specify a name and a description for the product.
4. Define measurement settings (refer to Section 7.2 [▶ 30]) and optionally configure limits.

   For **diet products** (see below), set the switch *Diet concentration measurement* to *Yes*.
5. Tap to select an image for the representation of the product.
6. Tap *Save* to save the collection of measurement settings for the product.

TIP: *The instrument comes with several predefined product settings, which you can use as a template.*

Diet products

Diet concentration measurements can only be performed with diet products and only after diet adjustments have been performed with the diet product.

The diet adjustments are stored with the diet product.

Measurements with diet products have to be performed with the highest possible accuracy. Therefore, some settings are fixed for diet products (the measurement performance in particular).

– Create a diet product for every diet beverage / package type combination for which you intend to perform diet measurements.

7.1.1 Importing/exporting products

You can define the measurement settings for a product on one instrument and transfer the product settings to another instrument of the same type.

Export of products

1. Select *Data explorer* in the menu, then tap on *Products*.
2. Tap *Select* in the action box, then select the product settings that you want to export.
3. Tap in the action control for the selection and specify where the export file shall be stored.

IMPORTANT: *Diet adjustments, measurement modes, and auto air check definitions are currently not included in the export.*

Import of products

1. Select *Products* in the menu.
2. Tap *Import products*, then select a file with the product settings that you have exported before.

   You can select which products to import from the file.
3. Tap *Import* to import the selected products.

   The instrument will restart.

7.2 Measurement settings

Measurement settings comprise the measurement parameters (Section 7.3 [▶ 31]), the assignment of a dashboard, and a report configuration for the results.

– For measurements without predefined product, assign dashboard and report configuration under *Setup* on the *Measurement* spot.

  It is not possible to perform diet concentration measurements from the *Measurement* spot.

7.2.1 Dashboards / measuring quantities

Dashboards serve to monitor your measurements.

The instrument already comes with dashboards predefined for various generic products. You can adapt them to your needs or define new dashboards according to your requirements.

You can place the following widgets onto a dashboard of the instrument:

– the live camera image of the density measuring cell (U-View™)

– measurement information (giving information about the current status of the measurement)

– display boxes for any measuring quantity

  (Select *Quantities* in the menu for a complete reference of available quantities. Tap on any of the quantities to see a comprehensive description.)

7.2.2 Reports

Measurement results are presented as reports, which you can access in the data explorer.

TIP: *The report configuration can also be changed after the measurement. It is independent of the dashboard configuration.*

7.2.3 User-defined measurement information

If you want to record additional specific information with every sample or product measurement, you can activate custom data fields. These data fields will show as input fields before you start a sample measurement. The text that you enter in a field can be included in the measurement report.

You find all activated custom data fields in the data group *Measurement*.

Defining custom data fields

1. Select *Settings* in the menu, then under *System* select *Custom data fields*.
2. Activate any of the available custom data fields with the corresponding switch.
3. Define a name for the custom data field.

   This name will identify the custom data field and serve as a label.
4. Optionally declare the custom data field as mandatory with the corresponding switch.

   If a custom data field is mandatory, you cannot start a measurement before you have entered text in the input field.

7.3 Measurement parameters

7.3.1 Measurement mode

(Cannot be changed for diet products)

– Select *Standard* for a standard single measurement of the filled sample.

– Alternatively, select one of the measurement modes from the list.

Refer to the table below for a description of the predefined measurement modes coming with the instrument. The table specifies the default settings, which you can adapt according to your needs. You may even completely reconfigure each of the predefined measurement modes.

Refer to Section 7.4 [▶ 33] for a comprehensive description of measurement modes and on how to define your own modes.

Table 12: Predefined measurement modes

Mode	Description
Multiple Filling	3 determinations of a single sample; new filling of sample for each determination; cleaning before refill
Multiple Meas.	3 determinations of a single sample from one filling
Repeated Mode	up to 3 determinations of a single sample; new filling of sample for each determination; no cleaning before refill; stops if two consecutive determinations deviate by less than all set limits (default for density: 0.0001 g/cm³), or after 3 determinations; saves all measurements
Temp. Scan	single measurements of a single sample at multiple temperatures: 30 °C, 25 °C, and 20 °C
ASTM D4052	3 determinations of a single sample; new filling of sample for each determination; no cleaning before refill; saves all measurements; gives warning if the two highest density results deviate by more than 0.0001 g/cm³

7.3.2 Set temperature

(Cannot be changed for diet products)

Set the measuring temperature here.

TIP: *Mind that some measuring quantities may be only valid at a specific temperature.*

7.3.3 Measurement performance

Select a measurement performance class for the measurement:

TIP: *For diet products, the measurement performance class Ultra-precise cannot be changed because the highest accuracy is required for diet measurements.*

The density value of measurements with measurement performance classes *Standard* and *Enhanced* is a value pre-calculated to the set temperature, even if the cell temperature is not stable.

TIP: *We recommend to add the quantity T (set) to the report configuration when you use measurement performance classes Standard or Enhanced.*

7.3.4 Check density stability

(Only available for the highest measurement performance class)

Yes	The measurement result is determined when the temperature value as well as the density value are stable within a defined deviation range.
No	The measurement result is determined when the temperature value is stable.

Generally, temperature stability is reached faster than density stability.

TIP: *Yes is the recommended standard setting for most precise measurements. Select No if the characteristics of your sample prevent achieving stability (inhomogeneous or unstable samples).*

IMPORTANT: *With diet products, density stability is always checked.*

7.3.5 Hold time

The instrument will wait this time span after all specified stability conditions are met, and then determines the measurement result. This gives the sample time for temperature conditioning.

7.3.6 Timeout

If a stable measurement result cannot be achieved, the instrument will abort the measurement process after the specified timeout (for example 10 minutes).

The time span begins when minimum temperature stability has been reached.

TIP: *A timeout may be caused by a filling error: In this case repeat the measurement. Or your sample is inhomogeneous or unstable: In this case deactivate checking for density stability.*

7.3.7 FillingCheck™

Yes	FillingCheck™ is active.
No	FillingCheck™ is deactivated.

FillingCheck™ is an automatic bubble detection based on an advanced analysis of the U-tube's oscillation pattern.

If applicable, a filling warning will be shown in the measurement information widget on the dashboard.

TIP: *Additionally check the filling visually by means of the built-in live camera (U-View™).*

TIP: *Yes is the standard setting. Select No if the detection of filling errors by FillingCheck™ obviously contradicts what you see in the live camera image.*

TIP: *FillingCheck™ provides excellent support to the operator for samples of low and medium viscosity ranges.*

The sensitivity of this feature depends on a combination of density, viscosity, and temperature, and is not constant. For example, certain samples with high density (approx. 1.5 g/cm³) and medium viscosity (approx. 550 mPa·s) might generate a filling warning also for correctly filled samples. In all such cases, changing the measuring temperature may influence this combination so that FillingCheck™ continues working as expected.

Some samples may generate a filling warning even when filled without bubbles, for example highly viscous samples or samples containing inhomogeneities. In these cases, we recommend to disable FillingCheck™ and perform repeated measurements to validate the quality of filling.

7.3.8 Diet product concentration measurement settings

(Only available for industry profile Beverages)

Diet concentration measurement

Yes	The product is used for diet concentration measurements. Process water and concentration adjustments are necessary before any measurement.
No	The product cannot be used for diet concentration measurements.

IMPORTANT: *If you set Diet concentration measurement to Yes, product settings are changed automatically to meet the performance requirements. The previous settings are irrecoverably lost.*

Blending ratio

Enter the blending ratio of the final beverage product. (*Example:* If the product sample consists of 1 part syrup and 6 parts water, the blending ratio is 1:6. Therefore, enter 6 in the input field.)

The blending ratio is relevant for every new process water adjustment, which affects the concentration of the sample. Therefore, the blending ratio is automatically taken account of when the concentration is recalculated.

Unit

Select the "unit" for the diet concentration measurement. If you change it, new diet adjustments are required for the particular diet product.

7.3.9 Other measurement parameters

Other measurement parameters may be available with installed options. For details refer to the respective manual of the option.

Auto air check

For details refer to Section 9.2.4 [▶ 44].

API input

(Only available for industry profile Petroleum products)

For the calculation of API quantities, the following input quantities are available:

- *Density* (in most cases select this to get reliable results)
- *Density NVC* (not viscosity-corrected)
- a special adjustment (refer to Section 9.3.4 [▸ 46])

Calculations are usually based on true density.

Thermal expansion factor

(Only relevant for industry profile Petroleum products)

The parameter is used for the calculation of API Custom quantities. It does not affect other measurements or calculations. API Group C (Custom) relates to petroleum samples not belonging to any pre-defined API classes.

The thermal expansion factor [°C–1] relates density changes of a liquid to temperature changes and is used to convert the measured density to reference conditions.

Canadian excise density input

For details refer to Section 9.3.5 [▸ 47].

7.4 Measurement modes

Measurement modes allow to define measurements as sequences of sub-measurements. They include the definition of filling and cleaning parameters, criteria when a sequence is finished, and the definition of temperature variation parameters.

The instrument comes with various predefined measurement modes, however, you can create your own measurement modes entirely according to your requirements.

7.4.1 Creating a measurement mode

- You can customize one of the existing measurement modes.
- Or you can create an entirely new measurement mode:
  a. Select *Measurement modes* in the menu, then tap .
  b. Specify a name for the measurement mode.
  c. Define the settings (refer to Section 7.4.2 [▸ 33] and Section 7.4.3 [▸ 34]).
  d. Tap *Save*.

7.4.2 Temperature variation settings

Define temperature variation settings on the left half of the measurement mode screen.

IMPORTANT: *Observe the measuring range of the instrument specified in Appendix A [▸ 71].*

Temperature scans (settings *Table* or *Steps*) enable you to measure a sample at several temperatures with one filling.

WARNING

Risk of injuries and fire by liquids leaking

When you perform temperature scans, make sure that the wetted parts are resistant to the filled sample at all measuring temperatures.

When you perform temperature scans, we recommend to observe the minimal step sizes between consecutive temperatures given in the table below in order to achieve reasonable measuring results.

Table 13: Recommended minimal temperature steps

Measurement performance class	Minimal step size	Model
Standard	1 °C (1.8 °F)	all models
Enhanced	0.1 °C (0.18 °F)	all models
Precise	0.01 °C (0.018 °F)	all models
Ultra-precise	0.01 °C (0.018 °F)	DMA 5002
	0.005 °C (0.009 °F)	DMA 6002

TIP: *To achieve highest measurement precision with temperature scans, set a hold time of at least 2 minutes.*

IMPORTANT: *For temperature scans, start with the highest temperature (cooling down to the final temperature) in order to prevent degassing in the measuring cell.*

Constant

The measurement will be performed at a single temperature specified when you define the measurement.

Table

The sub-measurements will be performed at temperatures specified in a table, which you have to import from a text file (tap *Import*).

Formal requirements for the text file:

- each temperature in a new line
- a point (“.”) as decimal point for the numbers
- an empty line terminates reading of the file

TIP: *Tap Template to generate and export a template file with an example temperature table, which you can adapt to your own requirements.*

Steps

The sub-measurements will be performed at temperatures that are a fixed step size apart, starting with the start temperature and ending with the final temperature.

Select the temperature step so that the final temperature can be reached by a whole number of steps.

7.4.3 Measurement mode parameters

Define all measurement mode parameters except temperature variation settings on the right half of the measurement mode screen.

With the available parameters, you can configure automatic routines consisting of multiple determinations (sub-measurements).

You can also combine a multiple-measurement-routine with a temperature scan (Section 7.4.2 [▶ 33]). In this case, the whole routine is executed at every temperature halt.

Number of determinations

Defines the maximum number of sub-measurements to be performed at the measuring temperature.

TIP: *The actual number of determinations performed may depend also on your comparison settings and the results of the determinations.*

If your measurement consists of more than one determination, an arithmetic mean and the standard deviation will be included in the measurement results.

Refill

Defines whether you want to refill sample between determinations.

Intermediate cleaning

Defines whether you want to perform a cleaning before sample is refilled between determinations.

Comparison settings

With this setting, you can activate measurement routines using different comparison criteria:

– *Compare and stop*

  Performs a series of determinations with stability check.

  – *If a deviation limit is defined for any of the connected measuring modules:*

    The measurement is finished when two consecutive determinations deviate by less than the deviation limit. *Save mode* determines what will be saved. The results of all measurements saved will be averaged for the calculation of the mean.

    If the comparison criterion cannot be met because the results of the single determinations differ too much, the measurement is finished after the set maximum number of determinations have been performed. In this case all results are saved.

  – *Else:*

    Similar to selecting *None* as the comparison setting.

– *ASTM D4052 for opaque samples*

  Performs a series of at least three determinations delivering measuring results according to ASTM D4052 for opaque samples: For full compliance, measure sample from one container without intermediate cleaning. The results of the two determinations with the highest density values will be averaged for the calculation of the mean. Save mode determines what will be saved.

  You can additionally define a deviation limit for the density module in order to evaluate the quality of the found measurement result. If the comparison criterion is not met by the two highest density results because they differ too much, you will be warned accordingly.

– *None*

  No comparison criteria will be used. All specified determinations will be performed. All measurement results will be saved and averaged for the calculation of the mean.

Save mode

Defines what results of the single determinations will be stored in addition to the mean and standard deviation of the series.

– *Save all measurements*

  Saves the results of all single determinations.

– *Valid two only*

  With Compare and stop:

  Saves the two consecutive results that meet all set comparison criteria.

  With ASTM D4052 for opaque samples:

  Saves the two results with the highest density value.

– *Last one only*

  (with Compare and stop)

  Saves the last determination meeting the comparison criteria.

7.5 Limit configuration

With products, you can define limits for any measuring quantity to be monitored. If the defined limits are exceeded during measurement, this will be indicated in the measurement report.

1. Select the product and tap in the action box to access the product settings.
2. Under *Limit configuration* tap *Configure*.

   The currently defined limits are shown in a list on the right.
3. Configure the limits:
   – To add measuring quantities, use the area on the left: First select a data group in the selection box on the top, then add quantities from the list below by tapping ✚.

– Tap on any of the items in the list on the right to select it. You can then select a unit for the quantity and define a lower and an upper limit to be monitored, or you can remove the quantity from the list.
– Tap on a selected item again to deselect it.

4. Tap *Save* to save the configuration of limits.
5. Tap *Save* to save the product settings.

8 Performing a measurement

Table 14: Steps of a typical measurement cycle

	Step		refer to
A	Check that the **measurement system** is properly installed and in good working order and that all conditions for a good measurement are met.		Section 4.1 [▶ 15] and below
B	Perform a **water check** to verify the instrument's accuracy before you start your daily routine measurements. After the check, dry the measuring cell.		Section 9.2 [▶ 42]
C	1	Choose a way to start your measurement: Use pre-defined **product settings** or define the **measurement settings** on the fly.	Section 8.1 [▶ 35] Section 7 [▶ 30]
	2	**Prepare** your **sample** if required.	Section 8.2 [▶ 36]
	3	**Fill** the **sample**.	Section 8.3 [▶ 37]
	4	**Start** the **measurement**.	Section 8.4 [▶ 39]
	5	**Clean and dry** the measuring cell.	Section 10.3 [▶ 50]
D	Perform an **air check** to verify the efficiency of your cleaning and drying procedure after you have finished your daily routine measurements and the measuring cell has been cleaned and dried.		Section 9.2 [▶ 42]

Refer to Section 9.3 [▶ 44] for recommendations when to perform an adjustment before a measurement.

WARNING

Risk of fire and injuries

In the very rare case of a malfunction of the temperature control, the measuring cell could heat up to 120 °C (248 °F), potentially causing liquids to spurt out.

– Ensure that the waste vessel is properly installed.
– Have a widget on the dashboard display the temperature of the measuring cell.
– Check the temperature of the measuring cell before you fill a sample or start a measurement.
– If you measure aggressive, toxic, or flammable samples, use only the smallest possible sample amount.
– If your sample is toxic or highly flammable, always handle it in an appropriate environment, for example under a fume hood, and ensure that the location is sufficiently ventilated.
– Measure only samples with an ignition point over 120 °C (248 °F).
– Wear protective clothing and safety goggles.

Preparatory steps

Before you start a measurement, check that:

– the measuring cell is clean and dry
– hoses are connected correctly
– hose connections are tight
– the waste hose leads into the waste container
– the volume of the waste container is large enough for the number of samples
– suitable cleaning liquids are at hand

To speed up measurements

– Use automatic sample names (Section 6.11 [▶ 28]).
– Set the measuring temperature on the instrument in advance using the header control.
– Bring the sample to measuring temperature in advance.
– **Not for diet products:** Select a faster measurement performance class and set measurement parameters so that the time for temperature conditioning of the sample becomes shorter (Section 7.3 [▶ 31]).

  Consider, however, that your measurement results will become less accurate by proceeding so.

8.1 Starting a measurement

Product measurements

For routine measurements, define your measurement settings as a product. You can add your routine product measurements to the home screen as favorites in order to start measurements directly from there.

– **Setting a product measurement as favorite**

  a. Select *Products* in the menu, then open the specific product.

  b. Verify that the product settings are correct, then tap *Create measurement*.

  c. Add the spot with the measurement setup as favorite (tap ☆).
  From here you can start a measurement by tapping *MEASURE*.

– **Starting a product measurement from the home screen**

  The favorite on the home screen combines two links.

  – Tap *Measure* ❯ on the favorite to directly start a quick or routine product measurement that requires no sample details.

    If you have activated a mandatory sample name or mandatory custom data fields, you will not be able to start a measurement directly. Tap on the product name instead.

  – Tap on the product name to start a measurement from the measurement setup.

    There you can add a sample name or verify the product settings (tap *Details…*).

    A measurement with a **diet product** requires previous diet adjustments of the diet product, which can be performed at this point. Refer to Section 9.3.3 [▸ 45] for detailed information on diet adjustments.

    To start a measurement, tap *MEASURE*.

Measurements without predefined product

(Not possible for diet measurements)

You can also perform a measurement without predefined product and define all measurement settings on the fly:

1. Select *Measurement* in the menu.
2. Define the measurement settings.
3. To start a measurement, tap *MEASURE*.

Additional measurement information on the measurement setup

– *Sample name*:

  The name entered here may be included in the pattern of an automatic sample name as *User input* (Section 6.11 [▸ 28]).

  Sample names can be declared as **mandatory**:

  – Select *Settings* in the menu, then under *System* select *Custom data fields*.

  – Switch *Sample name mandatory* to *Yes*.

    In this case, you cannot start a measurement before you have entered a sample name.

– *Custom data fields* (if defined, refer to Section 7.2.3 [▸ 30]):

  Text entered in a custom data field will be included in the measurement report.

8.2 Degassing samples

There are various methods to degas liquid samples. The preferable method for your application depends on the kind of sample and the amount of gas that is dissolved in the sample. Pay attention to always treat all samples the same way in order to get reproducible measuring results.

IMPORTANT: *Be aware of the fact that the composition of some samples may slightly change during the pretreatment due to the evaporation of volatile components.*

TIP: *Degassing efficiency also depends on the sample's temperature. Pre-condition cold samples to the measurement temperature before you begin the degassing procedure.*

Boiling the sample

WARNING

Health risk with toxic components

Samples containing toxic volatile components can cause irritation and serious injuries to your eyes, skin, and mucous membranes as well as toxication.

– If your sample contains volatile components that are toxic, always handle it in an appropriate environment like under a fume hood, particularly when you boil your sample.

WARNING

Risk of fire and burns with flammable liquids

When you boil flammable liquids, there is a risk of fire. Serious injuries are possible.

– Do not boil flammable liquids.

1. Boil the liquid for several minutes to remove dissolved gas.
2. Fill the boiled liquid into a clean glass flask and cover it.
3. Wait until the liquid has cooled down approximately to measuring temperature.

Stirring the sample

Stir your sample vigorously for 5 to 15 minutes (depending on the stirring equipment) until bubbling ceases.

You can pour the sample through a paper filter after stirring to degas it even more efficiently.

Using an ultrasonic bath

Put your sample for approx. 5 to 10 minutes into an ultrasonic bath until bubbling ceases.

8.3 Filling sample

WARNING

Rupture of adapters or hoses due to high temperature and high pressure

At high sample temperatures in combination with high pressure adapters or hoses may break. Liquids leaking or spurting out and flying particles may cause injuries.

– At measuring temperatures of 50 °C (122 °F) and higher the applied pressure must be limited to 5 bar (72.5 psi) absolute pressure.

WARNING

Dangerous liquids leaking due to unsuited components in a pressurized system

Unsuited components can cause rupture of hoses and connections coming loose when pressure is applied to the measurement system. Dangerous liquids spurting out or leaking may cause injuries or risk of fire.

– In pressurized measurement systems:
  Do not use the supplied hoses and injection adapters for filling. Exchange them with pressure-resistant components.
  Use only the injection adapters density pressure (mat. no. 159537) with polyurethane hoses 2x4 (mat. no. 135259).
– Do not exceed the maximal operating pressure of any single component.
– Before you start a measurement using high pressure, check the pressure tightness of the system with air.

WARNING

Risk of injuries and fire by liquids leaking

Filling samples and cleaning liquids that the wetted parts are not resistant to will corrode the wetted parts. Sample leaking from corroded parts may cause serious injuries.
Before you fill any sample or cleaning liquid, in particular hazardous or flammable chemicals, into the instrument:

– Strictly follow all safety instructions concerning the use of chemicals and the use of flammable chemicals (refer to Section 1 [▸ 7]).
– Make sure that all wetted parts are resistant to the filled-in liquid. Consider also the wetted parts of installed options.
  The chemical resistance depends on the temperature and concentration of the liquid.
– Make sure that you have suitable cleaning liquids at hand for cleaning the measuring cell.

NOTICE

Corrosive samples require special care

Samples with a moderate tendency to corrode borosilicate glass, such as strong alkali solutions (for example caustic soda), can be measured with the instrument. However:

– Remove corrosive samples immediately after measurement and rinse the measuring cell thoroughly.
– Check the validity of the adjustment more frequently than generally recommended. Perform a new adjustment if necessary.
– The measuring temperature for strong alkali solutions should not be higher than 20 °C (68 °F). Higher temperatures dramatically increase the speed of corrosion.

To achieve highly accurate measuring results, fill the sample into the measuring cell steadily and without bubbles.

TIP: *Sample containing dissolved CO_2 will cause bubbles in the measuring cell, which render the measurement results invalid. Degas your sample carefully as described in Section 8.2 [▸ 36].*

If you measure samples at temperatures that are significantly **higher than ambient temperature**, the tendency to form gas bubbles in the measuring cell will dramatically increase. To ensure precise results, degas your sample directly before measuring as described in Degassing samples, or treat it in the following way:

– Heat the sample up to a temperature significantly higher than the measuring temperature. Stir it during heating.

IMPORTANT: *For high accuracy measurements, be sure to apply exactly the same filling procedure for checks, adjustments, and measurements.*

Sample amount

WARNING

If you measure any aggressive, poisonous, or flammable sample at high pressure, use only the smallest possible sample amount.

If the measuring cell is clean and dry, you need approx. 1 mL of sample.

If you measure without cleaning and drying between samples, you will need a higher amount of sample because you have to flush residues of the previous sample out of the measuring cell to avoid cross-contamination.

Bubble detection – FillingCheck™ and U-View™ (live camera image)

FillingCheck™ helps you detect bubbles during filling. Activate the function in the measurement settings.

Additionally, check the filling visually by means of the built-in live camera (**U-View™**):

- Place the camera widget on the dashboard assigned to your measurement.
- Watch the live camera image on the dashboard during filling:
  - Tap on the image to open the camera screen.
  - Tap to zoom in, tap to zoom back out.
  - You can drag the zoomed image left or right to examine all parts of the measuring cell.
  - Tap ✔ to close the camera screen.

The camera image will be saved with the measurement results (unless deactivated with cell illumination).

8.3.1 Filling with a syringe (Luer tip)

WARNING

Risk of injuries by dangerous liquids leaking or spurting out

If you push the plunger of the syringe too hard, or if, for example, the measuring cell breaks, dangerous liquids may leak or spurt out of ruptures causing injuries.

- Wear safety goggles and protective gloves when you fill dangerous liquids.

IMPORTANT: *Do not use syringes that contain lubricants. The lubricants can dissolve into your sample and lead to a systematic measuring error.*

Filling position

Refer to Fig. 7 [▶ 16].

- To achieve best measurement results, fill with the syringe attached to the adapter Luer ¼" UNF on U-Dry (2).

  This is the standard filling position.
- *Only in the case that the available amount of sample is very limited:*
  - Take an adapter Luer ¼" UNF, mat. no. 64792, from the accessory kit and screw it into the sample inlet adapter (4) instead of the inlet hose (3).
  - Fill through this adapter using a 2 mL syringe.

To fill with a syringe (Luer tip)

1. Connect the syringe (filled with sample) to the adapter Luer ¼" UNF on U-Dry (or mounted directly on the sample inlet adapter).
2. Push the plunger of the syringe slowly and steadily until a drop emerges from the sample outlet adapter.
3. Leave the syringe in the filling position during the measurement.

TIP: *For high accuracy measurements, inject the entire sample volume.*

8.3.2 Filling automatically with an Xsample

Refer to the documentation of the Xsample for instructions on its installation and use.

8.3.3 Special filling techniques

Bubbling samples

If the sample to be measured tends to form gas bubbles, degas it before the measurement.

If this is not possible, fill the sample at a temperature higher than the measuring temperature.

You can also put the instrument at a slight angle (with spacers under the legs on the right side of the instrument), thus allowing the bubbles to escape due to buoyancy.

Suspensions and emulsions

Suspensions or emulsions may tend to separate in the measuring cell, giving incorrect results. Leave such samples in the measuring cell as briefly as possible. Pre-thermostat them before filling.

It may help to put spacers under the legs on the left side of the instrument, thus putting it at an angle to counter-balance the separation force generated by the oscillation of the density measuring cell.

Highly viscous samples

Highly viscous samples can be heated up to lower the viscosity. Always heat the sample to a temperature that is approx. 15 °C (27 °F) higher than the measuring temperature (mind the maximal measuring temperature of your instrument, though).

Pastes

Paste-like materials, such as toothpaste or tomato ketchup, can be filled by syringe. Inject these kinds of sample into the measuring cell by pushing the plunger very slowly and steadily.

If the sample has a very high viscosity, you can fill it into the syringe by pulling the plunger completely out of the syringe, then filling the sample from the back using a spoon, and finally remounting the plunger.

Liquids in aerosol cans

You can use the Anton Paar aerosol adapter, mat. no. 74650, to fill liquids from aerosol cans safely and conveniently into your instrument. Refer to the documentation of the aerosol adapter for details.

Gases

It is possible to measure gases with the instrument. For details contact your local Anton Paar representative and ask for the corresponding application report and the necessary accessories.

8.4 Actual measurement procedure

– When you have verified that all measurement settings are correct, and the sample has been filled, tap *MEASURE*.

  The measurement will be performed according to your settings. The progress bar shows the progress of the measurement.

  If the last digits of the density value are grayed out, this means that the set measurement performance is not yet fully met.

  When the measurement is finished, the results are displayed.

  The results together with the camera image (unless deactivated with cell illumination) and a time stamp are automatically saved in the data memory.

  Saved data can be accessed in the data explorer.

– Tap
  – *DONE* to close the results and finish or
  – *REMEASURE* to perform another measurement with the same settings.

8.5 Measuring at low temperatures / under high humidity conditions

If the ambient air is humid, and the measuring temperature is lower than the ambient temperature, condensation may occur inside the measuring cell and in the measuring cell block.

Condensation inside the density measuring cell causes adjustment and measurement errors. Condensation in the measuring cell block damages the electronics and may lead to a failure of the U-view™ function.

The higher the difference between the set measuring temperature and ambient temperature, and the higher the air humidity, the easier condensation occurs. The instrument's condition monitoring will show a warning if the temperature lies below the dew point.

8.5.1 Condensation inside the measuring cell

If U-View™ shows condensed water inside the measuring cell, install a drying cartridge to dry the air from the air pump outlet. When you use the internal air pump for drying the measuring cell, its air will then be dry.

A drying cartridge must be used for a measuring temperature of 20 °C under the following ambient conditions:

Ambient temperature	Relative air humidity
20 °C (68 °F)	>70 %
25 °C (77 °F)	>50 %
30 °C (86 °F)	>38 %

To remove condensation inside the measuring cell

1. Install a drying cartridge, mat. no. 65085 (Section 8.5.2 [▶ 39]).
2. Dry the measuring cell with the internal air pump as usual until you can't see condensed water anymore in U-View™ (Section 10.3 [▶ 50]).

8.5.2 The optional drying cartridge

The drying cartridge, mat. no. 65085, can be used to dry the air from the air pump outlet.

Installing the drying cartridge

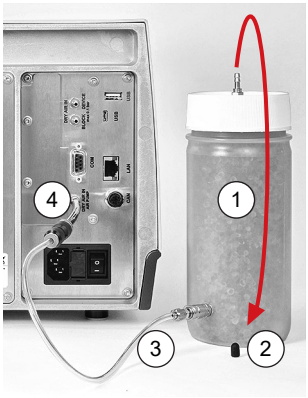


Fig. 22: *Drying cartridge installed*

1 Drying cartridge
2 Remove cap from inlet of drying cartridge
3 Transparent polyurethane hose
4 Black hose, connected to air pump inlet connector

1. Push the fitting on the thin, transparent polyurethane hose (coming with the drying cartridge) into the outlet connector at the bottom of the drying cartridge (3).
2. Push the open end of the transparent hose into the connector on the thicker, black hose (coming with the drying cartridge).
3. Connect the open end of the black hose to the air pump inlet connector "DRY AIR IN / AIR PUMP" at the rear of the instrument (4).
4. Remove the cap from the barbed fitting (inlet) on top of the drying cartridge (2).

NOTICE

– Never connect hoses containing liquids or moist gases to the air pump inlet connector "DRY AIR IN / AIR PUMP" as this may lead to condensation in the density measuring cell and subsequently to measurement and adjustment errors.
– Operate the air pump inlet only at ambient pressure.

To regenerate moist silica gel

The drying cartridge contains silica gel, a non-toxic drying agent. When active, the color of the drying agent is orange. Silica gel having absorbed liquid turns green.

Moist silica gel can be regenerated:

Pour the silica gel into a glass bowl and put it in a laboratory oven for a few hours (or overnight) until its color is orange again.

NOTICE

Do not use drying temperatures over 130 °C (266 °F). Otherwise the indicator function of the silica gel will be spoiled.

8.5.3 Preventing and removing condensation

If the measuring temperature is more than 5 °C (9 °F) lower than the ambient temperature, a dry air supply for the measuring cell and the measuring cell block must be used in addition to the drying cartridge.

The following specifications of the applied air are required:

- **0.03 bar** (0.435 psi) relative pressure
- max. volumetric flow rate: 80 L/h
- class 5 according to ISO 8573-1
- max. particle size: 40 µm
- max. pressure dew point: 10 °C below measuring temperature
- max. oil content: 25 mg/m³

Measuring cell block and camera

To prevent or remove condensation in the measuring cell block and on the camera:

1. Connect a dry air supply to the “DRY AIR IN / BLOCK” connector. Use a 3x5 mm hose made of suitable material, for example silicone.
2. Continuously flush the measuring cell block with dry air.

Interior of the housing

To prevent or remove condensation in the housing:

1. Connect a dry air supply to the “DRY AIR IN / DEVICE” connector. Use a 3x5 mm hose made of suitable material, for example silicone.
2. Continuously flush the housing’s interior with dry air.

NOTICE

Never connect hoses containing liquids or moist gases to the “DRY AIR IN / BLOCK” or “DRY AIR IN / DEVICE” connectors as this may lead to damage of the electronics.

8.6 Tips for highly accurate density measurements

In order to use the instrument’s full accuracy, you need to bring all measuring conditions close to their ideal state. Sources of measurement uncertainty include environmental and measuring conditions, sample handling, stability of the sample (for example absorption of air or water), and stability of the measurement process. The operator’s awareness and prevention of different sources of errors are essential to fully exploit the potential of the most accurate density meters on the market – the DMA.

The following tips may help you achieve highly accurate density results:

- Install the instrument in the right place.

  Refer to Section 4.1 [▶ 15] for the proper setup conditions.
- High humidity or a measuring temperature below the ambient temperature may lead to condensation in the density measuring cell.

  To avoid condensation, install a drying cartridge.
- Be aware of the ambient pressure when you compare the measured result to a reference value of a certified reference material.

  For example, the density of water between 970 mbar and 1013.25 mbar varies by approx. 0.002 kg/m³.
- Store samples and certified reference material in a dark place at temperatures below 20 °C. Avoid temperature changes.
- After the instrument has been switched off, give the instrument’s interior 24 hours for temperature conditioning if you want to achieve best instrument performance.
- Installing the injection adapters 12 hours before the actual measurement or adjustment (for example the day before) ensures relaxation of the density measuring cell as physical pressure or stress from the injection adapters has been applied during installation.
- Setting the measuring temperature at least 12 hours before the actual measurement (for example the day before) ensures temperature stability of the whole measurement system.

  Mind that the instrument operates in the mK range.
- The sample temperature should be slightly higher than the measuring temperature. This reduces the risk of degassing and the formation of micro-bubbles in the measuring cell.
- Inconsistent results have been tracked down to the use of plastic disposable syringes due to lubricants being dissolved by particular samples or plastic being soluble in the liquid. For these samples use glass syringes for filling.
- Select the highest measurement performance class and check for density stability (if available).
- Use the syringe holder or U-Dry when you fill by syringe. Follow the filling instructions in this manual.
- Avoid residues of sample or cleaning agent in the measuring cell due to insufficient drying times.

Depending on the nature of the sample, the following characteristics may have a considerable influence on the results of a density measurement:

– Be aware of the temperature dependence of density.

  For example, samples like isooctane or dodecane have a thermal expansion coefficient close to 1 kg/(m³K) leading to a density change of 0.01 kg/m³ at a temperature change of only 10 mK (0.01 °C / 0.018 °F).

– Hygroscopic samples, like ethanol, tend to absorb water from the air resulting in higher or lower density values compared to a stated reference value. The liquid samples have to be injected immediately after opening the sealed ampule or bottle. The longer the period between opening and measuring the sample, the higher the risk of a change of composition or contamination of the sample. Sample containers must only be used once, right after opening the sealing.

– Volatile components of samples, like ethanol, evaporate once the ampule or bottle is open, resulting in a change of density. The samples have to be filled immediately after opening the ampule or bottle.

– Ensure that your samples are completely homogeneous. Do not mix the samples by shaking them vigorously, but by stirring them gently with a glass rod. Avoid any inclusions of micro-bubbles.

Additional tip for diet measurements:

– Always measure fresh samples. Samples that have been stored for some time may show considerable deviations in the diet concentration.

9 Checking, adjusting and calibrating

9.1 Reference materials

You can predefine reference data for checks or calibrations as reference materials on the instrument (also for connected modules and options).

You can use reference data from

– certified reference materials (on certificate or container)

– data obtained by a previous product measurement

To access a list of stored reference materials

Select *Settings* in the menu, then under *Reference materials* select *Material setup*.

TIP: *Reference materials marked by have expired.*

9.1.1 Manual input or modification of reference data

Reference values are entered and stored as a table.

1. Select *Settings* in the menu, then under *Reference materials* select *Material setup*.
2. Tap in the action box to add a **new** reference material (or tap on an existing reference material to **edit** its settings).
3. Select *Manual input*.
4. Start with the *Header* tab.

   Reference material identification:

   Specify name, lot number, and certificate id for the reference material.

   Expiry date:

   Set the *Enable reminder* switch to *Yes* to specify an expiry date of the reference material.

   Selection of reference parameters:

   Under *Parameters* tap *Configure*. The currently selected parameters are shown in a list on the right.
   Note: Always select *T (set)* as the first parameter in the list. Do not select any other temperature parameter. The reference material will only be accepted for a check if the set measuring temperature and the temperature specified for the reference material are the same.

   – To add parameters, use the area on the left: First select a data group in the selection box on the top, then add quantities from the list below by tapping .

   – Tap on any of the items in the list on the right to select it. You can then edit various properties of the quantity or remove it from the list.

     Tap on a selected item again to deselect it.

   – Tap *Save* to save the list of selected parameters.

5. **Input of reference values:**
   Tap *Next* or tap on the *Table* tab.

   Table columns show the selected parameters. For each reference temperature, enter the reference values row by row.

   – Tap *Add* and specify the parameters, then tap *Save* to add a row to the table.

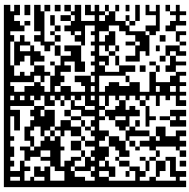
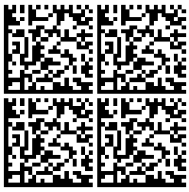
   – Tap on a table row to select it, tap on it again to deselect it.

   – Tap *Edit* or *Remove* to edit or remove a selected row.

6. Tap *Save* to save the configured reference material.

9.1.2 Input of reference data by QR code

Reference data available as QR code can be input with one of the following barcode scanners:

Barcode scanner	Configuration QR code
Zebra DS2208	
Zebra DS6707	

TIP: *If you face difficulties scanning from the instrument's display, you may scan instead the configuration QR code in the table above.*

1. Select *Settings* in the menu, then under *Reference materials* select *Material setup*.
2. Tap in the action box to add a **new** reference material.
3. Select *Scan QR code*.
4. Select your model of barcode scanner from the dropdown list.
5. Scan the corresponding QR code with the scanner to configure it for correct data input.
6. Scan the QR code of the reference material.

   Depending on the number of reference values, data transfer can take several seconds.
7. When ready, the reference data are displayed. Compare them with the certificate of the reference material to verify that they have been correctly transferred.

9.1.3 Import reference data from a product measurement

Reference data will be imported from a stored product measurement. The corresponding report configuration has to include all parameters required for the reference material.

1. Select *Settings* in the menu, then under *Reference materials* select *Material setup*.
2. Tap in the action box to add a **new** reference material.
3. Select *Import from measurements*.
4. Select the reference product measurement from the list: tap on the measurement and hold it until the selection is indicated by .
5. In the action control tap to import the reference values.
6. Finish reference data configuration.

   Reference material identification:

   Specify name, lot number, and certificate id for the reference material.

   Expiry date:

   Set the *Enable reminder* switch to *Yes* to specify an expiry date of the reference material.

   Selection of reference parameters:

   Under *Parameters* tap *Configure*. The currently selected parameters are shown in a list on the right.
   Note: Always select *T (set)* **as the first parameter in the list.** Do not select any other temperature parameter. The reference material will only be accepted for a check if the set measuring temperature and the temperature specified for the reference material are the same.

   – To add parameters, use the area on the left: First select a data group in the selection box on the top, then add quantities from the list below by tapping .

     You can only add parameters included in the report configuration of the imported product measurement.

   – Tap on any of the items in the list on the right to select it. You can then edit various properties of the quantity or remove it from the list.

     Tap on a selected item again to deselect it.

   – Tap *Save* to save the list of selected parameters.
7. Tap *Save* to save the configured reference material.

9.2 Checks

By checks, carried out in regular intervals, you can ensure that your measurements consistently deliver results of high accuracy.

With a density check, you fill a medium of known density (air, water, or a standard liquid specific to your needs) into the measuring cells and compare the measured density with the target value.

TIP: *The instrument takes automatically account of the set temperature and, with air checks, the measured air pressure.*

– Use **water checks** or **custom checks** to verify that the instrument is measuring with satisfactory accuracy.

  We recommend to perform a water check or a custom check every day before you start your measurements.

  Perform additional water checks or custom checks as required and at your own discretion, for example when you get unexpected results.

– Use **air checks** to verify the efficiency of your cleaning and drying procedure.

  We recommend to perform an air check every day after the measurements have been finished and the measuring cells have been cleaned and dried.

Perform additional air checks as required and at your own discretion, for example after the measurement of critical samples that might stick to the measuring cells (e.g., samples containing adhesives, sticky particles, proteins).

9.2.1 Check settings / custom checks

You can define checks for any measuring quantity available on the instrument.

– To define a custom check:
  a. Select *Checks* in the menu, then tap .
  b. Specify a name for the check and define the check settings.
– To edit check settings:
  a. Select *Checks* in the menu, then select one of the defined checks.
  b. Tap .
  c. Edit the settings as appropriate and save them.

Check settings

– Measurement settings for a check have to be defined as a product.

  For air check and water check, use *Generic liquids & gases*.
– *Target type:*
  – For an air check, select *Air*.
  – For a water check, select *Water*.
  – For a custom check, select *Constant* or *Reference material* and a *Reference material* (if available).
– *Limit configuration (not with air check):*
  a. Tap *Configure* to select the quantities to be checked and to define the check parameters.
  b. Select a group on the left (if available) to see a filtered list of measuring quantities.
  c. To check a quantity, select it from the list on the left (tap).
  d. Tap on a selected quantity in the list on the right to edit the check parameters for the quantity.
– Check parameters:
  – Select a unit for the check parameters and a reference value (if available) to be tested with the check.
  – For an air check or a water check, specify an upper and a lower deviation from the reference value. These are the maximal deviations allowed for the check to be passed.
  – For a custom check, specify an upper and a lower limit for the measuring quantity. The result of the check measurement must lie within the specified range for the check to be passed.

Table 15: Factory settings of max. upper/lower deviation for predefined air and water checks

DMA 4002	0.00005 g/cm³
DMA 5002	0.00005 g/cm³
DMA 6002	0.00001 g/cm³

– *Is GxP relevant*

  If you set this switch to *Yes*, check information will be included in the measurement report for GxP relevant measurements.

9.2.2 Check execution reminder

(Not available in non-storage mode)

You can activate and define a reminder that will tell you when to perform the next check.

1. Select *Checks* in the menu, then select the check for which you want to set a reminder.
2. To edit the check parameters, tap .
3. Activate *Check execution reminder*: *Yes*.
4. Now you can define
   – a time interval between check reminders
   – a time when the reminder shall be shown
   – whether the check is obligatory

     An obligatory check will not allow you to perform a measurement before you have performed the next valid check.
5. Save the settings.

Pending checks are indicated by in the header.

9.2.3 Performing a check

1. Select *Checks* in the menu, then select one of the available checks.
2. Observe all hints on the screen and fill the check medium.
   – For a water check, use freshly degassed ultrapure water.
   – For an air check, clean and dry the measuring cell thoroughly.

   Use the camera image to check that the density measuring cell is clean or that the check medium has been filled bubble-free.
3. Tap *START CHECK*.
4. The summary of the check will show the check results and a recommendation if the check has failed and an adjustment is necessary.

   All results are also saved in the data memory.
5. Tap *DONE* to close the summary.

IMPORTANT: *We advise you to follow the recommendations.*

If the water check has failed

We recommend taking corrective actions until the check is valid again:

– Examine the camera image included in the results to check that the water has been filled bubble-free.
– Check the quality of the water.
– Clean the measuring cell thoroughly.
– If above actions do not help, perform an air/water density adjustment.

9.2.4 Auto air check

If you want to verify before each measurement that the density measuring cell is clean, use the auto air check function. If activated, it initiates an air check automatically before a measurement starts.

TIP: *Auto air checks are only performed once before a series of sub-measurements starts.*

IMPORTANT: *The results of auto air checks are not saved in the data memory.*

1. First, determine an air check to be used for the auto air check:
   a. Select *Checks* in the menu, then select the air check to be used for the auto air check.
   b. To edit the check parameters, tap .
   c. Activate *Use this check for auto air check*: *Yes*.
   d. Save the settings.
2. When you define the measurement settings of a product or a measurement, you can now include an auto air check:

   Activate Auto air check: *Yes*.

Measurements with auto air check activated

1. Before you start the measurement, check that the measuring cell is clean and dry.
2. When you tap *MEASURE*, the auto air check will start.
3. Only when the auto air check succeeds, you will be prompted to fill and measure the sample.

9.2.5 Diet concentration check

From time to time (for example at the beginning of a new batch), verify the validity of the slope of the diet adjustment: Perform a diet concentration check using your lab reference method for comparison.

1. Take two fresh samples from the production line.
2. Analyze one sample with the lab reference method.
3. With the other sample, start a product measurement on the instrument (select the product that you want to check).
4. Compare the *Diet concentration* result of the finished measurement with the result of the lab reference analysis.
   – If the results differ by less than acceptable limits (defined by you), you can go on with your regular diet measurements.
   – If the results differ by more, perform a new diet concentration adjustment (refer to Section 9.3.3 [▶ 45]). Use the option *last saved measurement* for an immediate adjustment without new filling and measurement.

TIP: *The option "last saved measurement" is not available if you combine the diet concentration adjustment with a process water adjustment.*

9.3 Adjustments

With an adjustment, a sample of exactly known measurement properties (standard) is measured, and the instrument constants are adjusted in a way that the instrument delivers the known correct results.

IMPORTANT: ***Atmospheric pressure for adjustments***

The atmospheric pressure that you get from a local weather station is usually not the absolute atmospheric pressure, but a calculated atmospheric pressure value referenced to sea level.

TIP: ***Density adjustments for measurements in a pressurized system***

– *To achieve maximal accuracy, perform the water (or reference liquid) adjustment with the same pressure with which you are going to perform the sample measurements.*
– *Perform the air adjustment, as usual, at ambient pressure.*

9.3.1 Air/water density adjustment

Perform an air/water density adjustment if a water check has failed and corrective actions have not helped.

TIP: *The ThermoBalance™ technology allows for precise measurements over the whole temperature range with only one adjustment at 20 °C.*

Duration: 5 to 10 minutes if the instrument is already clean and dry and equilibrated to 20 °C

Adjustment media: dry air and freshly degassed ultra-pure water

1. Select *Adjustments* in the menu, then select *Air/Water* for density.
2. Enter the parameters for the air adjustment and tap *CONTINUE*.
   – The air humidity is set to 50 % per default.
   – The atmospheric pressure displayed is measured automatically by a built-in sensor.
3. Rinse and clean the measuring cell.

TIP: *If you use undenatured ethanol as the final rinsing liquid, only 3 to 4 minutes drying time are required.*

4. Dry the measuring cell.

   Close U-Dry to start the air pump, open U-Dry to stop the air pump.

5. Tap *CONTINUE*.

   The air adjustment routine is carried out.

6. Fill freshly degassed ultra-pure water into the measuring cell.

   Take care to fill the water without air bubbles.

7. Tap *CONTINUE*.

   The water adjustment routine is carried out.

8. The result of the adjustment is shown.

   Check the recommendation on the screen and apply or reject the adjustment.

   All results are also saved in the data memory.

IMPORTANT: *If you measure diet products, perform a diet process water adjustment after every air/water density adjustment.*

9.3.2 Air/water wide-range adjustment

Perform an air/water wide-range adjustment before the air/water density adjustment to achieve the highest possible precision of measurements at different temperatures.

The air/water wide-range adjustment performs a sequence of water adjustments followed by air adjustments at the temperatures listed in the table below.

Table 16: Air/water wide-range adjustment – sequence of adjustments and temperatures

Step	Water adjustments	Step	Air adjustments
1	60 °C (140 °F)	4	20 °C (68 °F)
2	40 °C (104 °F)	5	40 °C (104 °F)
3	20 °C (68 °F)	6	60 °C (140 °F)
		7	80 °C (176 °F)
		8	100 °C (212 °F)

Duration: approx. 150 minutes

Adjustment media: dry air and freshly degassed ultra-pure water

TIP: *To ensure bubble-free filling, boil the water and let it cool down to approx. 60 °C (140 °F).*

1. Select *Adjustments* in the menu, then select *Wide-Range* for density.

   The measuring cell is heated up to 60 °C.

   Tap *SKIP* to start filling immediately.

2. Fill freshly degassed ultra-pure water (at 60 °C) into the measuring cell.

   Water at 60 °C is prone to bubbling – consider the filling hints in Section 8.3 [▶ 37].

3. Tap *CONTINUE*.

   The first measurement serves to verify bubble-free filling.

4. After the first measurement, refill 2 mL of freshly degassed ultra-pure water (at 60 °C).

5. Tap *CONTINUE*.

   The sequence of water adjustments is carried out.

6. Rinse and clean the measuring cell.

TIP: *If you use undenatured ethanol as the final rinsing liquid, only 3 to 4 minutes drying time are required.*

7. Dry the measuring cell.

   Close U-Dry to start the air pump, open U-Dry to stop the air pump.

8. Tap *CONTINUE*.

9. Enter the air humidity and the atmospheric pressure.

   The air humidity is set to 50 % per default.

   The atmospheric pressure displayed is measured automatically by a built-in sensor.

10. Tap *CONTINUE*.

    The sequence of air adjustments is carried out.

11. The results of the adjustment are shown.

    Check the recommendation on the screen and apply or reject the adjustment.

    All results are also saved in the data memory.

9.3.3 Diet adjustments

(Only relevant for diet products)

The diet concentration is calculated from the density difference between the diet beverage and the process water that has been used for its production. In case of a pressurized measurement system, the CO_2-corrected density values are used.

Diet concentration adjustments bind the calculations to reference values which you have determined separately with your reference laboratory method.

The diet adjustments are stored with the diet products (Section 7.1 [▶ 30]).

Process water adjustment

Interval: To compensate changes of the process water and consequential fluctuations of the diet measurement results, perform the process water adjustment at least **daily**.

TIP: *If your process water results tend to show strong variations (>0.75 % Diet), we recommend to perform process water adjustments more often still.*

A process water adjustment is automatically stored with all currently defined diet products. Therefore, you need not perform the process water adjustment for each diet product.

Adjustment medium: process water taken freshly before the adjustment

1. Select *Products* in the menu, then select a diet product.

2. Check the measurement settings (or edit them), then tap *Create measurement*.

   If available, the diet adjustments stored with the product are shown.

3. Tap *Start* to start the adjustment procedure.
4. Select *Process water* and tap *CONTINUE*.
5. Fill process water and tap *CONTINUE*.
6. The result of the adjustment (density of the process water) is shown.

   Check the recommendation on the screen and apply or reject the adjustment.

Diet concentration adjustment

Interval: For each type of diet beverage that has already a diet concentration adjustment, we recommend checking the diet results in regular intervals (for example at the beginning of a new batch): Check with your reference laboratory method and perform a new concentration adjustment only if the result of the check deviates from the result delivered by the instrument more than you will accept. If you constantly get too large deviations, refer to the appendix “Troubleshooting” in the Reference Guide.

If your production process is very stable, the diet concentration adjustment can be valid for a long time. Sometimes, however, it may be necessary to perform concentration adjustments for every new batch due to production-related reasons.

Adjustment medium: freshly produced diet beverage sample of which the diet concentration has been determined separately with your reference laboratory diet measuring method (for example titration).

IMPORTANT: *You will achieve the best measurement results with the instrument in a pressurized measurement system and if the reference samples for the concentration adjustment are finished product packages from the filling line with the same carbonation level as the samples to be measured.*
If manually produced syrup mixtures or degassed samples are used for the adjustment, the accuracy of the measurements will be lower.

1. For final beverages, take two diet drink packages having come consecutively from the filling line.
   - Use one package to measure the diet concentration with your reference laboratory method.
   - Use the second package to perform the diet concentration adjustment.
2. Select *Products* in the menu, then select the specific diet product.
3. Check the measurement settings (or edit them), then tap *Create measurement*.

   If available, the diet adjustments stored with the product are shown.

4. Tap *Start* to start the adjustment procedure.
5. Select *Concentration* and tap *CONTINUE*.
6. If a stored measurement with the product is available, you can choose to perform the adjustment calculation with the *last saved measurement* or to perform a *new filling and measurement* first.

   Tap *CONTINUE*.

7. If your choice has been *New filling and measurement*:
   - Fill the diet sample and tap *CONTINUE*.

   If your choice has been *Last saved measurement*:
   - Tap *CONTINUE*.

     The result of the last measurement with the diet product will be used for the adjustment.
8. Enter the reference value determined with the reference laboratory method.

   Tap *CONTINUE*.

9. The result of the adjustment is shown.

   Check the recommendation on the screen and apply or reject the adjustment.

   If you apply the adjustment, a new diet slope will be calculated using the concentration adjustment value and the last process water value.

9.3.4 Special adjustments for density

Special adjustments are additional adjustments for specific applications, which may need specific density units, concentration ranges, or an adjustment at a specific temperature.

A special adjustment determines the adjustment constants A and B from the oscillation periods of two reference media with known density according to the following formula:

$$\rho = A \cdot PQ^2 - B$$

ρ	*reference density of medium*
A, B	*adjustment constants*
PQ	*oscillation period of medium*

You can freely specify the temperature at which the adjustment is performed.

IMPORTANT: *Qualifications for the reference media:*

- *The densities of the two reference media have to differ by at least 0.01 g/cm³.*
- *The oscillation periods PQ of the two reference media have to differ by at least 0.0001.*

TIP: *The special adjustment formula does not implement viscosity correction.*

Use of special adjustments

5 slots are available for the storage of different special adjustments.

Special adjustments can be called up as input for, e.g., the calculation of the ethanol concentration according to the Canadian excise alcohol table.

Density values based on special adjustments can be used like any other measuring quantity.

TIP: *A quantity based on a special adjustment will only show valid results if the measurement is performed at the same temperature as the underlying special adjustment.*

Performing a special adjustment

IMPORTANT: *The measurement settings for a special adjustment have to be defined in a product with measurement mode Standard before you can perform the special adjustment.*

1. Select *Adjustments* in the menu, then select *Special* for density.
2. Specify the settings for the special adjustment:
   – Enter a name for the adjustment.
   – Select a slot where the adjustment shall be stored.
   – Enter a unit.
   – Define the measurement settings by selecting a product (predefined or prepared by you beforehand).
3. Tap *START*.
4. Enter the reference density values for both reference media.
5. Tap *START*.
6. **First reference medium:**
   a. Rinse and clean the measuring cell.
   b. Dry the measuring cell.
   Close U-Dry to start the air pump, open U-Dry to stop the air pump.
   c. Fill the first reference medium into the measuring cell and tap *CONTINUE*.
   Ensure that the medium is filled without bubbles.
7. **Second reference medium:**
   a. Rinse and clean the measuring cell.
   b. Dry the measuring cell.
   Close U-Dry to start the air pump, open U-Dry to stop the air pump.
   c. Fill the second reference medium into the measuring cell and tap *CONTINUE*.
   Ensure that the medium is filled without bubbles.
8. The result of the adjustment is shown.
   Check the recommendation on the screen and apply or reject the adjustment.
   All results are also saved in the data memory.

9.3.5 Adjustment for alcohol concentration (Canadian excise)

The measuring quantity *Canadian excise* requires a special adjustment with apparent density values of air and water. To be able to use the quantity, proceed as follows.

1. Define a product for the special adjustment:
   – *Set temperature*: 20 °C
   – *Measurement performance class*: highest accuracy available
   – *Measurement mode*: *Standard*
2. Perform a special adjustment with air and water as the reference media (Section 9.3.4 [▶ 46]).
   – Specify the settings:
   Select a slot where the special adjustment shall be stored.
   Select the product that you have defined for the special adjustment.
   – Specify the reference values:
   Apparent density of air at 20 °C: 0
   Apparent density of water at 20 °C: 0.99715
   – Apply the adjustment if it is OK.
3. In the product definition for your product measurements, select the special adjustment for the parameter *Canadian excise density input*.
4. Measure your samples with these product settings.
   The measuring quantity *Canadian excise* (in the group *Alcohol functions*) will show the right values.

9.3.6 Adjustment of the built-in atmospheric pressure sensor

Adjust the pressure sensor if the value for the atmospheric pressure suggested by the instrument deviates by more than ±1.5 % from the actual pressure.

IMPORTANT: *Do not use the atmospheric pressure that you can get from a local weather station for adjustment because it is usually not the absolute atmospheric pressure, but a calculated atmospheric pressure value referenced to sea level.*

1. Select *Adjustments* in the menu, then select *Air pressure* for DCB.
2. Use a calibrated external pressure sensor to determine an exact value for the atmospheric pressure.
3. Enter the atmospheric pressure (in hPa) and the optional barometer ID.
4. Tap *START*.
5. The results of the adjustment are shown.
   Check the recommendation on the screen and apply or reject the adjustment.
   All results are also saved in the data memory.

9.3.7 Viewing the adjustment history

You can access and manage adjustment reports, like all saved data, in the data explorer:

– Select *Data explorer* in the menu, then select the data category *Adjustments*.
You will see a list of adjustments performed.

Alternatively, there is a shortcut from the adjustments spot to the data explorer:

– Select *Adjustments* in the menu, then tap below any of the defined adjustments.

  You will see the adjustment history already filtered for the specific adjustment.

9.3.8 Resetting adjustments to factory adjustment

You can reset the instrument's density adjustments to the factory adjustment:

1. Select *Adjustments* in the menu, then tap in the action box.
2. Switch the density factory adjustment to *Yes*.
3. Tap *Reset*.

   Density adjustments will be reset.

IMPORTANT: *Factory default reference values for the density of air and water are based on the formula of Spieweck and Bettin.*

IMPORTANT: *If you measure diet products: After resetting the adjustments, perform new diet adjustments.*

9.4 Calibrations

The goal of a calibration is to validate the accuracy of measurements.

To calibrate the instrument, measure a certified standard liquid and compare the result to the reference value indicated in the calibration certificate of the standard.

The physical properties (density, viscosity, etc.) of the liquid standards should be similar to those of the samples.

The frequency of calibrations with certified liquid standards depends on your requirements and judgment (recommendation: 1 to 2 calibrations per year).

IMPORTANT: ***Improper calibration due to spoiled media***

– *Always check the expiry date of the calibration liquids.*
– *Store the calibration liquids in a cool and dark place.*
– *Use the calibration liquids immediately and only once after the container has been opened.*

Performing a calibration

Refer also to Section 8.6 [▶ 40] for recommendations.

1. Perform a water check.
2. If necessary, perform an air/water adjustment.
3. Thoroughly clean and dry the measuring cell.
4. Start a measurement with the following measurement settings:
   – *Set temperature*: set to the temperature of the certified reference value
   – *Measurement performance class*: highest accuracy available
   – *Check density stability*: *Yes* (if available)
5. Open the bottle with the liquid standard.

   If your bottle with standard has a septum, we recommend that you pierce it carefully with a clean, sharp tool, then fill a Luer tip syringe with standard liquid by pushing the tip into the hole of the septum, holding the bottle upside down, and slowly pulling the plunger.
6. Immediately after opening the bottle, inject the standard into the measuring cell.
7. Perform a measurement.

TIP: *If you have enough standard liquid, we recommend to do a series of three measurements and take the arithmetic average of the results.*

8. After the measurement is finished, print the result.
9. Document the calibration procedure in a calibration record containing the operator's name, the date, place, description and results of the calibration procedure, and the calibration certificate of the liquid standard.

10 Upkeep and cleaning

10.1 Software administration

10.1.1 System information

All detailed technical information, version numbers, and serial numbers concerning your measurement system (including installed options), are listed in the system information:

1. Select *System information* in the menu.
2. Scroll through the listed information: software, components, boards, modules, etc.

10.1.2 Diagnostics package

In case of problems, you can greatly help Anton Paar's support team by providing a diagnostics package when asked for it.

Here's how to generate a diagnostics package:

1. Select *System information* in the menu.
2. Tap *Save diagnostics package* in the action box.
3. Select a storage location: a connected USB memory device or a registered network share.
4. Best leave the *File name* as is.
5. Tap *Save*.

10.1.3 Software update installation

TIP: *Your Anton Paar representative will inform you when a software update for your instrument is available.*

TIP: *You can download the latest instruction manual for your instrument from the product page on https://www.anton-paar.com.*

TIP: *Before you start a system update, make a backup of the system (refer to Section 10.2 [▸ 49]).*

1. Save the software update package in the root directory of a USB memory device or a registered network share.

   The software update package is a file with a file name extension ".aup". Its file name usually includes a version number that should be higher than that of the software installed on your instrument.
2. *With USB memory device:* Connect it to one of the USB sockets of the instrument.

NOTICE

A failed system update may render your instrument unusable

Do not disconnect the USB memory device during the update process.

3. Select *System update* in the menu.
4. Tap *Select package* and select the software update package on the USB memory device or on the network share.
5. Tap *Open*.

   The version of the software in the package is shown side by side with the currently installed software version. Check that this is the software version that you want to install.
6. Tap *INSTALL* and wait for the installation to finish.

10.1.4 Service functions and reset

The *Settings* menu includes a *Service* section:

– *Reset to factory* serves as a last resort to reset your instrument to factory settings.

  Avoid if possible.

– *Service mode* is reserved for authorized service technicians.

10.2 Backup and restore

Reasons for making a backup

– Safety – a backup enables you to easily recover settings that may have been modified by mistake.

– Intermediate storage – save all settings and measurement data when components of the instrument are to be upgraded or exchanged.

– Standard setup – configure the settings on one instrument and replicate them onto further instruments (of the same model).

TIP: *We recommend to make a backup of the settings after system installation.*

Data included in backup/restore choices

You can individually select to **backup** settings, users and roles (if system security is activated), and measurements:

– *Settings* include all instrument settings, system security settings, measurement settings, products, custom quantities, and check definitions. Dashboards and favorites are included, as well.

– *Users / roles* include all user accounts and role definitions.

– *Measurements* include all data stored with the results of product measurements and check measurements, but no measurement settings.

All backups include the whole set of adjustment data as well as instrument data for identification.

IMPORTANT: *Audit trail information is never included in a backup.*

With the **restore** function, you can select which data shall be restored (you can only select data included in the backup package):

– Select *Settings* to restore saved settings from the same instrument or to transfer settings from a reference setup onto another instrument.

– Select *Users / roles* to restore saved user accounts and role definitions from the same instrument or to transfer them from a reference setup onto another instrument.

– *Measurements*
  It is probably only meaningful to restore measurement data on the same instrument.

– *Adjustments* can only be selected if the backup package has been made on the same instrument because adjustments are instrument-specific.

IMPORTANT: *If you select to restore only measurements, the restore procedure will still reset all settings to factory settings.*

IMPORTANT: *You cannot restore data on an instrument with older software version from a backup made on an instrument with newer software version.*

10.2.1 Making a backup

IMPORTANT: *You can only start the backup procedure if no measurement is running.*

1. Select *Backup* in the menu.
2. Select a storage location where the backup package shall go: a connected USB memory device or a registered network share.
3. Select which data shall be included in the backup package.

The storage size available and a rough estimate of the storage size needed for the backup are shown in the hints area of the spot.

4. Tap *BACKUP* to start the backup procedure.

10.2.2 Restoring data from a backup

IMPORTANT: *You can only restore data from a backup package made on the same instrument model.*

TIP: *Restored data that have been exported before the backup will keep their "exported" status.*

1. Select *Restore* in the menu.
2. Open a backup package on a connected USB memory device or a registered network share.
3. Select which data shall be restored.
4. Tap *RESTORE* to start the restore procedure.
   - First, after a reboot, the instrument will be reset to factory settings.

     Measurement data will be removed.

     Adjustment data will only be reset if the backup package has been made on the same instrument, else not.
   - Then the selected data will be restored from the backup package.
   - Finally, the instrument reboots to load the restored settings.

10.3 Cleaning and drying the measuring cell

Employ a regular and effective cleaning routine and store the instrument under the recommended conditions.

Cleaning frequency

Clean and dry the measuring cell at least after each working day or working shift.

Cleaning more frequently can be necessary …

- before you perform adjustments
- before you measure a sample that is not miscible with the previous sample
- before you want to measure using a minimum sample amount
- before you measure a sample that could chemically react with the previous sample
- immediately after you have measured a sample that could solidify or harden in the measuring cell

Cleaning liquids

Employ two cleaning liquids in a row:

- Cleaning liquid 1 dissolves and removes sample residues in the measuring cell. It has to be a good solvent for all sample components.
- Cleaning liquid 2 removes cleaning liquid 1 and is easily evaporated by a stream of dry air so that drying of the cell is accelerated. Cleaning liquid 2 has to be a good solvent for cleaning liquid 1.

Table 17: Recommended cleaning liquids

Sample	Liquid 1	Liquid 2
aqueous samples, beverages	water	non-denatured ethanol
petrochemical samples	petroleum naphtha	acetone

Find more recommendations in the appendix of the Reference Guide.

If you are uncertain about a suitable cleaning liquid, perform preliminary tests on a glass plate (for example a microscopic slide):

- Put some drops of sample on the glass surface and try to remove it by rinsing with different liquids.
- Only if the sample can be removed completely by rinsing (**not wiping**) with a suitable cleaning liquid, it should be filled into the density measuring cell.

Cleaning procedure

WARNING

Risk of injuries and fire by liquids leaking

Before you fill any sample or cleaning liquid, in particular hazardous or flammable chemicals, into the instrument:

- Strictly follow all safety instructions concerning the use of chemicals and the use of flammable chemicals (refer to Section 1 [▶ 7]).
- Make sure that all wetted parts are resistant to the filled-in liquid (refer to the appendix). Consider also the wetted parts of installed options.

NOTICE

Risk of damaging the measuring cell

Do not use any mechanical action for cleaning the measuring cell.

IMPORTANT: *Observe all safety instructions for filling sample that are applicable for cleaning liquids.*

For a description of the cleaning and drying procedure with an optional Xsample, refer to the manual of the Xsample.

1. Select *Cleaning* in the menu.
2. Rinse the measuring cell with cleaning liquid 1 (minimum 5 mL).

   If your sample is viscous or contains particles, use more cleaning liquid.
3. Empty the measuring cell (by filling air).
4. Rinse the measuring cell with cleaning liquid 2 (minimum 5 mL).

5. Empty the measuring cell.
6. Continue with the drying procedure.

Drying procedure

IMPORTANT: *Consider to install a drying cartridge if the instrument's condition monitoring shows a warning.*

Fig. 23: *Drying the measuring cell*

1. Close U-Dry – the air pump starts automatically.

   Without U-Dry: Connect the air pump hose with Luer cone directly to the sample inlet adapter. On the *Cleaning* screen, tap ▶ to start the air pump.

2. Wait until the measuring cell is dry (stable density reading).

   The time needed depends on the vapor pressure of your cleaning liquid 2 and the temperature of the measuring cell (ethanol at 20 °C: approx. 5 minutes, acetone at 20 °C: approx. 3 minutes).

3. Open U-Dry – the air pump stops.

   You can also set the air pump to turn off automatically:

   – Tap ⚙ to open the air pump settings.
   – Switch *Turn off when density is stable* or *Turn off after timeout* on/off according to your requirements.
   – Tap *Save*.

   Without U-Dry: Tap ■ to stop the air pump. Disconnect the air pump hose from the sample inlet adapter.

⚠ WARNING

Risk of injuries and fire by liquids leaking

If liquids get into the air pump system, they may destroy the pump diaphragm and leak from the instrument.

– Disconnect the air pump hose before you start filling liquids.

10.4 Cleaning the instrument housing, U-Dry, and the touchscreen

⚠ WARNING

Before using any cleaning agents for the instrument's surface parts:

– Strictly follow all safety instructions concerning the use of chemicals and the use of flammable chemicals (refer to Section 1 [▸ 7]).
– Make sure that all surface parts are resistant (refer to section "Wetted parts" in the appendix). In case of uncertainties, contact Anton Paar GmbH.
– Decontaminate and remove aggressive sample residues on the instrument.

NOTICE

Corrosion due to unsuited means of cleaning

Using substances for cleaning that are not suitable causes corrosion of the instrument's surface parts. Never use:

– highly nonpolar solvents (like toluene, hexane, solvent naphtha)
– strong acids or bases (like nitric acid, sulfuric acid, hydrochloric acid, caustic soda)
– strong mechanical action (steel brush)

To clean the instrument housing, U-Dry, or the touchscreen, use a soft tissue which can be wetted with warm water, if necessary with a mild cleaning agent added (pH <10).

If necessary unmount U-Dry for cleaning.

10.5 Storing the instrument

Clean and dry the measuring cell before you store the instrument for **more than one day**. Otherwise algae may grow on the glass surface, which are difficult to remove.

If you store the instrument for **less than one day**, the measuring cell can be filled with ultra-pure water or stay filled with the last cleaning liquid used. If you have filled by syringe, leave the syringe mounted in the filling position to keep the liquid from running out.

10.6 Transporting the instrument

CAUTION

Risk of squeezing your fingers

Do not hold the instrument by its bottom to avoid squeezing your fingers when you put down the instrument.

– Empty the measuring cell and all hoses before you move or lift the instrument.
– To carry the instrument, put one hand into the recessed grip below the front and grasp the metal ledge on the rear with the other hand.
– Carry the instrument in front of you and keep it close to your body.

10.7 Exchanging the U-Dry filling adapter

The U-Dry filling adapter can be exchanged if damaged.

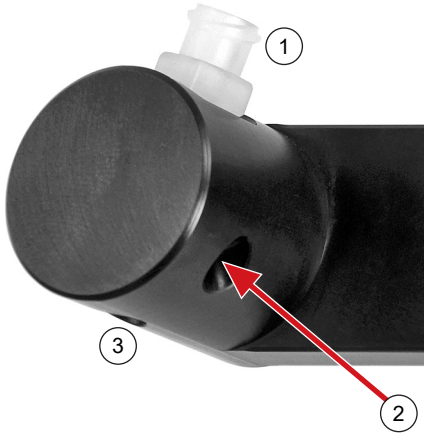


Fig. 24: *Exchanging the U-Dry filling adapter*

1 Filling adapter: adapter Luer ¼" UNF, mat. no. 64792
2 Fixing screw (in the hole): pan head screw M2x6, mat. no. 68028
3 Screw hole for the filling hose

1. The filling adapter (1) is locked by a fixing screw (2) against self-loosening.

   Loosen the fixing screw with the Phillips screwdriver from the accessory kit before exchanging the filling adapter (turn counterclockwise).
2. Exchange the filling adapter: turn counterclockwise to unmount, turn clockwise to mount.
3. Tighten the fixing screw hand-tight (turn clockwise).

11 Network and printer configuration

11.1 Network connection

TIP: *If you are in doubt about the correct settings, consult your network administrator.*

If you want to access network resources (like a network printer), you need to set up an Ethernet or WiFi connection first.

11.1.1 Setting up an Ethernet connection

1. Make sure that your instrument is connected to the network.
2. Select *Settings* in the menu, then under *Network & connections* select *Ethernet*.
3. Switch *Ethernet* to *ON*.

   The network configuration settings slide in.
4. To edit an already defined configuration:

   Scroll down to the end of the list and tap *Configure*. Then scroll back up.
5. Use the Configuration switch to select automatic or manual configuration.

   Automatic configuration (recommended)
   Use automatic configuration if your network server supports DHCP.

   – Scroll down to *DNS suffixes*.
   – Enter one or more DNS suffixes in the proper order (your domain names).

   Manual configuration
   Use manual configuration to set a fixed IP address for the instrument.

   – Set the IP address, the subnet mask, and the gateway address according to your local network.
   – Set the primary (and secondary) DNS name server addresses.
   – Enter one or more DNS suffixes in the proper order (your domain names).
6. Tap *Connect*.

If you experience problems connecting to the network, verify that your settings are correct.

TIP: *You cannot change the shown MAC address. This is a unique address specific for your instrument.*

11.1.2 Setting up a WiFi connection

1. Connect the WiFi dongle, mat. no. 194727, to one of the USB sockets of your instrument.
2. Select *Settings* in the menu, then under *Network & connections* select *WiFi*.
3. Switch *WiFi* to *Enabled*.

Under *Available Networks* you will see networks found.

4. Select a network and tap *Connect*.

   The name and connection status of the selected network will be displayed for the WiFi connection.

   To terminate the WiFi connection, tap *Disconnect*.

5. Tap *Settings* to edit the network configuration:
   - Use the *IP Configuration* switch to select automatic or manual configuration.

     With manual IP configuration, set the IP address, the subnet mask, and the gateway address according to your local network.
   - With automatic IP configuration, use the *DNS Configuration* switch to select automatic or manual configuration.

     With manual DNS configuration, set the primary and secondary DNS name server addresses and one or more DNS suffixes in the proper order (your domain names).
   - Tap *Save* to save the settings.

The settings of previously used networks are saved so that you need not configure them every time you connect to them.

Previously used networks are listed under *Known Networks*.

- To remove the connection details for a known network, select it in the list, then tap *Remove*.

11.2 Network shares

Table 18: Supported network shares

– Windows Server 2012
– Windows Server 2016
– Windows Server 2019

TIP: *If you are in doubt about the correct settings, consult your network administrator.*

You can use network shares as storage locations. To make them available for this purpose, register them on the instrument:

1. Configure a network connection first (Section 11.1 [▶ 52]).
2. Select *Settings* in the menu, then under *Network & connections* select *Network shares*.
3. Tap in the action box to add a **new** network share or tap on an existing network share to **edit** its settings.
4. Switch *Network share* to *Enabled* or *Disabled*.
   - *Enabled* makes the network share available for use.
   - *Disabled* temporarily disables the network share.
5. Define a unique *Display name* for the network share. You will later be able to identify it by this registered name.
6. In the *Server* input field, specify the full network path to the network share.

   A correct path begins with a double slash character (//).

   Mind to use the correct slash characters for the path. The instrument will not accept backslash characters (\).
7. We recommend to leave the *SMB version* at *Default* (setting it to the highest version available for communication).

   Alternatively, select a SMB version supported by the specified server.
8. Enter the correct authentication data for the network share in the *User name* and *Password* input fields.

   If you enter incorrect authentication data, you will later not be able to transfer data between the instrument and the network share.
9. Some configurations require to specify the domain for the authentication explicitly.

   In this case switch *Use domain* to *YES* and specify the domain name.
10. Tap *Test connection* to verify that the network path is correct.
11. Tap *Add* or *Save* (if you have edited an existing network share) to save the new settings.

After this, you can use the network share as a storage location identified by the registered display name.

If you experience problems writing to or reading from the network share, verify that your settings are correct.

11.3 Remote interface / AP Connect

Activating the remote interface, enables AP Connect to get access to the instrument.

1. Configure a network connection first (Section 11.1 [▶ 52]).
2. Activate the remote interface:
   - Select *Settings* in the menu, then under *Network & connections* select *Remote interface*.
   - Switch *Remote interface* to *activated*.

     When the remote interface is activated, the status of the interface is shown in the header.
   - To enable communication with AP Connect, do not alter the preset TCP port 8393.
3. Optionally define an instrument name, which will be used as a hostname in the DNS (Domain Name System):
   - Select *Settings* in the menu, then under *Network & connections* select *Instrument name*.

– Enter a *Hostname* for the instrument.

4. If you have activated system security:

   Remember to set remote interface permissions for the user(s) connecting via AP Connect.

11.4 Printers

You have to register your printer on the instrument to make it available for printing. The following sections describe the printer registration for each of the supported printer types.

11.4.1 Network printers

Table 19: Supported network printer models

– PCL 5 printers
– PCL 6 printers

1. Configure a network connection first (Section 11.1 [▶ 52]).
2. Make sure that your printer is connected to the network and switched on.
3. Select *Settings* in the menu, then under *Hardware* select *Printers*.
4. Tap in the action box to add a **new** network printer or tap on an existing network printer to **edit** its settings.
5. If you add a new network printer:

   Tap *Add network printer*.
6. Define a unique *Printer name* for the network printer. You will later be able to identify it by this registered name.
7. Use the corresponding switch to set the printer as the default printer.
8. From the *Model* list, select a driver class supporting your printer.
   – *Generic PCL 5 compatible printer (b/w)* should work for black & white laser printers.
   – *Generic PCL 6 compatible printer (color)* should work for color printers.
9. Specify the *Hostname* or *IP* of the network printer.

   The name or address depend on your network configuration.
10. Tap *Print test page* to verify that the network printer has been correctly registered and that the connection works.
11. Tap *Create* or *Save* (if you have edited an existing network printer) to save the new settings.

After this, you can use the registered network printer for printing on the instrument.

11.4.2 USB printers

Table 20: Supported USB printer models

– PCL 5 printers
– PCL 6 printers

1. Make sure that your printer is connected to one of the USB sockets of your instrument and switched on.
2. Select *Settings* in the menu, then under *Hardware* select *Printers*.
3. Tap in the action box to add a **new** USB printer or tap on an existing USB printer to **edit** its settings.
4. If you add a new USB printer:

   Tap *Add USB printer*.
5. Define a unique *Printer name* for the USB printer. You will later be able to identify it by this registered name.
6. Use the corresponding switch to set the printer as the default printer.
7. The field *Available printers* should show the connected printer detected by the instrument.

   If the field *Available printers* is empty, the instrument is not able to detect your printer.
   In this case contact your local Anton Paar representative.
8. From the *Model* list, select a driver class supporting your printer.
   – *Generic PCL 5 compatible printer (b/w)* should work for black & white laser printers.
   – *Generic PCL 6 compatible printer (color)* should work for color printers.
9. Tap *Print test page* to verify that the USB printer has been correctly registered and that the connection works.
10. Tap *Create* or *Save* (if you have edited an existing USB printer) to save the new settings.

After this, you can use the registered USB printer for printing on the instrument.

11.4.3 Serial printers

IMPORTANT: *Serial printers cannot be used as a full-featured equivalent of network or USB printers. They are primarily intended for basic measurement, check, and adjustment reports.*

Table 21: Supported serial printers

– Epson TM-U220 (compatible model available from Anton Paar)
– Citizen CBM-910 Type II
– Epson TM-U330D (Chinese)
– Generic RS-232 printer

1. Make sure that your printer is connected to the COM/RS-232 serial port of your instrument and switched on.
2. Select *Settings* in the menu, then under *Hardware* select *Receipt printer*.
3. From the *Receipt printer* list, select your printer model.

4. Use the switches to include or omit the listed information in the reports printed on the serial printer.

   Instrument identification comprises the instrument name, the serial number, and the current software version.

   For check reports, only the setting for *Instrument identification* applies.

5. Tap *Print test page* to verify that the serial printer has been correctly registered and that the connection works.

After this, you can use the registered serial printer for printing on the instrument.

Deactivating the serial printer

1. Select *Settings* in the menu, then under *Hardware* select *Receipt printer*.
2. From the *Receipt printer* list, select *(none)*.

The serial port can now be used for other purposes, for example RS-232 LIMS services.

12 Custom quantities

In addition to the measuring quantities already provided by the instrument, you can define custom quantities to serve your specific needs.

For example, to have your measurement results displayed in a unit not natively supported on your instrument, just define a custom quantity doing the conversion with a formula, and select the custom quantity in a dashboard widget.

You can use custom quantities in exactly the same way as measuring quantities. Therefore, you can include a custom quantity in the definition of another custom quantity.

You find all custom quantities that you have defined in the data group *Custom Quantities*.

Protected custom quantities

If system security is activated, a custom quantity can be protected, which means that it can only be edited or removed by the person who has defined it.

– To protect a custom quantity, set the switch *Protect* to *Yes* when you define the quantity.

12.1 Custom quantity defined by a formula

In this case, the custom quantity Q_c is a function of one or more already defined quantities Q_1, Q_2, …:

$$Q_c = f(Q_1, Q_2, \ldots)$$

The function is defined by the formula f.

You can use the following operators and functions to compose the formula:

Table 22: Available operators and functions

+	addition, unary plus (sign)
–	subtraction, unary minus (sign)
*	multiplication
/	division
**	exponentiation (powers)
sqrt()	square root
abs()	absolute value (discards sign)
log() ln()	logarithms to bases 10 and e
exp()	exponential function
sin() cos() tan() asin() acos() atan()	trigonometric functions and inverse

– Quantities used in the formula are denoted *Q1*, *Q2*, and so on. Case does not matter.

– Quantities have to be added to the formula before they can be used in it (explained below).

TIP: *The character serving as decimal separator in numbers depends on your regional settings.*

To define the custom quantity

1. Select *Quantities* in the menu to open a list of all available quantities.
2. Tap in the action box to add a custom quantity.
3. Select *Add formula*.
4. On the spot for the definition of the custom quantity, specify the name of the new quantity.

   You can also enter

   – a description

   – a designation for the unit to be displayed with the value of the quantity

   – the number of decimal places to be displayed

5. Specify an upper limit and a lower limit for the values of the custom quantity.

   If the value of the custom quantity exceeds these limits, the notification “*Out of range*” will be displayed instead of a value.

6. To enter the defining formula, tap into the *Formula* box and start typing the formula.

   – Combine numerical constants and defined quantities with the available operators and functions.

   – To add a quantity to the formula:

     Tap *Add quantity* (above the keyboard).

     Select the desired *Quantity* after you have selected the proper *Group*. Also select the correct *Unit* of the quantity (if applicable).

Tap *Save*.

The added quantity with its denotation is shown in a list below the *Formula* box. You can now use the denotation in the formula.

7. Tap *Save*.

12.2 Custom quantity defined by a two-dimensional (2D) polynomial

In this case, the custom quantity Q_c is a function of two already defined input quantities Q_1 and Q_2:

$$Q_c = f(Q_1, Q_2)$$

The function is a 2D polynomial of degree 3:

$$f(Q_1, Q_2) = c_{00} + c_{10} \cdot Q_1 + c_{20} \cdot Q_1^2 + c_{30} \cdot Q_1^3 + c_{01} \cdot Q_2 + c_{11} \cdot Q_1 Q_2 + c_{21} \cdot Q_1^2 Q_2 + c_{02} \cdot Q_2^2 + c_{12} \cdot Q_1 Q_2^2 + c_{03} \cdot Q_2^3$$

To define the custom quantity

The custom quantity is defined by the polynomial formula above. The polynomial coefficients c_{ij} have to be imported from a file.

1. Select *Quantities* in the menu to open a list of all available quantities.
2. Tap in the action box to add a custom quantity.
3. Select *Add 2D polynomial*.
4. On the spot for the definition of the custom quantity, specify the name of the new quantity.

   You can also enter

   – a description
   – a designation for the unit to be displayed with the value of the quantity
   – the number of decimal places to be displayed
5. Specify the input quantities 1 (Q_1) and 2 (Q_2):

   For each:

   – Select the proper *Group*.
   – Then select the input *Quantity*.
   – Select the correct *Unit* of the input quantity (if applicable).
6. To import the polynomial coefficients, tap *Import*.

   The CSV file to be imported must contain the coefficients in the correct order:

   – each coefficient in a new line
   – numbers have to use a point (.) as the decimal separator
   – numbers must not contain thousands separators or blanks
   – order of coefficients:
   c_{00} | c_{10} | c_{20} | c_{30} | c_{01} | c_{11} | c_{21} | c_{02} | c_{12} | c_{03}

   If you are not sure about the correct file format, you can generate a template file:

   – Tap *Template*.
   – Specify a file name and a location where it shall be stored.
   – Tap *Save*.

   Open the template file with any text editor and replace the numbers (= coefficient indices) by your coefficients in the given order. Then re-import the file.
7. Select the CSV file with the coefficients and tap *Open*.
8. Tap *Save*.

12.3 Custom quantity defined by a table

In this case, the custom quantity Q_c is a function of an already defined input quantity Q_i:

$$Q_c = f(Q_i)$$

The function is defined by data pairs ($Q_{i,1}$/$Q_{c,1}$), ($Q_{i,2}$/$Q_{c,2}$), ($Q_{i,3}$/$Q_{c,3}$) … relating values of the custom quantity to values of the input quantity and provided as a table in a file.

TIP: *Use table data from the technical literature or use your own experimental data, for example relating concentrations of a binary mixture to measured density values.*

TIP: *The larger the number of data pairs and the higher the accuracy of the data pairs, the higher the accuracy of the results that you can obtain.*

– If the value of the input quantity lies between table values, the function value is determined by linear interpolation.
– Function values will not be extrapolated. Therefore, the range of table values of the input quantity sets the limits of the range for which the function is defined. Ensure that your table data cover the whole range of values that you want to measure.

To define the custom quantity

1. Select *Quantities* in the menu to open a list of all available quantities.
2. Tap in the action box to add a custom quantity.
3. Select *Add Table*.
4. On the spot for the definition of the custom quantity, specify the name of the new quantity.

   You can also enter

   – a description
   – a designation for the unit to be displayed with the value of the quantity
   – the number of decimal places to be displayed
5. Specify the input quantity:

   – Select the proper *Group*.
   – Then select the input *Quantity*.

- Select the correct *Unit* of the input quantity (if applicable).

6. To import the defining table, tap *Import*.

   The CSV file to be imported must contain the data pairs of the function table:

   - each pair in a new line
   - the values of the pair separated by a semi-colon (;)
   - numbers have to use a point (.) as the decimal separator
   - numbers must not contain thousands separators or blanks

   If you are not sure about the correct file format, you can generate a template file:

   - Tap *Template*.
   - Specify a file name and a location where it shall be stored.
   - Tap *Save*.

   Open the template file with any text editor and replace the sample data by your function table in the same format. Then re-import the file.
7. Select the CSV file with the table data and tap *Open*.
8. Tap *Save*.

12.4 Editing a custom quantity

A protected custom quantity can only be edited by the person who has defined it.

1. Select *Quantities* in the menu to open a list of all available quantities.
2. Tap on a custom quantity that you want to edit.

   You can only edit custom quantities.
3. Tap in the action box.

   You will be back on the spot where you have defined the custom quantity.
4. Edit the properties of the custom quantity, modify the formula, or import a new table, depending on the type of custom quantity.
5. Tap *Save*.

12.5 Removing a custom quantity

A protected custom quantity can only be removed by the person who has defined it.

1. Select *Quantities* in the menu to open a list of all available quantities.
2. Tap on a custom quantity that you want to remove.

   You can only remove custom quantities.
3. Tap in the action box.
4. To confirm removal, tap *Yes*.

TIP: *In certain cases, you will not be able to remove a custom quantity (you will see an error message). This means that the custom quantity is still in use elsewhere. If you want to remove the custom quantity all the same, you will have to resolve the conflict first.*

13 System security and user management

System security on your instrument serves to guarantee data integrity and includes a user and role management enabling a fine-tuned access control for functions and data on the instrument.

IMPORTANT: *All system security rules are only enforced after they have been activated. They are not applied retroactively.*

13.1 Activating system security

Before you can use any of the included features, you need to activate system security:

1. Select *Settings* in the menu, then under *System security* select *Activation*.
2. Set the switch *System security* to *activated*.
3. Tap *Restart*.

   The instrument will restart and present a login screen.

After the first activation of system security, log in with the default administrator account (Section 13.5 [▶ 58]) in order to set up your user and role management.

IMPORTANT: *When you activate system security, RS-232 LIMS services will be deactivated.*

TIP: *Activation of system security automatically activates the audit trail.*

13.2 Logging in/out

When system security is activated, you can only get access to the instrument by logging in.

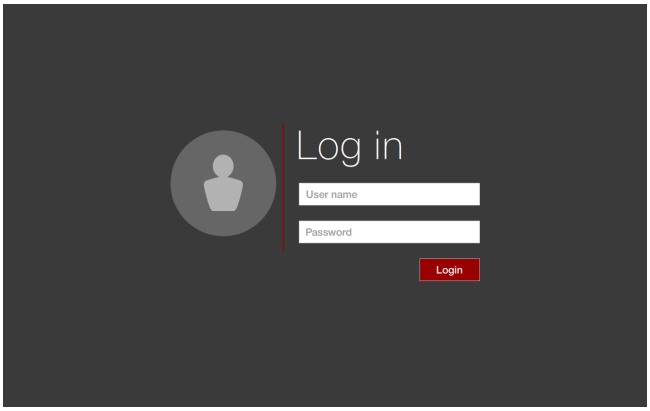


Fig. 25: *Login screen*

Logging in

On the login screen, enter a user name and the corresponding password, then tap *Login*.

The (automatically generated) initials of the user currently logged in are shown as a user identification in the header.

Fig. 26: *Example user identification in the header*

Logging out

1. To log out, tap on the user identification in the header (Fig. 26 [▶ 58]).

   A control panel slides in showing the available user operations:

Fig. 27: *Example control panel with user operations*

2. Tap *LOG OUT*.

   The login screen will appear.

TIP: *When you log out, operations that you have started will continue to run until finished.*

13.3 Auto login

You can specify one user to be automatically logged in when you switch on the instrument:

1. Select *Settings* in the menu, then under *System security* select *Login settings*.
2. Switch *Auto login* to *activated*.
3. Select one of the users as the auto login user.

TIP: *Be aware that anybody who has access to the instrument will be granted the same permissions as the auto login user.*

13.4 Locking the instrument/screen

You can lock the instrument/screen while you leave the instrument unattended. Operations that you have started will continue to run until finished.

Locking instrument/screen

1. Tap on the user identification in the header (Fig. 26 [▶ 58]).

   A control panel slides in showing the available operations (Fig. 27 [▶ 58]).

2. Tap *LOCK*.

   The lock screen shows the user identification of the user who has locked the instrument.

IMPORTANT: *If an administrator with permission for user management has locked the instrument, only this administrator can unlock it again.*

Auto lock

You can configure the instrument so that the screen is automatically locked after a specified period of inactivity.

1. Select *Settings* in the menu, then under *System security* select *Login settings*.
2. Set the switch *Auto lock* to *activated*.
3. Specify the *Inactivity period*, after which the screen is automatically locked.

Unlocking instrument/screen

– On the lock screen, enter the password of the user shown, then tap *Unlock*.

– You can also change to another user:

  – On the lock screen, tap .

  – Enter a user name and the corresponding password, then tap *Login*.

13.5 User and role management

The instrument comes with preset user accounts with different permissions according to their assigned roles:

Table 23: Factory default user accounts

User name	Password	Role
administrator	administrator	Administrator
operator	operator	Operator
service	service	Services

TIP: *We recommend to change the default passwords when you set up your user management.*

TIP: *Be aware that the default administrator has not been granted all permissions.*

The default accounts can be arbitrarily edited, even removed.

To set up a user and role management according to your requirements

– Define the **login settings**. These include the rules for user names and passwords. Refer to Section 13.5.1 [▶ 58].

– Define the **roles** available on the instrument. These are sets of permissions. Refer to Section 13.5.2 [▶ 59].

– Add individual **user accounts**. Refer to Section 13.5.3 [▶ 59].

13.5.1 Login settings

1. Select *Settings* in the menu, then under *System security* select *Login settings*.
2. Now you can set your rules for user names (length) and passwords (length, allowed / restricted / mandatory characters). Factory presets are given in Table 24 [▶ 59].

- Only when you specify that passwords are **required**, password rules will be enforced.
- **Whitelists** define characters that are available for use.
- You can specify that and when the password **expires**. After the set period, passwords have to be changed.
- Password **history** specifies how often you have to change a password until you can use a former password again.
- You can specify that **failed authentications** shall be tracked. In this case a user account will be deactivated after a specified number of consecutive attempts to enter a wrong password.

TIP: *Take measures to prevent that you end up with all accounts with user management permission having been deactivated due to failed authentication attempts.*

IMPORTANT: *Be aware that all unsaved data and settings on the instrument will be lost if all users have locked themselves out. There is no backdoor.*

IMPORTANT: *Since login settings are not applied retroactively:*

- *Rules for the user name only hold for user accounts added after rule definition. Already existing user accounts will not be affected.*
- *If new password rules conflict with existing passwords, affected users will be prompted to set a new password when they log in the next time. They cannot log in with their existing password.*

Table 24: Factory default login settings

User name	*Minimum length*	6 *char.*
Password	*Password required*	*Yes*
	Minimum length	6 *char.*
	History	5
	Shall password expire	*No*
	Track failed authentications	*No*
	Mandatory characters	*No*
	Restrict characters	*No*

TIP: *The login settings also include auto login settings (refer to Section 13.3 [▶ 58] for details).*

13.5.2 Roles

Roles are sets of **permissions**, which you can assign to a user account as a whole.

The instrument comes with predefined roles listed in Table 23 [▶ 58] together with the predefined user accounts to which the roles have been assigned.

Like the default accounts, the default roles can be arbitrarily edited, even removed.

Role management

1. Select *Settings* in the menu, then under *System security* select *Roles*.
2. In role management:
   - Tap on an existing role to see its definition and assigned user accounts, to edit, copy, or remove the role.
   - Tap to add a new role.

Defining or (re-)activating a role

Define role settings when you add a new role, copy an existing one, or edit an existing one. The wizard is subdivided in three tabs:

- Under *Common settings* you specify the name of the role and activate or deactivate the role.
- Under *Permissions* you set the permissions for the role: activate or deactivate the checkboxes beside the list of functions to grant or withdraw a permission.

TIP: *You cannot withdraw your own permission "System: login settings/roles/users" (if you have been granted it). This prevents locking yourself out.*

- Under *User assignment* you can assign the role to users: activate the checkboxes beside the list of users (or deactivate a checkbox to withdraw the role).

  Alternatively, you can assign roles to a user in the user management.
- Finally tap *Save* to save all settings.

13.5.3 User accounts

User accounts allow to personalize the home screen and, through the assignment of roles, to control the personal access to functions, data, and settings.

Refer to Table 23 [▶ 58] for the factory preset user accounts.

User management

1. Select *Settings* in the menu, then under *System security* select *Users*.
2. In user management:
   - Tap on an existing user account to see user details and assigned roles, to change the password, to edit, copy, or remove the user account.
   - Tap to add a new user account.

Defining or (re-)activating a user account

Define user account settings when you add a new user account, copy an existing one, or edit an existing one. The wizard is subdivided in two tabs:

- Under *Common settings* you specify the name of the account (*User name*) and activate or deactivate the account.

The initials of the user are automatically generated from the *Full name*. They are used as the user identification in various places.

When you create a new user account, you can also specify an *Initial password* and whether it has to be changed on the first login.

– Under *Role assignment* you can assign roles to the user account: activate the checkboxes beside the list of roles (or deactivate a checkbox to withdraw the role).

  A user can be assigned multiple roles.

  Alternatively, you can assign a role to users in the role management.

– Finally tap *Save* to save all settings.

13.5.4 Changing your own password

Every user can change his/her own password:

1. Tap on the user identification in the header (Fig. 26 [▶ 58]).

   A control panel slides in showing the available operations (Fig. 27 [▶ 58]).
2. Tap *CHANGE PASSWORD*.
3. Enter the old password.
4. Enter the new password and repeat it to confirm.
5. Tap *Change*.

13.5.5 Forgotten passwords

An administrator who has the permission for user management can reset a forgotten password:

1. Select *Settings* in the menu, then under *System security* select *Users*.
2. In user management, tap on the account of the user whose password you want to reset.
3. Tap *Change password* in the action box.
4. Set the new password and specify whether it has to be changed on the next login.
5. Tap *Change*.

TIP: *If the user account has been deactivated due to failed authentication attempts, the account has to be re-activated (refer to Section 13.5.3 [▶ 59]).*

13.6 Audit trail

Activation of system security automatically activates the audit trail. To manually activate the audit trail:

1. Select *Settings* in the menu, then under *System security* select *Audit trail*.
2. Switch *Audit trail* to *activated*.

After activation of the audit trail, the following events in the measurement system are logged in the audit trail:

Table 25: Events logged in audit trail

Instrument	– start
System	– backup – restore – update (incl. attempt) – reset to factory settings
System settings (incl. time, language)	– change settings
System connectivity (incl. network, printers)	– create – edit – remove – change settings
System security	– activate/deactivate – change login settings – change system settings
Audit trail	– activate/deactivate – change settings – print – export – remove
Electronic signature	– activate/deactivate – change settings – signing steps
User/role management	– create – edit – remove – change settings
User authentication	– login (incl. attempt) – logout – change password
Measurement settings (incl. products, checks, custom quantities, hardware settings)	– create – edit – remove – change settings
Measurements (incl. checks, adjustments)	– start – stop (incl. abortion) – failed/applied/rejected/ reset to factory adjustment
Measurement reports (incl. checks, adjustments)	– print – export – remove
Reference materials	– create – edit – remove – change settings

– The system will warn you when the maximum number of audit trail entries has been reached.
– After the maximum number of audit trail entries has been reached, you cannot start any kind of measurement (product, check, adjustment) until you have exported or printed and removed the existing audit trail entries.

13.6.1 Viewing and commenting audit trail entries

1. In the data explorer, select *Audit trail*.
2. Tap on any entry in the numbered list of audit trail entries to view it.

Audit trail comments

You can comment audit trail entries that have been generated with your user account:

– Enter a comment in the open audit trail entry, then tap *Add*.

Audit trail comments cannot be altered after they have been added. They have become part of the audit trail entry.

13.6.2 Exporting or printing audit trail entries

1. In the data explorer, select *Audit trail*.
2. In the action box, tap *Export* or *Print*.
3. For **export**, select a storage location where the audit trail export shall go: a registered network share or a connected USB memory device.
   – You can edit the file name and select a format for the export.

     You can export the data as a PDF file or a CSV file.

     If you choose to export a CSV file, you can define the data format by tapping .
   – Tap Save.

     All audit trail entries will be exported and marked as exported by .

     A checksum file is exported together with the exported audit trail file (refer to Section 5.7 [▶ 25]).

     The export itself generates another audit trail entry.

   For **printing**, select the printer (serial printers cannot be selected), the paper size and optional grayscale, then tap *Print*.

13.6.3 Removing audit trail entries

You can remove only audit trail entries that have been exported or printed before (marked by).

1. In the data explorer, select *Audit trail*.
2. In the action box, tap *Remove*.
3. Tap *Yes* to confirm removal.

   All audit trail entries that have been previously exported or printed are removed.

13.6.4 Automatic audit trail archiving

You can configure the instrument so that audit trail entries are regularly and automatically archived (exported and then removed).

1. Select *Settings* in the menu, then under *System security* select *Audit trail*.
2. Set the switch *Auto archive* to *activated*.
3. Specify the *Archive interval*, after which the audit trail entries are regularly archived.
4. Specify a location where the export shall go.

13.7 Electronic signature

Measurement and check reports can be signed electronically to certify their authenticity.

IMPORTANT: *You can only sign the reports of measurements or checks that have been performed after activation of the electronic signature.*

13.7.1 Activating and configuring electronic signature

1. Select *Settings* in the menu, then under *System security* select *Electron. signature*.
2. Switch *Electronic signature* to *activated*.

Requirements when signing

– If you set *Password required* to *activated*, signers will have to specify their password when they sign.
– If you set *Comment required* to *activated*, signers will have to enter a comment when they sign.

Signing models and signing roles/levels

You can choose one of three signing models: select *Signing steps* accordingly.

– *3-Step Signing* requires 3 roles:
  – *Submitter*
  – *Reviewer*
  – *Approver*
– *2-Step Signing* requires 2 roles:
  – *Submitter*
  – *Approver*
– *1-Step Signing* requires 1 role:
  – *Submitter*

Only users who have been granted the permissions for one (or more) of these roles can sign with their role. Refer to Section 13.5 [▶ 58] for details on user and role management.

TIP: *The 1-Step Signing model is useful if you transfer measurement results to AP Connect and complete the signing procedure there.*

TIP: *When you assign roles, keep in mind that only users who have performed a measurement or check can sign as Submitter of the corresponding report.*

IMPORTANT: *Be careful when you switch between signing models because the signing model is included in the measurement or check report, and you cannot change the report retroactively.*

Substitute signing

If you set *Substitute signing* to *activated*, signers with the appropriate permissions can sign for their role and lower-level roles in one go.

For example, an *Approver* can sign for all the other roles, even if none of them has yet signed the report.

Substitute signing is applicable for *2-Step Signing* or *3-Step Signing*.

With substitute signing, a comment is always mandatory, irrespective of how the switch *Comment required* has been set.

13.7.2 Signing rules

- Every user can only sign a report with one role (except when substitute signing is activated).
- The signing sequence has to follow the sequence of roles according to their level (as described in Section 13.7.1 [▶ 61]).
- Only the user who has performed a measurement or check can sign as *Submitter* (and only as *Submitter*).

  (When substitute signing is activated, signing with a higher-level role may include signing as *Submitter*.)
- Electronic signatures cannot be revoked.

13.7.3 Signing a measurement or check report

The list of measurement or check reports in the data explorer shows the signing state of the report.

Fig. 28: *Example measurement report in the data explorer: 3-step signing, submitter has already signed*

1. To sign a report, open it in the data explorer (tap on the measurement in the list).
2. In the action box, tap .

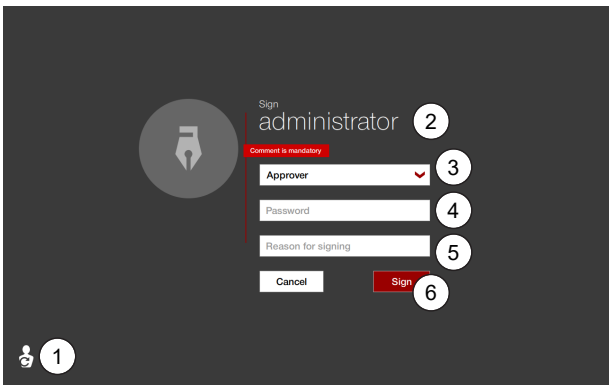


Fig. 29: *Example signing screen*

1 *You can temporarily change the user for signing here*
2 *User name of the signer*
3 *When substitute signing is activated, the user may select the role for signing*
4 *Password of the signer if it has been set as required*
5 *Comment if it has been set as required or, in this case, mandatory anyway because substitute signing is activated*
6 *Tap the button to conclude signing*

3. Fill out the input fields on the signing screen.

   What you see on the signing screen depends on your settings for electronic signing.

   All input fields that you see are required fields.

   You can temporarily change to another user on the signing screen:

   – On the signing screen, tap .
   – Enter a user name and the corresponding password, then tap *Login*.

     The new signing screen reflects the role of the user who is only temporarily logged in for signing. The original user stays logged in.
4. Tap *Sign*.

14 LIMS services via RS-232 serial interface

Your instrument is able to answer service requests by client software like a LIMS (Laboratory Information Management System) or a simple terminal program. The client software may retrieve information from or execute operations on the instrument. Communication is handled via RS-232 serial interface.

– You have to activate RS-232 LIMS services before you can use them (Section 14.2.1 [▶ 63]).

14.1 Serial connection between the instrument and a PC

You need a crossed serial cable for the hardware connection:

– Use RS-232 cable, 1.5 m, crossed, mat. no. 12455.

– Or, with RS-232 connection cable, 3 m, mat. no. 70429, you need also the gender changer, mat. no. 302592.

If your PC does not feature an RS-232 connector, you can connect to a USB socket using a USB/RS-232 converter.

14.2 Status of RS-232 LIMS services

If activated, the RS-232 LIMS services will stay activated after a reboot of the instrument.

14.2.1 Activating RS-232 LIMS services

TIP: *RS-232 LIMS services can only be activated when system security is deactivated (refer to Section 13.1 [▶ 57]).*

IMPORTANT: *RS-232 LIMS services and the serial printer share the serial port. You have to deactivate the serial printer first before you can activate RS-232 LIMS services.*

1. Select *Settings* in the menu, then under *Network & connections* select *RS232 LIMS*.
2. Switch *Services* to *Enabled*.

   The header control for RS-232 LIMS services is shown in the header indicating that the instrument is ready for commands via RS-232 serial interface.
3. The hints area of the spot shows the settings of the serial interface. Set the serial interface settings of your client software accordingly (also refer to Section 14.3 [▶ 63]).

Deactivating RS-232 LIMS services

To deactivate RS-232 LIMS services, switch *Services* back to *Disabled*.

14.2.2 Header control for RS-232 LIMS services

To access status information on the RS-232 LIMS services, tap on the header control .

– On the control panel, you will see an overview of the commands last received by the instrument.
– Tap *CHANGE* to directly access the spot with the settings for the RS-232 LIMS services.

14.3 Interface settings and communication protocol

Settings of the serial interface

Parameter	Setting
Baud rate	9600 baud
Data bits	8
Stop bits	1
Parity	none
Handshake	none

Communication protocol

– Server and client communicate text based with encoding ISO-8859-15.
– Communication is in English, irrespective of the regional settings.
– Command lines and responses are terminated by [CR] (ASCII 13).
– Commands are terminated by a colon (ASCII 58) only if a modifier or an argument follows.
– Command modifiers are terminated by a semicolon (ASCII 59) only if an argument follows.
– Command arguments are terminated by a semicolon (ASCII 59).
– Arguments have a value and may have a name specified in the form *"value"* or *name="value"*.

  Argument names are followed by an equals sign (ASCII 61) and the argument value.

  Argument values:
  – enclosed in double quotation marks (ASCII 34)
  – point (ASCII 46) as decimal separator
  – no thousands separator
  – units enclosed in square brackets
– Commands, modifiers, and argument names are not case sensitive.

Generic description of the communication syntax

Command lines sent by the client have the following form:[a]

```
command
command: modifier[[; argument1;]...;][b]
command: argument1; [argument2;[...;]]
```

`command`	command to be executed (refer to Section 14.4 [▶ 65] for a command reference)
`modifier`	command modifier (if available)
`argumentN`	command arguments

Responses sent to the client after processing the command have the following form:[a]

```
Resp command: ErrorCode (ErrorText) [Data: result1;[result2;[...;]]]
```

`command`	command executed
`ErrorCode`	code describing the outcome after the command has been processed (refer to Table 26 [▶ 64])
`ErrorText`	short text explaining the error code Do only rely on the error code for evaluation. The text may be changed at any time.
`resultN`	Results can have the form *"value"* or *name="value"*. The list of results can be any length, depending on the command.

[a] *Brackets indicate that the enclosed term is optional.*

[b] *Only modifiers `SingleLineResponse` and `NoQuotesResponse` can be combined with arguments.*

Examples:

```
GetInstrumentInfo
Resp GetInstrumentInfo: 0 (Ok) Data: Type="DMA 4501"; Serial="12345687";

SetTemperature: Temperature="30.0"; Unit="[°C]";
Resp SetTemperature: 0 (Ok)

GetQuantityUnits: quantityID="M0009";
Resp GetQuantityUnits: 0 (Ok) Data: "[°C]";"[°F]";"[K]";
```

Error codes in RS-232 LIMS services response

Table 26: Error codes returned by RS-232 LIMS services

Code	Description
0	*OK* – Everything is in order / the command has been successfully processed / the instrument is idle.
–1	*Too many commands are running* – Wait for a command to be processed and finished before you send a new one.
–2	*Parsing the command line failed* – Check the syntax of your command line.
–3	*Unknown command* – Refer to Section 14.4 [▶ 65] for an overview of the available commands.
–4	*Invalid number of arguments* – The number of arguments specified for the command does not meet requirements. Refer to Section 14.4 [▶ 65] for the correct command syntax.
–5	*Invalid argument* – Verify that the argument name and value are supported and valid.
–6	*System not ready* – The command cannot be processed because another operation is already running on the instrument.
–7	*Processing command failed*
–8	*Operation canceled* – The command has been canceled (by the *Cancel* command or by a user controlling the instrument).
–9	*No data* – No data found or available.

14.4 Command reference

Cancel

Use the command to cancel a running operation. Currently only a product measurement started with `StartProductMeasurement` can be canceled.

```
StartProductMeasurement: ProductId="f2210d84bf3f4523a71e847398f3b7fd";
  SampleName="My Demo Sample";

GetMeasurementStatus
Resp GetMeasurementStatus: -6 (SystemNotReady)

Cancel
Resp Cancel: 0 (Ok)

Resp StartProductMeasurement: -8 (OperationCanceled)

GetMeasurementStatus
Resp GetMeasurementStatus: 0 (Ok)
```

1. In this example, a measurement for product identifier “f2210d84bf3f4523a71e847398f3b7fd” is started.
2. A status check by `GetMeasurementStatus` shows that the system is not ready for the measurement.
3. So you cancel the measurement and receive the corresponding status messages.
4. When you repeat the status check, you see that the instrument is idle (code 0).

GetHelp

Use the command to request a list of available commands or to get information on a specific command and its syntax.

```
GetHelp
Resp GetHelp: 0 (Ok) Data: *RS232 LIMS Services Commands:
** Cancel *Cancel running operation
** GetHelp *Get list of available commands or the description of a single command
** GetInstrumentInfo *Get information about the instrument
** GetMeasurementData *Get measurement data
** GetMeasurementStatus *Get a value indicating whether a product measurement is
  running
** GetProductName *Get name of specified product
** GetProducts *Get list of all available products
** GetProtocolVersion *Get the protocol version of the RS232 LIMS services
** GetQuantities *Get list of available quantities
** GetQuantityName *Get name of specified quantity
** GetQuantityUnits *Get available units of specified quantity
** GetReferenceDate *Get reference date used for GetData command.
** SetReferenceDate *Set reference date used for GetData command.
** SetTemperature *Set the cell temperature
** StartProductMeasurement *Start a measurement for a specified product.

GetHelp: GetProtocolVersion
Resp GetHelp: 0 (Ok) Data: GetProtocolVersion:
*Get the protocol version of the RS232 LIMS services
Usage: GetProtocolVersion
```

1. First the list of commands is requested.
2. Then information on the command `GetProtocolVersion` is requested.

GetInstrumentInfo

Use the command to request the instrument's type and serial number.

```
GetInstrumentInfo
Resp GetInstrumentInfo: 0 (Ok) Data: Type="DMA 4501"; Serial="12345687";
```

GetMeasurementData

Use the command to retrieve measurement results from the data saved on the instrument. The output depends on selected quantities and units, the current reference date, and on the availability of measurement data.

```
GetMeasurementData
Resp GetMeasurementData: 0 (Ok) Data: "11720"; "2018-01-07T12:49:08.9657960
  +01:00";"Île-de-France";"Croix";"0";"25.60"; "1.2346";

GetMeasurementData
Resp GetMeasurementData: 0 (Ok) Data: "11721"; "2018-01-07T12:49:27.8313800
  +01:00";"Montélimar";"Lanester";"0";"20.00"; "23.1200";
```

The simplest way to retrieve data is by using `GetMeasurementData` without arguments.

In doing so repeatedly until error code –9 (no data) is returned, you can retrieve one by one all data sets that are newer than the initial reference date.

The concept of the **reference date** is basic for understanding how the command works:

- You can set the reference date with the command `SetReferenceDate` and request it with the command `GetReferenceDate`.
- The default reference date is the date and time when the instrument has been turned on.

  Therefore, `GetMeasurementData` will only deliver measurement data of the day (or none if you have not yet performed a measurement after switching on the instrument) – unless you have set the reference date differently with `SetReferenceDate`.
- If `GetMeasurementData` finds and delivers measurement data, the reference date will subsequently be set to the date and time of the found measurement.

  This enables you to sequentially retrieve measurement data.

`GetMeasurementData` always delivers the oldest set of measurement data that is newer than the refence date.

The data values are in accordance with the currently selected quantities and units.

To retrieve specific quantities or units of a measurement, specify a selection of quantity identifiers, optionally followed by unit identifiers, with the command `GetMeasurementData`.

TIP: *You can select up to 15 quantities with one request.*

TIP: *Use `SetReferenceDate` followed by `GetMeasurementData` with different quantity selections to retrieve additional quantities for the same measurement.*

- You can request a list of all available quantity identifiers with the command `GetQuantities`.
- You can request a list of all available unit identifiers for a specific quantity with the command `GetQuantityUnits`.

RS-232 LIMS services will remember your selection of quantities and units and will apply it (until you reset it) when you subsequently use the command `GetMeasurementData` without arguments.

```
GetMeasurementData:"P0001";"P0002";"M0005 [°F]";"M0017 [kg/m³]";
Resp GetMeasurementData: 0 (Ok) Data: "11720"; "2018-01-07T12:49:08.9657960
  +01:00";"78.08";"1234.6";

GetMeasurementData
Resp GetMeasurementData: 0 (Ok) Data: "11721"; "2018-01-07T12:49:27.8313800
  +01:00";"68.00";"23120.0";

SetReferenceDate: Date="2018-01-07T12:49:27+01:00";
Resp SetReferenceDate: 0 (Ok)
```

```
GetMeasurementData:"P0001";"P0002";"M0019";"M0034";"M0024";
Resp GetMeasurementData: 0 (Ok) Data: "11721"; "2018-01-07T12:49:27.8313800
  +01:00";"2.1000";"3.4000";"5.6000";
```

Table 27: Modifiers supported by `GetMeasurementData`

`Header`	Request an identifiers list of the currently selected quantities.
`HeaderNames`	Request a names list of the currently selected quantities.
`NoQuotesResponse`	Suppresses quotation marks in the response.
`ResetSelection`	Resets the current selection of quantities and units to a default. The default selection is also used after switching on the instrument.
`SingleLineResponse`	Delivers the response in a single line (no newline characters).
`Units`	Request an identifiers list of the currently selected units or the default units used.

```
GetMeasurementData: ResetSelection
Resp GetMeasurementData: 0 (Ok)

GetMeasurementData: Header
Resp GetMeasurementData: 0 (Ok) Data: "P0001";"P0002";"P0003";"P0004";
  "P0005";"M0005";"M0017";

GetMeasurementData: HeaderNames
Resp GetMeasurementData: 0 (Ok) Data: "Measurement Number";"Date of
  Measurement";"Sample Name";"Product Name";"Status";"T (cell)";"Density";

GetMeasurementData: Units
Resp GetMeasurementData: 0 (Ok) Data: "[-]";"[-]";"[-]";"[-]";"[-]";"[°C]";
  "[g/cm³]";

GetMeasurementData: SingleLineResponse
Resp GetMeasurementData: 0 (Ok) Data: "0.9883";"20.21";"36";

GetMeasurementData: SingleLineResponse; "M0017";"M0005";"P0001";
Resp GetMeasurementData: 0 (Ok) Data: "0.9883";"20.21";"36";
```

`GetProductName`

Use the command to request the name of the product corresponding to a specific identifier.

You may also use `all` as a modifier to retrieve a list of all available products (similar to the command `GetProducts`). The list includes names. An empty line marks the end of the list.

The command accepts the modifier `NoQuotesResponse`.

```
GetProductName: ProductId="f2210d84bf3f4523a71e847398f3b7fd";
Resp GetProductName: 0 (Ok) Data: Name="Generic Liquids";

GetProductName: all
Resp GetProductName: 0 (Ok) Data:
"f2210d84bf3f4523a71e847398f3b7fd"="Generic Liquids";
"ac815f86a3474acc81f75b00372ecbf1"="Lubricants";
"1feb0d0eab9c4e51860926655ec3f8f6"="Acids and Bases";
"73b331c21c3a4807a715ee2c5e4e3a2f"="Cosmetics (homogeneous)";
"1bfb1f42ed80423294aa07618d8a34c3"="Cosmetics (inhomogeneous)";
```

```
"b1bf926ec76d48c69dc39c4b47c0f62c"="Crude Oil";
"721cb88aedb242e7bfc5a2ad11d992b3"="Fuel Oil";
"fc997314de304a3991d01c0ff0d09682"="Pharmaceuticals";
```

GetProducts

Use the command to request the unique identifiers for all available products.

Use these identifiers for other commands like `GetProductName` or `StartProductMeasurement`.

```
GetProducts
Resp GetProducts: 0 (Ok) Data: "f2210d84bf3f4523a71e847398f3b7fd";
  "ac815f86a3474acc81f75b00372ecbf1";"1feb0d0eab9c4e51860926655ec3f8f6";
  "73b331c21c3a4807a715ee2c5e4e3a2f";"1bfb1f42ed80423294aa07618d8a34c3";
  "b1bf926ec76d48c69dc39c4b47c0f62c";"721cb88aedb242e7bfc5a2ad11d992b3";
  "fc997314de304a3991d01c0ff0d09682";
```

GetProtocolVersion

Use the command to request the version of the communication protocol.

```
GetProtocolVersion
Resp GetProtocolVersion: 0 (Ok) Data: Version="1.0.0";
```

GetQuantities

Use the command to request the unique identifiers for all available quantities.

Use these identifiers for other commands like `GetQuantityName` or `GetQuantityUnits`.

```
GetQuantities
Resp GetQuantities: 0 (Ok) Data: "P0001";"P0002";"P0003";"P0005";"P0004";
  "M0001";"M0002";"M0003";"M0004";"M0005";"M0006";"M0007";"M0008";"M0009";
  "M0010";"M0011";"M0012";"M0013";"M0014";"M0015";"M0016";"M0017";"M0018";
  "M0019";"M0020";"M0021";"M0022";"M0023";"M0024";"M0025";"M0026";"M0027";
  "M0028";"M0029";"M0030";"M0031";"M0032";"M0033";"M0034";"M0035";"M0036";
  "M0037";"M0038";"M0039";"M0040";"M0041";"M0042";"M0043";"M0044";"M0045";
  "M0046";"M0047";"M0048";"M0049";"M0050";"M0051";"M0052";"M0053";"M0054";
  "M0055";"M0056";"M0057";"M0058";"M0059";"M0060";"M0061";"M0062";"M0063";
  "M0064";"M0065";"M0066";"M0067";"M0068";"M0069";"M0070";"M0071";"M0072";
  "M0073";"M0074";"M0075";"M0076";"M0077";"M0078";"M0079";"M0080";"M0081";
  "M0082";"M0083";"M0084";"M0085";"M0086";"M0087";"M0088";"M0089";"M0090";
  "M0091";"M0092";"M0093";"M0094";"M0095";"M0096";"M0097";"M0098";"M0099";
  "M0100";"M0101";"M0102";"M0103";"M0104";"M0105";"M0106";
```

GetQuantityName

Use the command to request the name of the quantity corresponding to a specific identifier.

You may also use `all` as a modifier to retrieve a list of all available quantities (similar to the command `GetQuantities`). The list includes names. An empty line marks the end of the list.

The command accepts the modifier `NoQuotesResponse`.

```
GetQuantityName: QuantityId="P0003";
Resp GetQuantityName: 0 (Ok) Data: Name="Sample Name";

GetQuantityName: all
Resp GetQuantityName: 0 (Ok) Data:
"P0001"="Measurement Number";
"P0002"="Date of Measurement";
"P0003"="Sample Name";
"P0005"="Status";
"P0004"="Product Name";
"M0001"="T (Board)";
"M0002"="Hum. (Board)";
"M0003"="p (Board)";
```

GetQuantityUnits

Use the command to request the units available for the quantity corresponding to a specific identifier.

The command accepts the modifier `NoQuotesResponse`.

```
GetQuantityUnits: QuantityID="M0009";
Resp GetQuantityUnits: 0 (Ok) Data: "[°C]";"[°F]";"[K]";

GetQuantityUnits: QuantityID="P0003";
Resp GetQuantityUnits: 0 (Ok) Data: "[-]";
```

GetReferenceDate

Use the command to request the current reference date. Refer to the description of the command `GetMeasurementData` for an explanation of the concept and function of the reference date.

The reference date is delivered in ISO 8601 date/time format including time zone information.

The command accepts the modifier `NoQuotesResponse`.

```
GetReferenceDate
Resp GetReferenceDate: 0 (Ok) Data: Date="2018-01-07T12:49:27.8313800+01:00";
```

SetReferenceDate

Use the command to set the reference date. Refer to the description of the command `GetMeasurementData` for an explanation of the concept and function of the reference date.

The reference date has to be specified in ISO 8601 date/time format including time zone information.

You may also use `now` as the argument to set the reference date to the current date and time.

```
SetReferenceDate: Date="2017-02-23T17:58:12.6035379+01:00";
Resp SetReferenceDate: 0 (Ok)

SetReferenceDate: now
Resp SetReferenceDate: 0 (Ok)
```

```
GetReferenceDate
Resp GetReferenceDate: 0 (Ok) Data: Date="2018-03-06T07:59:58.8137648+01:00";
```

SetTemperature

Use the command to set the temperature of the measuring cell.

```
SetTemperature: Temperature="30.0"
Resp SetTemperature: 0 (Ok)

SetTemperature: Temperature="60.0 [°F]";
Resp SetTemperature: 0 (Ok)
```

1. If no unit is specified with the temperature value, the default unit [°C] is used.
2. You may specify one of the available units with the temperature value: [°C], [°F], [K].

StartProductMeasurement

Use the command to start and perform a measurement for a product (specified by identifier).

Specify a sample name as the second argument.

Take care that you do not start a measurement while another process is running on the instrument (for example cleaning, adjusting, measuring).

```
StartProductMeasurement: ProductId="f2210d84bf3f4523a71e847398f3b7fd";
  SampleName="My Demo Sample";
Resp StartProductMeasurement: 0 (Ok)

StartProductMeasurement: ProductId="f2210d84bf3f4523a71e847398f3b7fd";
  SampleName="My Demo Sample";Temperature="68 [°F]";
Resp StartProductMeasurement: 0 (Ok)

StartProductMeasurement: ProductId="f2210d84bf3f4523a71e847398f3b7fd";
  SampleName="My Magazine Sample";Vial="3";
Resp StartProductMeasurement: 0 (Ok)
```

1. The error code returned by RS-232 LIMS services indicates the status of the measurement after it has finished:

   0: The measurement has finished successfully or with warnings.

   –7: The measurement has failed or has finished with errors.

   –8: The measurement has been canceled by the command `Cancel` or by a user on the instrument.
2. You may optionally set a temperature for the measurement, overriding the temperature defined in the product settings.
   - If no unit is specified with the temperature value, the default unit [°C] is used.
   - You may specify one of the available units with the temperature value: [°C], [°F], [K].
3. For measurements with a sample changer, specify the vial number in the magazine as an argument.

15 Maintenance and repair

15.1 Maintenance performed by an authorized Anton Paar representative

The product does not require a periodic maintenance by an authorized Anton Paar representative to retain warranty coverage.

To fulfill requirements of regulatory authorities e.g. FDA 21 CFR 211.67, PIC/S 023-2 (5.5), Anton Paar offers services for compliant preventive maintenance and requalification for qualified Anton Paar products in case of software update, repair, and location change.[1]

Following parts are generally excluded from the warranty (wear and tear parts)

– Syringes

[1] For detailed information, please refer to general terms of delivery (GTD) on the Anton Paar website (https://www.anton-paar.com).

- Hoses
- Adapters, connectors, fittings
- Pump diaphragms
- Filters
- O-rings, seals, gaskets
- Cables
- Fuses
- Batteries
- Desiccants
- Protection foils and covers

All parts damaged in consequence of a fall of the instrument are generally excluded from the warranty as well.

15.2 Repair performed by an authorized Anton Paar representative

In case your product needs repair, contact your local Anton Paar representative, who will take care of the necessary steps. If your product needs to be returned, request an RMA (Return Material Authorization Number). It must not be sent without the RMA and the filled “Safety Declaration for Instrument Repairs”. Please make sure it is cleaned before return.
Do not return products that are contaminated by radioactive materials, infectious agents or other substances that cause health hazards.

TIP: *Find the contact data of your local Anton Paar representative on the Anton Paar website (https://www.anton-paar.com) under “Contact”.*

Appendix A Technical data

Appendix A.1 Specifications

	DMA 4002	DMA 5002	DMA 6002
Density			
Measuring range	0 g/cm³ to 3 g/cm³		
Repeatability s.d.[a]	0.00001 g/cm³	0.000003 g/cm³	0.000001 g/cm³
Reproducibility s.d.[a]	0.00005 g/cm³	0.000005 g/cm³	0.000005 g/cm³
Accuracy	0.00005 g/cm³	0.00005 g/cm³ (full range) 0.00001 g/cm³ (limited range)[b]	0.000005 g/cm³[c]
Resolution	0.00001 g/cm³	0.000005 g/cm³	0.000001 g/cm³
Temperature			
Measuring range[d]	0 °C to 100 °C (32 °F to 212 °F)		
Repeatability s.d.[a]	0.01 °C (0.018 °F)	0.01 °C (0.018 °F)	0.001 °C (0.0018 °F)
Accuracy	0.02 °C (0.036 °F)	0.015 °C (0.027 °F) (full range) 0.01 °C (0.018 °F) (15 °C to 20 °C)	0.01 °C (0.018 °F)
Measuring time[e]	approx. 20 seconds Diet measurements: typically 0.5 to 6 minutes		
Sample volume	approx. 1 mL		
Accuracy and convenience features	ambient air pressure sensor | full range viscosity correction | reference oscillator | automatic bubble detection | camera image of the measuring cell | dew point warning (condition monitoring)		

[a] *According to ISO 5725*

[b] *Under ideal conditions and for low viscosities | 0 g/cm³ to 1.05 g/cm³ | 15 °C to 20 °C (59 °F to 68 °F)*

[c] *Under ideal conditions and for samples with physical properties similar to the adjustment standards*

[d] *Cooling down more than 15 °C (27 °F) below ambient temperature only with CK models of the instrument*

[e] *After full temperature equilibrium*

Table 28: Additional specifications for industry profile *Beverages*

	DMA 5002	DMA 6002
Diet		
Measuring range	0 to 200 % Diet 0 to 200 mL NaOH 0 to 200 g/L TA 0 to 600 mg/100 mL H_3PO_4	0 to 200 % Diet 0 to 200 mL NaOH 0 to 200 g/L TA 0 to 600 mg/100 mL H_3PO_4
Repeatability s.d.[a]	0.5 % Diet	0.5 % Diet

[a] *Determined according to ISO 5725*

Table 29: Typical accuracy of conversion for concentration measurement of aqueous solutions

	DMA 4002	DMA 5002	DMA 6002
Ethanol [% w/w] Measuring range: 0 to 100	0.05[a]	0.02[a]	<0.01
Extract [% w/w] / **sugar** [°Brix] Measuring range: 0 to 80	0.015	0.01	<0.01
HCl [% w/w] Measuring range: 0 to 40	0.02	<0.01	<0.01
NaOH [% w/w] Measuring range: 0 to 50	0.02	<0.01	<0.01
H_3PO_4 [% w/w] Measuring range: 0 to 85	0.03	<0.01	<0.01
HNO_3 [% w/w] Measuring range: 0 to 85	0.035	<0.01	<0.01
H_2SO_4 [% w/w] Measuring range: 0 to 94	0.025	<0.01	<0.01

[a] *In the temperature range 15 °C to 25 °C (59 °F to 77 °F), the accuracy is 0.01 % w/w.*

NOTE: *The accuracy is not the same over the whole concentration range. The values given are typical values for orientation purposes.*

Appendix A.2 Instrument data and operating conditions

Data memory	– audit trail entries: up to 50,000 – measurement data: up to 10,000 (with camera image) – check results: up to 500 – adjustment results: up to 300 – products: up to 400 – custom quantities: up to 50 – images: up to 50 – users and roles: not limited, tested with up to 1000 users and 100 roles
Display	10.1” TFT WXGA (1280x800 px); PCAP touchscreen
Controls	touchscreen, optional keyboard, mouse, and barcode reader
Interfaces	4x USB 2.0 (type A)[a], 1x USB OTG (Micro-A), 1x RS-232, 1x Ethernet (100 Mbit), 1x CAN Bus
RS-232C printer settings	Baud rate: 9600; Parity: none; Stop bit: 1; Data bits: 8
Environmental conditions (EN 61010)	indoor use only

Ambient temperature	15 °C to 35 °C (59 °F to 95 °F)
Air humidity	10 % to 90 % relative humidity, non-condensing
Altitude	max. 3000 m (9800 ft)
Operating pressure sample	max. 10 bar (145 psi) absolute pressure
Pressure range	0–50 °C (32–122 °F): max. 10 bar (145 psi) absolute pressure[b] >50 °C (>122 °F): max. 5 bar (72.5 psi) absolute pressure
Pressure drying air	max. 0.1 bar (1.45 psi) relative pressure
Pollution degree	2
Overvoltage category	II
Voltage	100 to 240 V~, 50/60 Hz, fluctuation ±10 %
Power consumption	190 VA (incl. Xsample and external measuring modules)[c]
Power inlet	according to IEC/EN 60320-1/C14, protection class I
Fuses	ceramic tube fuses 5x20 mm; IEC60127-2; AC 250 V; T 5 AH
Dimensions (L x W x H)	526 mm x 347 mm x 230 mm (20.7 in x 13.7 in x 9 in)
Weight	22.04 kg (48.6 lbs)

[a] *USB memory devices have to be formatted with FAT32 or exFAT file system*

[b] *For the measuring cell together with the injection adapters DMA/CarboQC, mat. no. 159537, in the specified temperature range*

[c] *In the stand-alone configuration (no Xsample or external measuring modules) the power consumption will not exceed 85 VA*

Appendix A.3 Wetted parts and housing surface materials

The following materials are in contact with samples and the cleaning liquids:

Instrument

Material	Part
Borosilicate glass	density measuring cell

Standard accessories

Material	Part
HDPE (high-density polyethylene)	waste vessel
PEEK (polyether ether ketone)	U-Dry, syringe holder
Polypropylene / polyethylene	syringe 2 mL Luer
PTFE (polytetrafluo-roethylene)	injection adapters, male Luer plug, adapter Luer cone, U-Dry Luer cone, standard filling and waste hose
Silicone	hose
Tefzel	adapter UNF ¼” Luer, adapter Luer ¼” UNF

Instrument housing surface materials

Front, top, sides, bottom cover	Durotect PUR Plus 2K texture paint
Back	aluminum
Extension slot cover plate	ABS (acrylonitrile butadiene styrene) + PC (polycarbonate)

Appendix B Reference density values

The default reference values for the densities of air and water are based on the formulas by Spieweck and Bettin[2].

Alternatively, you can select reference values according to the CIPM formula for air[3] and the IAPWS formula for water[4].

All these reference tables cover the whole measuring range of the instrument.

To set your preferred density reference table:

1. Select *Settings* in the menu, then under *System* select *Global units*.
2. Select a water density table or an air density table from the corresponding drop-down box.

IMPORTANT: *Perform an air/water density adjustment after changing any of the reference tables. The current adjustment and the selected reference density tables have to match.*
You will not be able to perform measurements or checks until you have readjusted the instrument.

Appendix B.1 Density of air

For reference tables, refer to Table 30 [▶ 74] and Table 31 [▶ 76].

Formula for the calculation of the density of air by Spieweck/Bettin (simplified equation; given an air humidity of 50 %):

$$\rho = \left[\frac{0.34844 \cdot p - 0.5 \cdot (0.252 \cdot t - 2.0582)}{273.15 + t}\right] / 1000$$

ρ *density [g/cm³]*
t *temperature [°C]*
p *pressure [hPa]*

Numbers are valid for a CO_2 content in air of 0.04 % v/v; change ρ by ±1/19000 for every change in CO_2 volume content of ±0.0001.

Appendix B.2 Density of water

For a reference table, refer to Table 32 [▶ 77].

Formula for the calculation of the density of water by Spieweck/Bettin (valid for an ambient pressure of 1013.25 hPa; covers temperature range from 0 °C to 100 °C):

$$\rho(t) = \frac{\sum_{n=0}^{5} a_n \cdot t^n}{1 + b \cdot t}$$

ρ *density*
t *temperature*
a_0 = *9.998 395 2 x 10² kg/m³*
a_1 = *1.695 257 7 x 10¹ °C⁻¹kg/m³*
a_2 = *–7.990 512 7 x 10⁻³ °C⁻²kg/m³*
a_3 = *–4.624 175 7 x 10⁻⁵ °C⁻³kg/m³*
a_4 = *1.058 460 1 x 10⁻⁷ °C⁻⁴kg/m³*
a_5 = *–2.810 300 6 x 10⁻¹⁰ °C⁻⁵kg/m³*
b = *1.688 723 6 x 10⁻² °C⁻¹*

Formula for the calculation of the density of water according to IAPWS (valid for an ambient pressure of 0.1 MPa; covers temperature range from 0 °C to 100 °C):

$$\rho = 1/v_0$$

The formula for v_0 is given as equation (2) in IAPWS SR6-08 (2011)[4].

Appendix B.3 Reference density tables for air and water

Table 30: Density of air [g/cm³] according to Spieweck/Bettin

Temperature [°C]	Density at the pressure [hPa]							
	900	**920**	**940**	**960**	**980**	**1000**	**1013.25**	**1050**
–10	0.001200	0.001227	0.001253	0.001280	0.001306	0.001333	0.001350	0.001399
–5	0.001176	0.001202	0.001228	0.001254	0.001280	0.001306	0.001323	0.001371
0	0.001152	0.001177	0.001203	0.001228	0.001254	0.001279	0.001296	0.001343
5	0.001129	0.001154	0.001179	0.001204	0.001229	0.001254	0.001271	0.001317
10	0.001107	0.001131	0.001156	0.001181	0.001205	0.001230	0.001246	0.001291

2 F. Spieweck, H. Bettin: Review: Solid and liquid density determination. tm – Technisches Messen 59 (1992) 7–8, pp. 285–292.

3 A. Picard, R.S. Davis, M. Gläser, K. Fujii: Revised formula for the density of moist air (CIPM-2007). Metrologia 45 (2008), pp. 149–155.

4 International Association for the Properties of Water and Steam: Revised supplementary release on properties of liquid water at 0.1 MPa. IAPWS SR6-08 (2011). Available at www.iapws.org.

Temperature [°C]	Density at the pressure [hPa]							
15	0.001085	0.001110	0.001134	0.001158	0.001182	0.001206	0.001222	0.001267
20	0.001065	0.001088	0.001112	0.001136	0.001160	0.001184	0.001199	0.001243
25	0.001045	0.001068	0.001091	0.001115	0.001138	0.001162	0.001177	0.001220
30	0.001025	0.001048	0.001071	0.001094	0.001117	0.001140	0.001156	0.001198
35	0.001007	0.001029	0.001052	0.001075	0.001097	0.001120	0.001135	0.001176
40	0.000989	0.001011	0.001033	0.001055	0.001078	0.001100	0.001115	0.001156
45	0.000971	0.000993	0.001015	0.001037	0.001059	0.001081	0.001095	0.001135
50	0.000954	0.000976	0.000997	0.001019	0.001040	0.001062	0.001076	0.001116
55	0.000938	0.000959	0.000980	0.001001	0.001023	0.001044	0.001058	0.001097
60	0.000922	0.000943	0.000964	0.000984	0.001005	0.001026	0.001040	0.001079
65	0.000906	0.000927	0.000947	0.000968	0.000989	0.001009	0.001023	0.001061
70	0.000891	0.000911	0.000932	0.000952	0.000972	0.000993	0.001006	0.001043
75	0.000877	0.000897	0.000917	0.000937	0.000957	0.000977	0.000990	0.001027
80	0.000862	0.000882	0.000902	0.000922	0.000941	0.000961	0.000974	0.001010
85	0.000849	0.000868	0.000887	0.000907	0.000926	0.000946	0.000959	0.000995
90	0.000835	0.000854	0.000874	0.000893	0.000912	0.000931	0.000944	0.000979
95	0.000822	0.000841	0.000860	0.000879	0.000898	0.000917	0.000929	0.000964
100	0.000809	0.000828	0.000847	0.000865	0.000884	0.000903	0.000915	0.000949

Table 31: Density of air [g/cm³] according to CIPM

Temperature [°C]	Density at the pressure [hPa]							
	900	**920**	**940**	**960**	**980**	**1000**	**1013.25**	**1050**
–10	0.001191	0.001218	0.001244	0.001271	0.001298	0.001324	0.001342	0.001390
–5	0.001169	0.001195	0.001221	0.001247	0.001273	0.001299	0.001316	0.001364
0	0.001147	0.001172	0.001198	0.001224	0.001249	0.001275	0.001292	0.001338
5	0.001126	0.001151	0.001176	0.001201	0.001226	0.001251	0.001268	0.001314
10	0.001105	0.001129	0.001154	0.001179	0.001203	0.001228	0.001244	0.001290
15	0.001085	0.001109	0.001133	0.001157	0.001181	0.001206	0.001222	0.001266
20	0.001065	0.001088	0.001112	0.001136	0.001160	0.001183	0.001199	0.001243
25	0.001045	0.001068	0.001092	0.001115	0.001138	0.001162	0.001177	0.001220
30	0.001025	0.001048	0.001071	0.001094	0.001117	0.001140	0.001155	0.001198
35	0.001006	0.001028	0.001051	0.001073	0.001096	0.001119	0.001134	0.001175
40	0.000986	0.001008	0.001030	0.001053	0.001075	0.001097	0.001112	0.001153
45	0.000966	0.000988	0.001010	0.001031	0.001053	0.001075	0.001090	0.001130
50	0.000945	0.000967	0.000988	0.001010	0.001031	0.001053	0.001067	0.001107
55	0.000924	0.000945	0.000966	0.000988	0.001009	0.001030	0.001044	0.001083
60	0.000902	0.000923	0.000944	0.000965	0.000985	0.001006	0.001020	0.001059
65	0.000879	0.000899	0.000920	0.000940	0.000961	0.000982	0.000995	0.001033
70	0.000854	0.000874	0.000894	0.000915	0.000935	0.000955	0.000969	0.001006
75	0.000827	0.000847	0.000868	0.000888	0.000908	0.000928	0.000941	0.000978
80	0.000799	0.000819	0.000839	0.000858	0.000878	0.000898	0.000911	0.000947
85	0.000768	0.000788	0.000807	0.000827	0.000846	0.000866	0.000879	0.000914
90	0.000735	0.000754	0.000773	0.000793	0.000812	0.000831	0.000844	0.000879
95	0.000698	0.000717	0.000736	0.000755	0.000774	0.000793	0.000805	0.000840
100	0.000658	0.000677	0.000695	0.000714	0.000733	0.000751	0.000764	0.000798

Table 32: Density of water [g/cm³] at temperature T [°C]

T [°C]	IAPWS-95 / CIPM	Spieweck / Bettin	T [°C]	IAPWS-95 / CIPM	Spieweck / Bettin	T [°C]	IAPWS-95 / CIPM	Spieweck / Bettin
0	0.999843	0.999840	**40**	0.992216	0.992212	**80**	0.971790	0.971785
1	0.999902	0.999899	**41**	0.991830	0.991826	**81**	0.971165	0.971159
2	0.999943	0.999940	**42**	0.991437	0.991432	**82**	0.970534	0.970528
3	0.999967	0.999964	**43**	0.991036	0.991031	**83**	0.969898	0.969892
4	0.999975	0.999972	**44**	0.990628	0.990623	**84**	0.969257	0.969252
5	0.999967	0.999964	**45**	0.990213	0.990208	**85**	0.968611	0.968606
6	0.999943	0.999940	**46**	0.989791	0.989786	**86**	0.967961	0.967955
7	0.999904	0.999901	**47**	0.989362	0.989358	**87**	0.967305	0.967300
8	0.999851	0.999848	**48**	0.988926	0.988922	**88**	0.966645	0.966639
9	0.999784	0.999781	**49**	0.988484	0.988479	**89**	0.965980	0.965974
10	0.999702	0.999699	**50**	0.988035	0.988030	**90**	0.965310	0.965304
11	0.999608	0.999605	**51**	0.987579	0.987575	**91**	0.964635	0.964630
12	0.999500	0.999497	**52**	0.987117	0.987113	**92**	0.963955	0.963950
13	0.999380	0.999377	**53**	0.986649	0.986644	**93**	0.963271	0.963266
14	0.999247	0.999244	**54**	0.986174	0.986169	**94**	0.962582	0.962577
15	0.999103	0.999099	**55**	0.985693	0.985688	**95**	0.961888	0.961883
16	0.998946	0.998942	**56**	0.985206	0.985201	**96**	0.961189	0.961185
17	0.998778	0.998774	**57**	0.984712	0.984707	**97**	0.960486	0.960482
18	0.998599	0.998595	**58**	0.984213	0.984208	**98**	0.959778	0.959774
19	0.998408	0.998404	**59**	0.983707	0.983702	**99**	0.959066	0.959062
20	0.998207	0.998203	**60**	0.983196	0.983191			
21	0.997995	0.997991	**61**	0.982678	0.982673			
22	0.997773	0.997769	**62**	0.982155	0.982150			
23	0.997541	0.997537	**63**	0.981626	0.981621			
24	0.997299	0.997295	**64**	0.981091	0.981086			
25	0.997048	0.997043	**65**	0.980551	0.980546			
26	0.996786	0.996782	**66**	0.980005	0.979999			
27	0.996516	0.996511	**67**	0.979453	0.979448			
28	0.996236	0.996232	**68**	0.978896	0.978890			
29	0.995947	0.995943	**69**	0.978333	0.978327			
30	0.995649	0.995645	**70**	0.977765	0.977759			
31	0.995343	0.995339	**71**	0.977191	0.977185			
32	0.995028	0.995024	**72**	0.976612	0.976606			
33	0.994705	0.994700	**73**	0.976028	0.976022			
34	0.994373	0.994369	**74**	0.975438	0.975432			
35	0.994033	0.994029	**75**	0.974843	0.974837			
36	0.993685	0.993681	**76**	0.974243	0.974237			
37	0.993330	0.993325	**77**	0.973637	0.973632			
38	0.992966	0.992962	**78**	0.973027	0.973021			
39	0.992595	0.992591	**79**	0.972411	0.972405			

Appendix C Recommended cleaning liquids for typical samples

Table 33: Recommended cleaning liquids for typical samples

Sample	Suggested cleaning liquid 1	Suggested cleaning liquid 2
Alcohols e.g. ethylene glycol, propylene glycol, glycerol, mixtures (e.g. antifreeze)	– warm water – ethanol 96 %	– alcohol (e.g. ethanol 96 %) – acetone
Alcoholic beverages e.g. alcopops, beer, cider, gin, spirits, sparkling wine, wine	– water – enzymatic lab cleaner[a]	alcohol (e.g. ethanol 96 %)
Alcoholic beverages malt, wort	– water – enzymatic lab cleaner[a]	alcohol (e.g. ethanol 96 %)
Detergents and liquid soap	water	alcohol (e.g. ethanol 96 %)
Edible oils	– petroleum naphtha – hexane – isohexane	– alcohol (e.g. ethanol 96 %) – acetone
Fuel	petroleum naphtha	– alcohol (e.g. ethanol 96 %) – acetone
Fuel e.g. diesel fuel, biodiesel, kerosene, aviation gasoline, light heating oils	– petroleum benzine – petroleum ether – petroleum naphtha – white spirit – pentane – heptane – cyclohexane – nonane	– alcohol (e.g. ethanol 96 %) – acetone
Heavy oil samples e.g. crude oils, heavy crude oils	– toluene – petroleum naphtha – white spirit	– alcohol (e.g. ethanol 96 %) – acetone
Hydraulic fluids mineral oil based	– petroleum benzine – petroleum ether – petroleum naphtha – heptane – white spirit	–
Hydraulic fluids oil based	– xylene – toluene	– petroleum benzine – heptane – petroleum ether
Lubricating oil and other fresh oils	petroleum naphtha	– alcohol (e.g. ethanol 96 %) – acetone
Lubricating oil and other fresh oils fresh lube oils incl. gear oils, oils for industrial machinery, automatic transmission fluid (ATF), transformer oils, heat transfer oils, oils for conservation and corrosion protection	– petroleum benzine – toluene – xylene – mesitylene	– alcohol (e.g. ethanol 96 %) – acetone
Milk, cream	– water – dish washing agent in water – enzymatic lab cleaner[a]	alcohol (e.g. ethanol 96 %)

Sample	Suggested cleaning liquid 1	Suggested cleaning liquid 2
Motor oil	petroleum naphtha	– alcohol (e.g. ethanol 96 %) – acetone
Nonalcoholic beverages e.g. orange juice, syrup, soft drinks	– (warm) water – dish washing agent in water	alcohol (e.g. ethanol 96 %)
Perfume, after-shave	– alcohol (e.g. ethanol 96 %) – acetone	–
Salad dressing, mayonnaise	– petroleum naphtha – dish washing agent in water	alcohol (e.g. ethanol 96 %)
Schnapps	alcohol (e.g. ethanol 96 %)	–
Shampoo	water	alcohol (e.g. ethanol 96 %)
Suntan lotion	– petroleum naphtha – dish washing agent in water	alcohol (e.g. ethanol 96 %)
Waxes, paraffin-type samples	– toluene – petroleum naphtha – white spirit	– alcohol (e.g. ethanol 96 %) – acetone
Wood protection, white spirit based (water-based)	– petroleum naphtha – (water)	alcohol (e.g. ethanol 96 %)

[a] *Using an enzymatic lab cleaner is recommended for special cleaning. After using the lab cleaner, it is necessary to rinse the measuring cell with water.*

IMPORTANT: *To prevent **limestone deposits**, never use **tap water** as the cleaning liquid 2. Use ultra-pure water instead.*

IMPORTANT: *Strong **alkaline lab cleaners** (with a pH >10.5) should only be applied briefly and at temperatures below 25 °C because strong bases attack the glass surface upon prolonged exposure and at high temperatures.*

TIP: *We recommend "Winepress Cleaner PM Membrane Presses", cat. no. 409004, by Wigol® or "TM Desana" by Thonhauser. Refer to the instructions of the manufacturer concerning the concentration of the cleaning agent.*

Some samples that contain proteins, for example beer or wort, may cause residues in the measuring cell after longer measurement periods. In this case, use an enzymatic lab cleaner to remove the residues from the measuring cell.

NOTICE
Do not use cleaners containing abrasives.

Appendix D Troubleshooting

Table 34: Checks / adjustments / calibrations

Problem	Cause / Corrective action	Refer to
Readjustment for air/water is necessary very often.	Bad water quality for checks/adjustments: – Use freshly degassed ultra-pure water.	Section 9.2 [▶ 42] Section 9.3 [▶ 44]
	The measuring cell is not clean: – Clean and dry the measuring cell perfectly before an air check/adjustment.	Section 10.3 [▶ 50]
	The density measuring cell is corroded by hydrofluoric acid, strong alkaline solutions, or mechanical abrasion: – Do not leave glass-corroding liquids in the measuring cell.	Section 10.3 [▶ 50]
	Direct sunlight on the instrument: – Install the instrument at a place without direct sunlight.	Section 4.1 [▶ 15]

Problem	Cause / Corrective action	Refer to
The air/water adjustment is still not finished after 10 minutes.	The measuring cell is not sufficiently dry for the air adjustment: – Clean and dry the measuring cell perfectly before an air check/adjustment.	Section 10.3 [▶ 50]
	There are gas bubbles in the measuring cell during water adjustment: – Repeat the filling procedure and use freshly degassed ultra-pure water.	Section 9.3 [▶ 44]
Negative slope warning after diet concentration adjustment	Wrong adjustment liquids have been used: – Use process water for the process water adjustment and the product for the concentration adjustment. (The product must have higher density than the process water.)	Section 9.3.3 [▶ 45]
The density calibration has failed. The results deviate from the reference values.	Bad cleaning and drying: – Improve your cleaning and drying procedure.	Section 10.3 [▶ 50]
	The calibration liquid has been stored too long: – Use a fresh calibration liquid.	Section 9.4 [▶ 48]
	Adjustment problems: – Improve your adjustment routine.	Section 9.3 [▶ 44]
The diet concentration check has failed.	The reference sample has been stored too long: – Use fresh samples directly from the production line for the check measurement.	Section 9.2.5 [▶ 44]
	Sample volume too low: – Use enough sample, depending on the configuration of the measurement system, to avoid sample cross-contamination.	
	Adjustment problems: – Always use fresh process water for the process water adjustment and fresh samples for the concentration adjustment. – Depending on process water stability, perform process water adjustments more frequently. – The sample to get the lab reference value and the sample used for the concentration adjustment should be the same and taken at the same time.	Section 9.3.3 [▶ 45]
	Bad cleaning: – Improve your cleaning procedure.	Section 10.3 [▶ 50]

Table 35: Measurements

Problem	Cause / Corrective action	Refer to
Measurement Info: "*Density: set temperature cannot be reached*"	The measuring temperature set is more than 15 °C (27 °F) below ambient temperature. – With a CK model of the instrument: Connect the cooling to an external thermostat. – Otherwise: Try to lower the ambient temperature.	Section 4.6 [▶ 17]
Measurement Info: "*Filling Warning*"	Highly viscous samples may show a filling warning.	Section 8.3.3 [▶ 38]
	Gas bubbles in the measuring cell: – Degas the sample.	Section 8.2 [▶ 36] Section 8.3 [▶ 37]

Problem	Cause / Corrective action	Refer to
	– Fill the sample at a higher temperature than the measuring temperature.	
Measurement Info: "*Error: No Oscillation*"	The density measuring cell is only partly filled: – Fill the sample again.	Section 8.3 [▶ 37]
Measurement Info: "*Timeout Error*"	The sample is instable (e.g. an emulsion) or dissociates: – Pre-heat / pre-cool the sample to measuring temperature. – Select a measurement performance with faster measurement and deactivate the check for density stability.	Section 8.3.3 [▶ 38] Section 7.3.3 [▶ 31] Section 7.3.4 [▶ 32]
	The timeout is set too short: – Change the timeout setting.	Section 7.3.6 [▶ 32]
Measurement value "——"	The measurement value is out of range / not delivered. – Check that the measuring cell is properly filled.	Section 8.3 [▶ 37]
	The density module has been deactivated for the measurement. – In the product settings or measurement settings, set the corresponding switch "module active" to *Yes*.	
	The output quantity is not valid for the set temperature.	
Error message: "*The camera image could not be saved.*"	– Restart the instrument.	
Error message: "*Density: Glass cell could be broken.*"	The density cell could be broken. This error might also appear due to inhomogeneous filling. – If this error persists, do not fill any liquids, turn off the instrument, and contact your local Anton Paar representative.	

Table 36: Display

Problem	Cause / Corrective action	Refer to
Display problems	– Restart the instrument.	

Table 37: Printing

Problem	Cause / Corrective action	Refer to
No printout on printer	Office printer problems: – Check that the printer has enough paper, toner, etc. Refer to the manual of the printer.	
	The office printer type is not supported by the instrument.	Section 11.4 [▶ 54]
	The printer has not been registered on the instrument.	
	The printer settings are not correct.	
	Chinese printer: – Select the Chinese printer from the list.	
The printout on an RS-232 printer makes no sense.	Wrong communication settings on the RS-232 printer: – Change the DIP switch settings. Refer to the manual of the printer.	Appendix A.2 [▶ 72]

Table 38: Network

Problem	Cause / Corrective action	Refer to
Network shares lose connection when idle for some time.	Depending on your network configuration, network shares may lose connection when they have been idle for some time. Connections can be forced open: – Select *Settings* in the menu, then under *Hardware* select *Instrument settings*. – Switch *Keep network share open* to *Yes* and leave the spot screen to activate the setting. When activated, this function will create temporary dummy files (immediately removed again) every 5 minutes on all open network shares.	

To regain access to a locked instrument

1. Switch the instrument off.
2. Wait for 15 seconds.
3. Switch the instrument on again.

If above instructions do not solve your problem or if you do not find your problem in the list, contact your local Anton Paar representative.

If your instrument needs repair, refer to Section 15.2 [▸ 71].

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