

Reference Guide

DMA 1002

DMA 502

Density Meter

Instrument software version: from 6.5

Find out more



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Date: June 2025

Document number: E15IB011EN-A

Original instructions

Table of contents

1	Safety instructions	7
1.1	General safety instructions.....	7
1.2	Conventions of safety messages and typography	8
2	Overview	8
2.1	Measuring principle	9
2.2	Intended use of the instrument.....	9
2.3	Functional components	10
3	Supplied parts	11
4	Installation	13
4.1	Installation requirements	13
4.2	Mounting the filling equipment	13
4.2.1	Mounting syringe holder, all hoses, and waste vessel	13
4.2.2	Mounting funnel, all hoses, and waste vessel.....	14
4.3	Installation of optional parts	15
4.4	Power connection.....	16
4.5	Switching the instrument on/off.....	16
4.6	Basic instrument settings and first checks	16
5	Operation	16
5.1	Basic operation and input devices	16
5.1.1	Touchscreen	16
5.1.2	Onscreen keyboard.....	17
5.1.3	USB mouse (optional).....	17
5.1.4	USB keyboard (optional).....	17
5.1.5	USB barcode reader (optional)	18
5.1.6	USB memory devices (optional)	18
5.2	Functional screen elements	18
5.2.1	Header	18
5.2.2	Favorites button	18
5.2.3	Combined links	18
5.2.4	Action boxes	18
5.3	Screens – navigation, information, control.....	19
5.3.1	Home screen – your favorites	19
5.3.2	Menu – all the functions	19
5.3.3	Spots.....	19
5.3.4	Wizards	20
5.3.5	Dashboards – the measurement stage.....	20
5.3.6	Widgets on a dashboard	20
5.3.7	Modal messages.....	21
5.4	The data explorer	21
5.4.1	Comparing data sets.....	21
5.4.2	Exporting or printing single data sets.....	22
5.4.3	Exporting or removing multiple data sets.....	22
5.5	Reports.....	22
5.5.1	Configuring report contents.....	22
5.6	Data exports / MD5 checksum file	22
6	Instrument settings	22
6.1	Language and regional settings.....	22
6.2	Time settings.....	23

6.3	Display brightness.....	23
6.4	Camera settings.....	23
6.5	Global units.....	23
6.6	Automatic export of result reports.....	23
6.7	System security.....	23
6.7.1	Non-storage mode.....	23
6.7.2	Restricted use of the USB interface.....	24
6.7.3	Restricting the visibility of measurement values.....	24
7	Measurement settings – products.....	24
7.1	Products.....	24
7.2	Measurement settings.....	24
7.2.1	Dashboards / measuring quantities.....	24
7.2.2	Reports.....	24
7.3	Measurement parameters.....	25
7.3.1	Set temperature.....	25
7.3.2	Measurement performance.....	25
7.3.3	Check density stability.....	25
7.3.4	Hold time.....	25
7.3.5	Timeout.....	25
7.3.6	FillingCheck™.....	25
7.3.7	Thermal expansion factor.....	26
7.4	Limit configuration.....	26
8	Performing a measurement.....	26
8.1	Starting a measurement.....	27
8.2	Degassing samples.....	27
8.3	Filling sample.....	28
8.3.1	Filling with a syringe (Luer tip).....	29
8.3.2	Filling with the optional funnel.....	29
8.3.3	Special filling techniques.....	29
8.4	Actual measurement procedure.....	30
8.5	Measuring at low temperatures / under high humidity conditions.....	30
8.5.1	Condensation inside the measuring cell.....	30
8.5.2	The optional drying cartridge.....	30
8.5.3	Preventing and removing condensation.....	31
8.5.4	Removing condensation using the internal air pump.....	31
9	Checking, adjusting and calibrating.....	32
9.1	Checks.....	32
9.1.1	Check settings / custom checks.....	32
9.1.2	Check execution reminder.....	33
9.1.3	Performing a check.....	33
9.1.4	Auto air check.....	33
9.2	Adjustments.....	33
9.2.1	Performing an adjustment.....	34
9.2.2	Resetting adjustments to factory adjustment.....	34
9.3	Calibrations.....	34
10	Upkeep and cleaning.....	35
10.1	Software administration.....	35
10.1.1	System information.....	35
10.1.2	Diagnostics package.....	35
10.1.3	Software update installation.....	35
10.1.4	Service functions and reset.....	35

10.2	Backup and restore	35
10.2.1	Making a backup	36
10.2.2	Restoring data from a backup	36
10.3	Cleaning and drying the measuring cell	36
10.4	Cleaning the instrument housing and the touchscreen	38
10.5	Storing the instrument	38
10.6	Transporting the instrument	38
11	Network and printer configuration	38
11.1	Network connection	38
11.1.1	Setting up an Ethernet connection	38
11.1.2	Setting up a WiFi connection	39
11.2	Network shares	39
11.3	Remote interface / AP Connect	40
11.4	Printers	40
11.4.1	Network printers	40
11.4.2	USB printers	40
11.4.3	Serial printers	41
12	Custom quantities	41
12.1	Custom quantity defined by a formula	41
12.2	Custom quantity defined by a table	42
12.3	Editing a custom quantity	42
12.4	Removing a custom quantity	42
13	System security and user management	43
13.1	Activating system security	43
13.2	Logging in/out	43
13.3	Auto login	43
13.4	Locking the instrument/screen	43
13.5	User and role management	44
13.5.1	Login settings	44
13.5.2	Roles	44
13.5.3	User accounts	45
13.5.4	Changing your own password	45
13.5.5	Forgotten passwords	45
13.6	Audit trail	45
13.6.1	Viewing and commenting audit trail entries	46
13.6.2	Exporting or printing audit trail entries	46
13.6.3	Removing audit trail entries	46
13.7	Electronic signature	47
13.7.1	Activating and configuring electronic signature	47
13.7.2	Signing rules	47
13.7.3	Signing a measurement or check report	47
14	LIMS services via RS-232 serial interface	48
14.1	Serial connection between the instrument and a PC	48
14.2	Status of RS-232 LIMS services	48
14.2.1	Activating RS-232 LIMS services	48
14.2.2	Header control for RS-232 LIMS services	48
14.3	Interface settings and communication protocol	49
14.4	Command reference	50
15	Maintenance and repair	56
15.1	Maintenance performed by an authorized Anton Paar representative	56
15.2	Repair performed by an authorized Anton Paar representative	56

Appendix A Technical data 57

Appendix A.1 Specifications..... 57

Appendix A.2 Instrument data and operating conditions..... 57

Appendix A.3 Wetted parts and housing surface materials 58

Appendix B Factory default role permissions 58

Appendix C Troubleshooting..... 60

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

2 Overview

The compact density meter DMA 502/1002 measures the density of liquid samples by use of the oscillating U-tube method, which was first introduced on the market by Anton Paar in 1967. It combines high precision with easy operation and robust design. The instrument will cope with almost any sample that you can fill and clean.

Accurate results in the shape required

The instrument corrects viscosity-related errors automatically. An integrated Pt 100 platinum thermometer together with Peltier elements provide an extremely precise thermostating of the sample.

The density value can be automatically converted into concentration values for numerous generic user products (already factory-programmed).

Precise sample filling

Accurate and repeatable results strongly depend on bubble-free filling ensured by the peristaltic pump optionally integrated in the instrument.

FillingCheck™ automatically detects gas bubbles in the measuring cell by an advanced analysis of its oscillation pattern, and will generate a warning message in that case. Additionally, you can visually inspect the measuring cell on the real-time camera image (U-View™).

Intuitive user interface

Operate the instrument via the touchscreen user interface with the same ease as your smartphone. If you prefer, you can optionally connect an external keyboard or mouse and a barcode reader.

Data export/printouts

You can export all measured data as a PDF or CSV file onto any connected storage device. Data can be printed via USB, network, or serial port.

Ready for AP Connect

The instrument is compatible with AP Connect, the lab execution software by Anton Paar.

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:

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

Density and specific gravity are highly temperature-dependent.

U-Pulse method

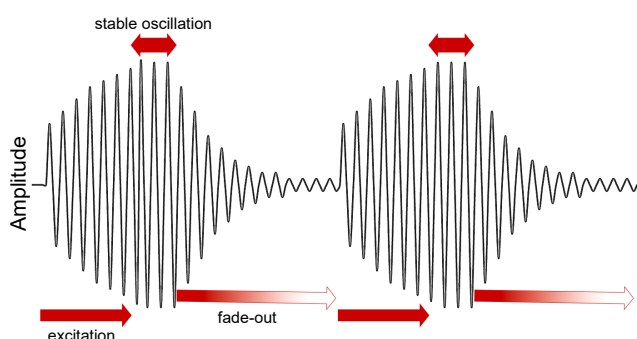


Fig. 1: Outline of the U-Pulse (pulsed excitation) method

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.

Due to the temperature dependency of the density value, a precise temperature control of the sample is required.

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.

2.2 Intended use of the instrument

Your instrument is capable of measuring nearly every liquid, independent of its composition and viscosity.

Typical samples include soft drinks, various types of oil, acids and bases, infusion solutions, pastes and creams from applications as diverse as petrochemicals, food & beverages, chemicals, pharmaceuticals and cosmetics.

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.

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

2.3 Functional components

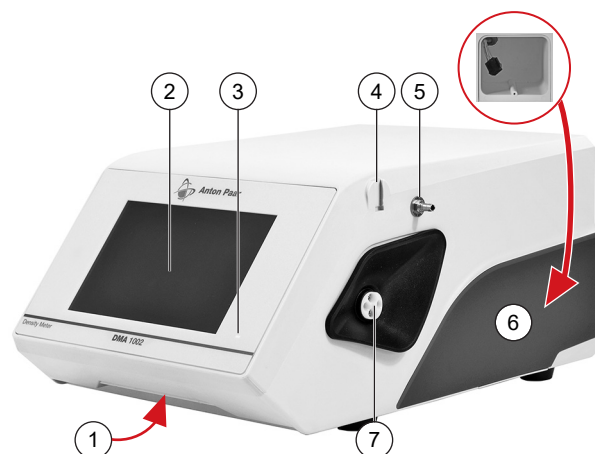


Fig. 2: Front and right side of the instrument

- 1 Recessed grip for transportation
- 2 Touchscreen
- 3 Power LED
- 4 Socket for syringe holder or funnel
- 5 Air pump outlet (5 mm barbed)
- 6 Slot for the optional peristaltic pump (to access, lift off cover held by magnets)
- 7 Sample inlet and outlet

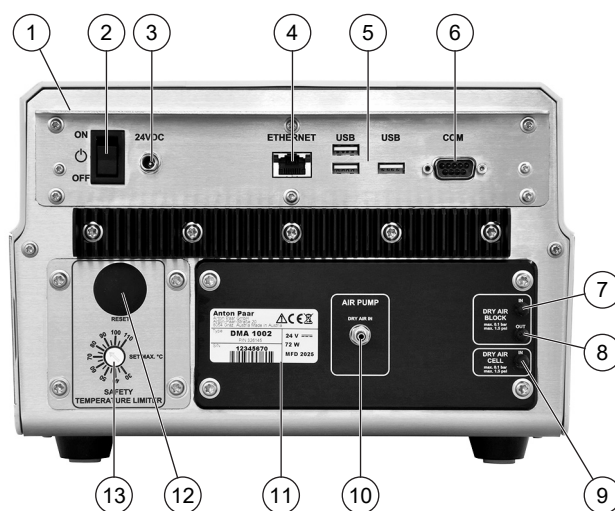


Fig. 3: Rear of the instrument

- 1 Ledge handle for transportation
- 2 On/off switch
- 3 DC power jack
- 4 Ethernet terminal (RJ45 connector)
- 5 USB 2.0 sockets (type A), 3x
- 6 COM / RS-232 serial port (DE-9M connector)
- 7 DRY AIR BLOCK IN connector (3.5 mm barbed) – drying of cell block inlet / max. 0.1 bar (1.5 psi) rel.
- 8 DRY AIR BLOCK OUT connector (3.5 mm barbed) – drying of cell block outlet
- 9 DRY AIR CELL IN connector (3.5 mm barbed) – drying of measuring cell inlet / max. 0.1 bar (1.5 psi) rel.
- 10 AIR PUMP / DRY AIR IN connector (3.5 mm barbed) – air pump inlet
- 11 Type plate with serial number S/N (P/N = mat. no.)
- 12 Reset button of safety temperature limiter
- 13 Safety temperature limiter

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 1: Supplied parts

	Qty.	Description	Mat. No.
	1	DMA 502 laboratory density meter	325846
		or DMA 1002 laboratory density meter	326145
	1	Power supply	325849
	1	Power cable	
	1	Instruction Manual and Safety Information English	387353
	1	Waste vessel 500 mL	6210
	1	Density standard ultra pure water 5x10 mL (only with DMA 1002)	96044

Table 2: Supplied accessory kit DMA MR 502/1002

	Qty.	Description	Mat. No.
	1	Accessory kit DMA MR 502/1002	383822
<i>containing:</i>			
	1	Syringe holder 02	387520
	1	Hose 145x3x2 PTFE 2x1/4"-28 UNF	386159

	Qty.	Description	Mat. No.
	1	Hose 300x3x2 PTFE "AA"	3443
	2 m	Hose 4x6 mm silicone	57024
	2	Male Luer plug PTFE	63865
	2	Adapter Luer 1/4" UNF	64792
	2	Adapter Luer cone PTFE black	384626
	5	Syringe 5 mL Luer (without seal)	63130
	1	Phillips screwdriver PH-0x40	75030

Table 3: Optional accessories and consumables

Description	Mat. No.
Funnel DMA 502	386784
Xsample 200 High-Resistance peristaltic pump	187548
Aerosol adapter	74650
Accessory kit for pasty samples	190063
Syringe clamp for 5 mL plastic syringe	25921
Drying cartridge	65085
Printer Epson TM-U220	93362
Wi-Fi/Bluetooth dongle	194727
ISO 17025 calibration density G2	157100
ISO 17025 calibration density/temp G2	219479
ISO 17025 extra calibration density	157102

4 Installation

4.1 Installation requirements

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

Find all Technical Data in Appendix A [► 57].

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

To achieve best measurement results, operate the instrument under typical laboratory conditions:

- 23 ±2 °C (73.4 ±3.6 °F) ambient temperature
- <60 % relative humidity
- no direct sunlight

The setup location and surroundings must meet the minimum requirements specified under “Operating conditions” in the Technical Data (Appendix A [► 57]).

NOTICE

No spray water protection at the rear

Consider that the rear of the instrument is not protected against spray water, whereas the front, top, and sides are.

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

Leave a minimal distance of 10 cm (4 in) between the cooling fins on the rear of the instrument and any wall. Also ensure that the heat can freely dissipate. Do not install the instrument in a cabinet.

The instrument requires an electrical outlet nearby:

- 100–240 V~, 47–63 Hz, 1.5 A

4.2 Mounting the filling equipment

Samples may be filled by syringe, through an optional funnel (only DMA 502), or automatically by an optional Xsample 200 peristaltic pump.

- To mount the syringe holder and the filling hoses, refer to Section 4.2.1 [► 13].
- To mount the funnel and the filling hoses, refer to Section 4.2.2 [► 14].
- To install Xsample 200, refer to the documentation coming with Xsample 200.

4.2.1 Mounting syringe holder, all hoses, and waste vessel

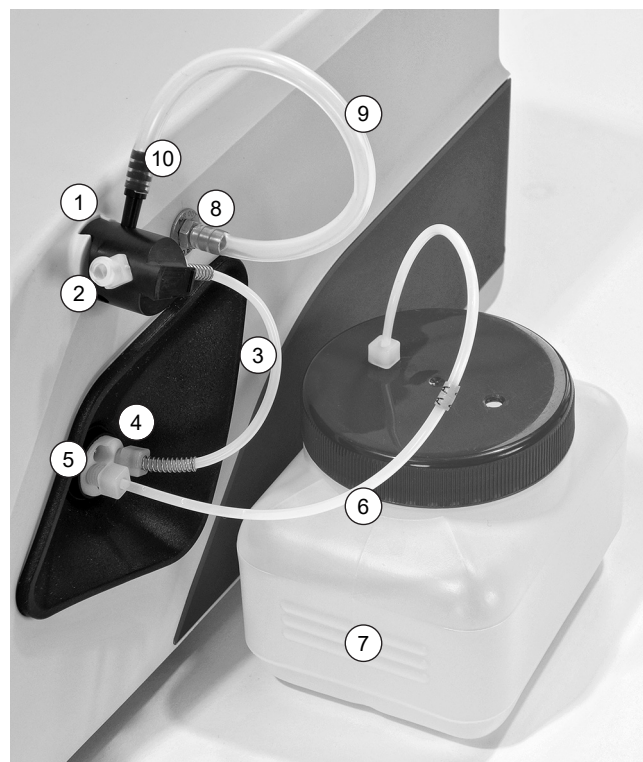


Fig. 4: Mounting the syringe holder, all hoses, and the waste vessel

- 1 Syringe holder mounted in the socket
- 2 Adapter Luer ¼" UNF, mat. no. 64792
- 3 Hose 145x3x2 PTFE 2x¼"-28 UNF, mat. no. 386159
- 4 Sample inlet
- 5 Sample outlet
- 6 Hose 300x3x2 PTFE "AA", mat. no. 3443
- 7 Waste vessel
- 8 Air pump outlet
- 9 Air pump hose
- 10 Adapter Luer cone PTFE black, mat. no. 384626

Depending on which side of the syringe holder you slide into the socket, you can switch between two filling positions of the syringe (refer to Fig. 5 [► 14]):

- **45° position (a):** The filling position of the syringe is at an angle of 45°. The hole of the fixing screw points downwards.
- **90° position (b):** The filling position of the syringe is upright. The hole of the fixing screw points towards the back of the instrument.

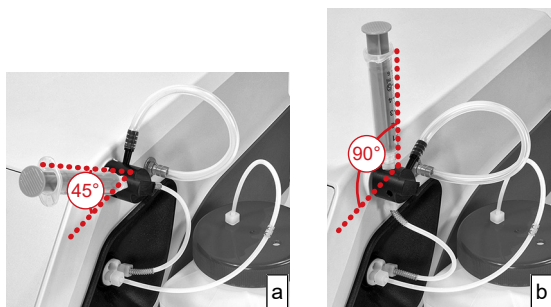


Fig. 5: Filling positions with the syringe holder

To mount the syringe holder and the filling hose

Refer to Fig. 4 [► 13].

1. Take the syringe holder (1) from the accessory kit.
2. Screw an adapter Luer ¼" UNF (2) into the screw hole at the broader end of the tapered dovetail.
3. Screw one end of the hose 145x3x2 PTFE (3) into the opposite screw hole.
4. Tighten the fixing screw in the syringe holder to secure the adapters in place.
5. Insert the appropriate tail of the syringe holder (depending on the desired filling position) into the socket on the instrument (1).

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

The position can be changed at any time without the need to unscrew the adapters.

6. Screw the free end of the hose (3) into the sample inlet (4).

Choose any of the two hose connections on the instrument (4 or 5), whichever suits your needs better. The other one will be the sample outlet.

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.

Refer to Fig. 4 [► 13].

1. Close the sample outlet (5) tightly with a male Luer plug, mat. no. 63865.
2. Draw up air into a plastic syringe from the accessory kit and connect the syringe to the adapter (2) on the syringe holder.
3. Inject, with moderate pressure, the air in the syringe into the instrument.
4. 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 tighten all adapters and hose connectors firmly and repeat the leak tightness test.
- If the leak tightness test still fails after that, contact your local Anton Paar representative.

To mount the waste hose and the waste vessel



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.

Refer to Fig. 4 [► 13].

1. Screw one end of the hose 300x3x2 PTFE (6) into the threaded hole in the cap of the waste vessel (7).
2. Screw the other end of the hose (6) into the sample outlet of the instrument (5).

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

To mount the air pump hose

Refer to Fig. 4 [► 13].

1. Cut a piece of approx. 20 cm (8 in) length from the supplied silicone hose, mat. no. 57024.
2. Attach an adapter Luer cone (10) to one end of the air pump hose (9).
3. Connect the other end of the air pump hose to the air pump outlet (8).

4.2.2 Mounting funnel, all hoses, and waste vessel

(Only DMA 502)

With DMA 502, low-viscosity samples (up to 50 mPa·s dynamic viscosity) can be filled using a funnel, mat. no. 386784, as an alternative to syringe filling.

For all instructions refer to Fig. 6 [► 15].



Fig. 6: Mounting the funnel, all hoses, and the waste vessel

- 1 Funnel mounted in the socket
- 2 Sample inlet adapter
- 3 Sample outlet adapter
- 4 Sample outlet of the funnel
- 5 Waste vessel
- 6 Air pump outlet
- 7 Air pump hose
- 8 Adapter Luer cone PTFE black, mat. no. 384626
- 9 PTFE Luer extension 80 mm, mat. no. 175611 (in parking position)

To mount the funnel, the filling hose, and the waste hose

1. Insert the tapered dovetail of the funnel fixture into the socket on the instrument (1).
2. Screw the adapters on the free ends of the hoses into the sample inlet (2) and the sample outlet (3).

Choose any of the two hose connections on the instrument as the sample inlet, the other one will be the sample outlet.

Use the tool, mat. no. 11153, coming with the funnel, to tighten the adapters.



Fig. 7: Tool, mat. no. 11153, to tighten the adapters

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. Close the sample outlet of the funnel (4) tightly with a male Luer plug, mat. no. 63865.
2. Connect a PTFE Luer extension 80 mm to the tip of a plastic syringe from the accessory kit.
3. Draw up air into the syringe and stick it (with the Luer extension at the tip) into the funnel.
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 tighten all adapters and hose connectors firmly and repeat the leak tightness test.
- If the leak tightness test still fails after that, contact your local Anton Paar representative.

Positioning the waste vessel

The funnel comes with a specific waste vessel featuring a center hole in the lid.

- Position the waste vessel so that the sample outlet of the funnel (4) aligns with the center hole in the lid. Lifting the funnel slightly, may help positioning the waste vessel.

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

To mount the air pump hose

1. Cut a piece of approx. 30 cm (12 in) length from the supplied silicone hose, mat. no. 57024.
2. Attach an adapter Luer cone (8) to one end of the air pump hose (7).
3. Attach a Luer extension (9) to the Luer cone.
4. Put the tip of the Luer extension in the parking position of the funnel.
5. Connect the other end of the air pump hose to the air pump outlet (6).

4.3 Installation of optional parts

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

4.4 Power connection



WARNING

Risk of electric shock or fire

- Use only a power supply that has come with your instrument or that is explicitly provided for your instrument (DC 24 V complying with PELV [protective extra-low voltage] according to EN 61140).
- Connect the power supply only to an electrical outlet with protective earthing.

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, 47–63 Hz).

1. Connect the power supply to the DC power jack on the rear of the instrument and fix the cable with the knurled sleeve.
2. Use the supplied power cable to connect the power supply with a suitable electrical outlet.

4.5 Switching the instrument on/off

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

- The power LED indicates whether the instrument is running or not.
- After the instrument has been switched on, the home screen will come up on the display.

Verification of software integrity

During the startup of the instrument, the integrity of the instrument's program code is verified by the calculation and comparison of a hash value.

The hash value of your software version can be found in the system information:

- Select  *System information* in the menu, then find *Software hash*.

4.6 Basic instrument settings and first checks

1. After installation, set the instrument settings (refer to Section 6 [► 22]).
2. If you don't want to use the predefined products, you may define your own products (refer to Section 7 [► 24]).
3. If you want to use settings (including product settings) already defined on another instrument (same model), you can import them by using the restore function for a backup from the other instrument.

4. Conclude initial setup with an air check and a water check (refer to Section 9.1 [► 32]) to verify that your instrument is in perfect condition. Your instrument has been factory adjusted, but during transport the density adjustment may have been compromised.

- If both checks succeed, your instrument is ready for routine measurements.
- Else perform an air/water adjustment as described in Section 9.2 [► 33].

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 [► 43] 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.

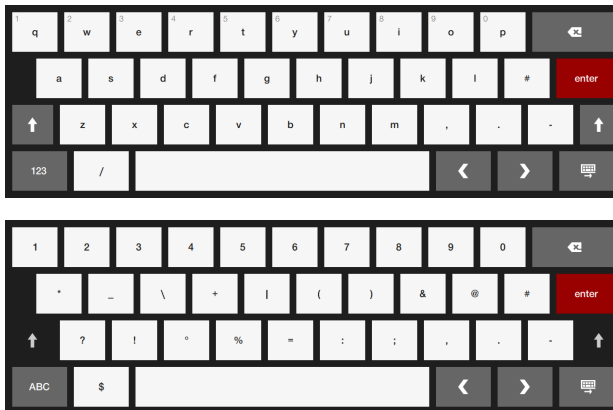


Fig. 8: Example onscreen keyboards (English) – above: alphabetic | below: numerical

- 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. 9: 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 4 [► 17] for their meaning.

Table 4: Function keys on the onscreen keyboard

	Hides the onscreen keyboard. (Tap on the input field to have it reappear.)
	Switches alphabetic/numerical keyboard to numerical/alphabetic keyboard.
	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.
	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 6.1 [► 22].

- 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 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.

5.2.3 Combined links

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



Fig. 10: 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).

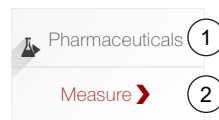


Fig. 11: Example of a favorite combining a link to the measurement setup (for a product) with direct measurement start (with the product settings)

- 1 Links to measurement setup
- 2 Directly starts a measurement

5.2.4 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:

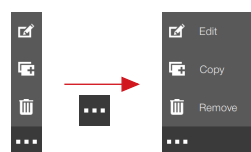


Fig. 12: Example of a spot action without/with details

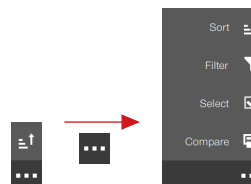


Fig. 13: Example of a list action without/with details

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. 14: 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. 15: 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

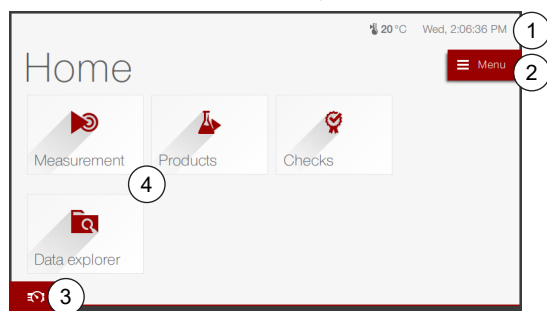


Fig. 16: Example home screen

- 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

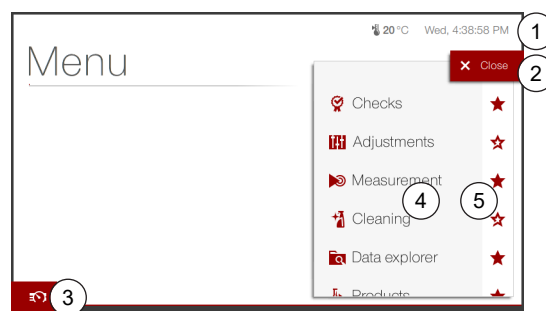


Fig. 17: Example menu screen

- 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

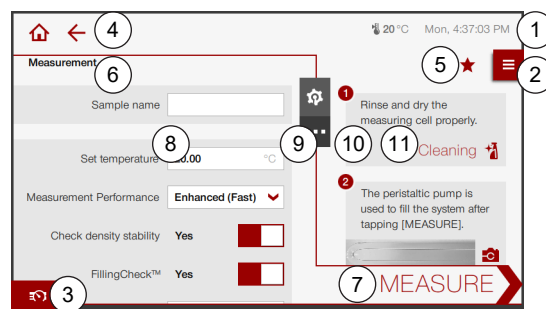


Fig. 18: A typical spot screen

- 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

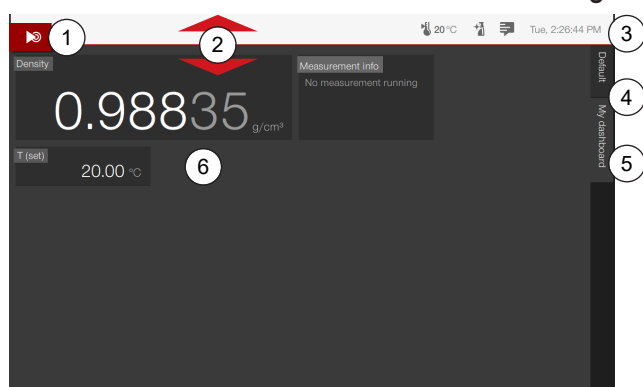


Fig. 19: Example dashboard

- 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.

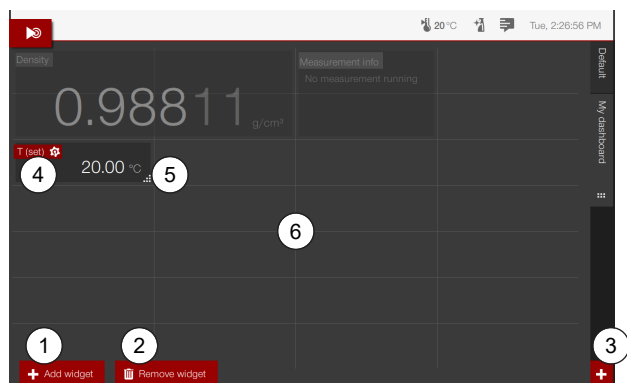


Fig. 20: Dashboard in edit mode

- 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.

Audit trail data

For detailed information on handling audit trail data, refer to Section 13.6 [► 45].

Electronic signature

For detailed information on signing measurement or check reports, refer to Section 13.7 [► 47].

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 5: 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 [► 21]).
	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 [► 22] 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 [► 40]).
- 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 [► 39]).

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 5 [► 21]).
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.

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*.

5.6 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

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

6.1 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.

6.2 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 6.1 [► 22]).

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.

6.3 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.

TIP: The display brightness is reduced when no user interaction has been detected for 20 minutes. As soon as you touch the screen, the display brightness is back to its previous value.

6.4 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.

6.5 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.

6.6 Automatic export of result reports

You can configure the instrument so that after a measurement, check, or adjustment, result reports are automatically 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 **Automatic Export** select  **Export**.
2. Set the switch to **activated** for any data type to activate the function for the corresponding data.
3. After you have activated the function, you can select and configure a file format and specify a location where the exported data shall be stored.

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

A checksum file is exported together with every exported result report (refer to Section 5.6 [► 22]).

6.7 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 [► 43] for details.

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

6.7.1 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 [▶ 43]).

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.

6.7.2 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 [▶ 43]).

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.*

6.7.3 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 [▶ 43]).

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

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 and optionally configure limits.
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.

7.2 Measurement settings

Measurement settings comprise the measurement parameters, 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**.

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.

7.3 Measurement parameters

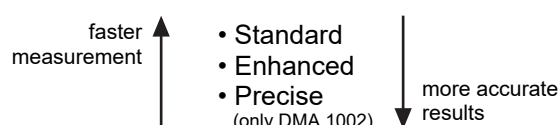
7.3.1 Set temperature

Set the measuring temperature here.

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

7.3.2 Measurement performance

Select a measurement performance class for the measurement:



We recommend the performance class with the highest possible accuracy as the standard setting (*Precise* for DMA 1002, *Enhanced* for DMA 502).

The *Density* widget includes a **precision indicator** showing the measurement performance class set and the currently reached measurement performance class (according to the stability criteria met). Read the precision indicator as follows (example for DMA 1002):

Indicator	Measurement performance class
	<i>Standard</i>
	<i>Enhanced</i>
	<i>Precise</i>
White squares indicate the measurement performance class set. Green squares indicate the measurement performance class currently reached.	
	Example: The measurement performance class <i>Precise</i> has been set (white squares). Currently the measurement reaches measurement performance class <i>Enhanced</i> (green squares).

7.3.3 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).

7.3.4 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.

TIP: A hold time of 4 minutes for DMA 502 and 5 minutes for DMA 1002 is recommended when you measure without checking density stability. When you check density stability, the standard hold time is 0 minutes.

7.3.5 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 with measurement start.

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 (and set a hold time).

7.3.6 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 Filling-Check™ and perform repeated measurements to validate the quality of filling.

7.3.7 Thermal expansion factor

(Only available in product settings)

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.

7.4 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 6: 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 [► 13] 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 9.1 [► 32]
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 [► 27] Section 7 [► 24]
2 Prepare your sample if required.	Section 8.2 [► 27]
3 Fill the sample .	Section 8.3 [► 28]
4 Start the measurement .	Section 8.4 [► 30]
5 Clean and dry the measuring cell.	Section 10.3 [► 36]
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 9.1 [► 32]

Refer to Section 9.2 [► 33] 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 150 °C (302 °F).

- Set the safety temperature limiter on the rear of the instrument (13, Fig. 3 [► 10]) to a temperature that is safe for your sample (use a screwdriver).

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

- Set the measuring temperature on the instrument in advance using the header control.
- Bring the sample to measuring temperature in advance.
- 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 [▶ 25]).

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

Hints for accurate measurements – temperature equilibration

If you want to achieve most accurate measurement results, give the measuring cell and sample enough time for temperature conditioning:

- Keep the instrument continuously switched on or at least switch it on well before measurements (more than an hour before).
- Keep the instrument at a constant temperature over a long time (more than an hour).
- **If you change the measuring temperature**, wait 1 hour per 10 °C (18 °F) temperature difference at the new temperature before starting measurements.

Perform a check or calibration measurement at the new temperature in order to check the accuracy of the measurements at the new temperature.

If the check or calibration measurement fails, perform an adjustment at the new temperature and again a check.

- As a rule of thumb allow for a conditioning time of 1 minute per every 10 °C (18 °F) **difference between the temperature of the filled sample and the set measuring temperature**.
- If you do not check density stability in your measurement, set an additional hold time of 4 minutes (DMA 502) / 5 minutes (DMA 1002).
- If you measure density that is not viscosity-corrected, allow for a longer conditioning time: approx. 5 minutes if you check density stability or approx. 10 minutes if you don't.

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.
 - 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...*).
- To start a measurement, tap *MEASURE*.

Measurements without predefined product

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*.

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.*

Using a syringe

The syringe must be large enough to leave space for creating a vacuum.

1. Fill the syringe up to two thirds with sample and close its tip with your finger.
2. Pull the piston to create a vacuum.
3. Release your finger to let the gas out.
4. Repeat the procedure at least three times.

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

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.

NOTICE

Proceeding in case of instrument leaks

If liquid leaks from the draining hole by the sample inlet:

- Perform a leak tightness test as described in the installation section.
- If the leak tightness test fails, contact your local Anton Paar representative.

You can fill the sample with a syringe, through an optional funnel, or with an optional peristaltic pump. Refer to the documentation of the peristaltic pump for instructions on its installation and use.

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

TIP: Sample containing dissolved CO₂ will cause bubbles in the measuring cell, which render the measurement results invalid. Degas your sample carefully as described in Section 8.2 [► 27].

Sample amount

If the measuring cell is clean and dry, you need approx. 2 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.

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

- To achieve best measurement results, fill with the syringe attached to the adapter Luer ¼" UNF on the syringe holder.
- This is the standard filling position.
- Only in the case that the available amount of sample is very limited:

- Remove the adapter Luer ¼" UNF from the syringe holder and screw it into the sample inlet of the instrument (instead of the inlet hose).
- 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 the syringe holder (or mounted directly on the sample inlet of the instrument).
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.

8.3.2 Filling with the optional funnel

Pour approx. 10 mL liquid directly into the funnel. The circumferential mark inside the funnel indicates the 10 mL level.

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.

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.

When the measurement is finished, the results are displayed.

The results together with the camera image 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 and on the measuring cell and in the measuring cell block.

Condensation inside and on 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 [► 30]).
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 [► 36]).

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. 21: 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 "AIR PUMP / DRY AIR IN" 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 “AIR PUMP / DRY AIR IN” 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

To prevent or remove condensation on the measuring cell:

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

Measuring cell block

To prevent or remove condensation in the measuring cell block:

1. Connect a dry air supply to the “DRY AIR BLOCK IN” connector. Use a 3x5 mm hose made of suitable material, for example silicone.

2. Remove the cap from the “DRY AIR BLOCK OUT” connector.
3. Continuously flush the measuring cell block with dry air.

NOTICE

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

8.5.4 Removing condensation using the internal air pump

If no external dry air supply is available, you may use the internal air pump to remove condensation on the measuring cell and in the measuring cell block.

IMPORTANT: *This is a solution for emergency cases and not intended for long-term use.*

The procedure requires to install an optional drying cartridge, mat. no. 65085, and an optional filter set DMA 502/1002, mat. no. 387931.



Fig. 22: Example: Removing condensation from the measuring cell block with the internal air pump

- 1 Drying cartridge
 - 2 Remove cap from inlet of drying cartridge
 - 3 Hose connection from drying cartridge to air pump inlet connector
 - 4 Filter
 - 5 Long hose of the filter set
 - 6 Air pump outlet
 - 7 DRY AIR BLOCK IN connector / remove cap from OUT connector
 - 8 DRY AIR CELL IN connector
1. Install the drying cartridge as described in Section 8.5.2 [► 30].
This ensures that the air from the air pump is dry.
 2. Install the filter set:
 - The long hose (5) may be disconnected from the filter(4): In this case connect the end with the hose clamp to the filter with a clockwise turn.
 - Connect the open end of the long silicone hose 4x6 mm (5) to the air pump outlet (6).
 3. Connect the open end of the short silicone hose 3x5 mm to the inlet where dry air is required:

- “DRY AIR CELL IN” connector (8) if you want to dry the outside of the measuring cell
 - “DRY AIR BLOCK IN” connector (7) if you want to dry the measuring cell block
In this case remove the cap from the “DRY AIR BLOCK OUT” connector.
4. On the instrument, select  *Cleaning* in the menu.
 5. Tap the temperature in the screen header and set it to the maximal temperature.
 6. Disable air pump timeout:
 - Tap .
 - In the air pump settings, set the switch *Turn off after timeout* to *Off*.
 - Tap *Save*.
 7. After maximal temperature has been reached, tap  to start the air pump.
 8. When condensation has disappeared, tap  to stop the air pump.
 9. Restore your standard settings for the temperature and air pump timeout.

Consider to prevent condensation as described in Section 8.5.3 [▶ 31](#).

9 Checking, adjusting and calibrating

9.1 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 cell and compare the measured density with the target value.

- 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 the check at the same temperature as 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 cell has 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 cell (e.g., samples containing adhesives, sticky particles, proteins).

9.1.1 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

- Select a *Group*, then a *Quantity* to be checked.
For an air check or a water check, select *Density* for *Group* and a density parameter for *Quantity*.
- Select a unit for the check parameters.
- *Target type (only with density parameters)*:
 - For a custom check, select *Constant*.
 - For an air check, select *Quantity*.
Then select *Air density* as *Target quantity*.
 - For a water check, select *Quantity*.
Then select *Water density* as *Target quantity*.
- Select a *Reference value* to be tested with the check (*only for custom checks*).
- Check limits:
 - 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.
 - 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.
- Define the measurement settings for the check.

Table 7: Factory settings of max. upper/lower deviation for predefined air and water checks

DMA 502	0.001 g/cm ³
DMA 1002 ^a	0.0002 g/cm ³

^a If required, you may enter a max. deviation as low as the specified accuracy of the instrument.

9.1.2 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.

9.1.3 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 ultra-pure 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.

9.1.4 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.

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 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.

The instrument features a 2-point adjustment (air/water adjustment) and a wide range adjustment.

DMA 1002 also features a 1-point adjustment (water adjustment) as the standard adjustment. After ten 1-point adjustments you are prompted to perform a 2-point adjustment for accuracy reasons.

- Perform a density adjustment if a check has failed and corrective actions have not helped.
- We recommend to perform an air/water density adjustment if you relocate the instrument to a place where the ambient temperature differs by more than 10 °C (18 °F).
- *DMA 1002 only:* To achieve highest accuracy, we recommend to perform an air/water density adjustment after each temperature change. Wait at least one hour after the required temperature has been reached.
- You will likely never need a wide range adjustment. Be aware that it will last several hours. However, a wide range adjustment may be useful when you adjust your instrument at a temperature

in the middle of the range, and if subsequent measurements are out of specifications at other temperatures.

9.2.1 Performing an adjustment

Adjustment media: dry air and freshly degassed ultra-pure water for the air/water adjustment

The 1-point water adjustment simply skips the air adjustment.

IMPORTANT: *You cannot use the peristaltic pump for adjustments.*

IMPORTANT: *We strongly recommend to adjust the instrument at the temperature at which you will perform your measurements.*

IMPORTANT: *Start an adjustment only after the instrument has been running at the start temperature of the adjustment for more than 1 hour (the longer, the better).*

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.

1. Select  **Adjustments** in the menu, then select one of the available density adjustments.
2. 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.*

3. Tap **Start Air Pump** to dry the measuring cell.
4. Tap **Stop Air Pump** when the measuring cell is dry.
5. Tap **DONE**.
6. **Air adjustment:**

- 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.

- Enter the adjustment temperature.
- Tap **START**.

The air adjustment routine is carried out.

7. **Water adjustment:**

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

Take care to fill the water without air bubbles.

- Tap **START**.

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.

Applied results are also saved in the data memory.

9.2.2 Resetting adjustments to factory adjustment

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

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

Adjustments will be reset.

After resetting to factory adjustment, perform an air/water adjustment before you continue with checks and measurements.

9.3 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

Start a calibration only after the instrument has been running at the temperature of the calibration for more than 1 hour (the longer, the better).

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 [▶ 35]).

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.*

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 re-set 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 8: Recommended cleaning liquids

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

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. Connect the adapter Luer cone of the air pump hose to the adapter Luer 1/4" UNF on the syringe holder (or mounted directly on the sample inlet adapter of the instrument).
2. On the **Cleaning** screen, tap  to start the air pump.
3. 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).

4. Tap  to stop the air pump.

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**.

5. Disconnect the air pump hose from the syringe holder (or 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 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)

**WARNING****Possible shock current over wet skin**

In case of moist cleaning unplug the power supply from the instrument.

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

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.

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 9: Supported network shares

- | |
|---|
| <ul style="list-style-type: none"> – 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 [p. 38]).
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 [► 38]).
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 10: Supported network printer models

- PCL 5 printers
- PCL 6 printers

1. Configure a network connection first (Section 11.1 [► 38]).
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 11: 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

Table 12: 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. 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*.

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 $Q_1, Q_2, \dots$:

$$Q_c = f(Q_1, Q_2, \dots)$$

The function is defined by the formula f .

You can use the following operators and functions to compose the formula:

Table 13: 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 Q_1 , Q_2 , 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 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*.

12.3 Editing a custom quantity

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*.

12.4 Removing a custom quantity

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 [► 44]) 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.

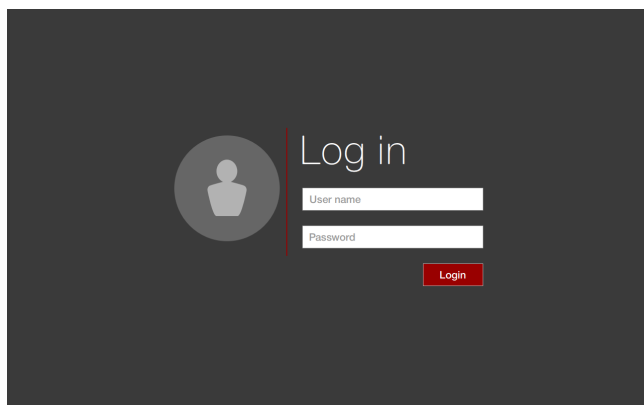


Fig. 24: Login screen

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. 25: Example user identification in the header

Logging out

1. To log out, tap on the user identification in the header (Fig. 25 [► 43]).

A control panel slides in showing the available user operations:

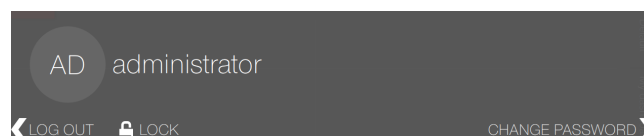


Fig. 26: Example control panel with user operations

2. Tap **LOG OUT**.

The login screen will appear.

TIP: When you log out, operations that you have started will be stopped.

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. 25 [► 43]).

A control panel slides in showing the available operations (Fig. 26 [► 43]).

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 14: 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 [► 44].
- Define the **roles** available on the instrument. These are sets of permissions. Refer to Section 13.5.2 [► 44].
- Add individual **user accounts**. Refer to Section 13.5.3 [► 45].

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 15 [► 44].

- 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 15: 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 [► 43] 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 14 [► 44] 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 14 [► 44] 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. 25 [► 43]).

A control panel slides in showing the available operations (Fig. 26 [► 43]).

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 [► 45]).

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 16: 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, hard- ware settings)	– create – edit – remove – change settings
Measurements (incl. checks, adjust- ments)	– start – stop (incl. abortion) – failed/applied/rejected/ reset to factory adjust- ment
Measurement reports (incl. checks, adjust- ments)	– 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 5.6 [► 22]).

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.

13.7 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.*

NOTE: *Electronic signatures are not included on the printout of serial printers.*

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 [► 44] 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**.

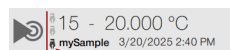
With substitute signing, a comment is always mandatory, irrespective of how the switch **Comment required** has been set.

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 [► 47]).
- 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.



signing state of report

Fig. 27: 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 .

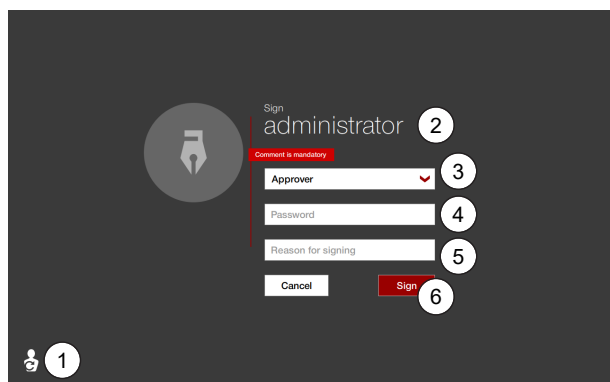


Fig. 28: Example signing screen

- 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 [► 48]).

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 [► 43]).

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 [► 49]).

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
<i>Baud rate</i>	9600 baud
<i>Data bits</i>	8
<i>Stop bits</i>	1
<i>Parity</i>	none
<i>Handshake</i>	none

Communication protocol

- Server and client communicate text based with encoding ISO-8859-15.
- Communication is in English, irrespective of the regional settings.

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 [► 50] 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 17 [► 50])
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 " <i>value</i> " or <i>name</i> =" <i>value</i> ". 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";
```

- 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 semi-colon (ASCII 59) only if an argument follows.
- Command arguments are terminated by a semi-colon (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.

Error codes in RS-232 LIMS services response

Table 17: Error codes returned by RS-232 LIMS services

Code	Description
0	<i>OK</i> – Everything is in order / the command has been successfully processed / the instrument is idle.
–1	<i>Too many commands are running</i> – Wait for a command to be processed and finished before you send a new one.
–2	<i>Parsing the command line failed</i> – Check the syntax of your command line.
–3	<i>Unknown command</i> – Refer to Section 14.4 [► 50] for an overview of the available commands.
–4	<i>Invalid number of arguments</i> – The number of arguments specified for the command does not meet requirements. Refer to Section 14.4 [► 50] for the correct command syntax.
–5	<i>Invalid argument</i> – Verify that the argument name and value are supported and valid.
–6	<i>System not ready</i> – The command cannot be processed because another operation is already running on the instrument.
–7	<i>Processing command failed</i>
–8	<i>Operation canceled</i> – The command has been canceled (by the <i>Cancel</i> command or by a user controlling the instrument).
–9	<i>No data</i> – 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 reference 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 18: 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
- 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".

¹ For detailed information, please refer to general terms of delivery (GTD) on the Anton Paar website (<https://www.anton-paar.com>).

Appendix A Technical data

Appendix A.1 Specifications

	DMA 502	DMA 1002
Density		
Measuring range	0 g/cm ³ to 3 g/cm ³	
Repeatability s.d. ^a	0.0002 g/cm ³	0.00005 g/cm ³
Reproducibility s.d. ^a	0.0004 g/cm ³	0.00007 g/cm ³
Accuracy ^b	0.001 g/cm ³	0.0001 g/cm ³
Resolution	0.0001 g/cm ³	0.00001 g/cm ³
Temperature		
Measuring range	15 °C to 40 °C (59 °F to 104 °F)	15 °C to 60 °C (59 °F to 140 °F)
Repeatability s.d. ^a	0.1 °C (0.18 °F)	0.02 °C (0.036 °F)
Accuracy	0.3 °C (0.54 °F)	0.03 °C (0.054 °F) ^c
Resolution	0.01 °C (0.01 °F)	0.01 °C (0.01 °F)
Sample volume	<2 mL (incl. filling adapter)	
Sample viscosity	0 to 35,000 mPa·s	
Accuracy and convenience features	full range viscosity correction U-View™ FillingCheck™	

^a According to ISO 5725

^b Under ideal conditions and for low densities/viscosities

^c If room temperature does not deviate more than ± 2 °C from room temperature of the last temperature adjustment

Appendix A.2 Instrument data and operating conditions

Data memory	– audit trail entries: up to 5,000 – measurement data: up to 5,000 (with camera image) – check definitions: up to 100 – check results: up to 500 – adjustment results: up to 100 – products: up to 400 – custom quantities: up to 50 – users and roles: not limited, tested with up to 1000 users and 100 roles
Display	7" TFT WVGA (800x480 px); PCAP touchscreen
Controls	touchscreen, optional keyboard, mouse, and barcode reader
Interfaces	3x USB ^a , 1x RS-232, 1x Ethernet
RS-232C printer settings	Baud rate: 9600; Parity: none; Stop bit: 1; Data bits: 8
Environmental conditions (EN 61010)	indoor use only
Ambient temperature	5 °C to 35 °C (41 °F to 95 °F) permissible operating temperature
Air humidity	10 % to 90 % relative humidity, non-condensing ^b
Altitude	max. 3000 m (9800 ft)

Operating pressure sample	max. 10 bar (145 psi) absolute pressure
Pressure drying air	max. 0.1 bar (1.45 psi) relative pressure
Pollution degree	2
Overvoltage category	II for the supplied AC adapter
Power supply	instrument: DC 24 V, 3 A via supplied power supply: 100 to 240 V~, 47 to 63 Hz, fluctuation $\pm 10\%$, 1.5 A
Power consumption	72 W
Dimensions (L x W x H)	375 mm x 265 mm x 180 mm (14.8 in x 10.4 in x 7.1 in)
Weight	13.5 kg (29.8 lbs)

^a USB memory devices have to be formatted with FAT32 or exFAT file system

^b Drying the measuring cell is mandatory when humidity is condensing

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
PTFE (polytetrafluoroethylene)	filling adapter and O-ring

Standard accessories

Material	Part
HDPE (high-density polyethylene)	waste vessel
Polypropylene / polyethylene	syringe
PTFE (polytetrafluoroethylene)	adapters, Luer plug, filling hose, waste hose
Tefzel	adapter Luer 1/4" UNF

Optional filling funnel

Material	Part
PTFE (polytetrafluoroethylene)	hoses
Steel 1.4301	funnel

Instrument housing surface materials

Housing	Crastin S600F40 NC010 (colored)
Touchscreen	glass, chemically hardened
Rubber cover	HNBR (hydrogenated nitrile butadiene rubber)
Protection plate	steel 1.4301

Appendix B Factory default role permissions

Permission		Administrator	Operator	Services
Adjustments	Execute air / water	•	—	•
Adjustments	Execute density one-point	•	—	•
Adjustments	Execute density wide-range	•	—	•
Audit trail	Export	•	—	—
Audit trail	Manage	•	—	—
Audit trail	Print	•	—	—
Audit trail	Remove	•	—	—
Audit trail	View	•	—	•

Permission		Administrator	Operator	Services
Checks	Define	•	—	•
Checks	Edit	•	—	•
Checks	Remove	•	—	•
Checks	Start	•	•	•
Checks	Stop	•	•	•
Dashboards	Manage	•	—	•
Data explorer	Change comparison settings	•	—	•
Data explorer	Remove adjustment data	•	—	•
Data explorer	Remove check data	•	—	•
Data explorer	Remove measurement data	•	—	•
Data explorer	View adjustment report	•	•	•
Data explorer	View check report	•	•	•
Data explorer	View measurement report	•	•	•
Electronic signature	Approver	—	—	—
Electronic signature	Manage	•	—	—
Electronic signature	Reviewer	—	—	—
Electronic signature	Submitter	—	—	—
Measurements/Products	Allow [REMEASURE]	—	—	—
Measurements	Edit settings	•	—	•
Measurements	Start	•	•	•
Measurements	Stop	•	•	•
Products	Manage	•	—	•
Products	Start measurements	•	•	•
Products	Stop measurements	•	•	•
Remote interface	Abort measurements	—	—	—
Remote interface	Export adjustments	—	—	—
Remote interface	Export audit trail	—	—	—
Remote interface	Export checks	—	—	—
Remote interface	Export measurements	—	—	—
Remote interface	Remove adjustments	—	—	—
Remote interface	Remove audit trail	—	—	—
Remote interface	Remove checks	—	—	—
Remote interface	Remove measurements	—	—	—
Remote interface	Start measurements	—	—	—
Remote interface	View adjustments	—	—	—
Remote interface	View audit trail	—	—	—
Remote interface	View checks	—	—	—
Remote interface	View measurements	—	—	—
Service	Execute service adjustments	•	—	•
Service	Execute service login	—	—	•
Service	Execute service procedures	—	—	•

Permission		Administrator	Operator	Services
System security	Change system settings	•	–	–
System security	Deactivate	•	–	–
System	Change automatic export settings	•	–	•
System	Change network/connection	•	–	•
System	Change printer settings	•	–	•
System	Change system settings	•	–	•
System	Execute backup	•	–	•
System	Execute “Reset to factory settings”	•	–	•
System	Execute update	•	–	•
System	Login settings / Roles / Users	•	–	–
System	Manage custom quantities	•	–	•
System	Restore backup file	•	–	•

• permission granted | – permission not granted

Appendix C Troubleshooting

Problem	Cause / Corrective action	Refer to
The temperature of a board is too high.	– Switch the instrument off and let it cool down. – Check that the setup location is according to requirements.	Section 4.1 [► 13]
The block temperature is below dew point.	Install a drying cartridge or connect a dry air supply.	Section 8.5 [► 30]
Temperature control error	– Press the reset button of the safety temperature limiter on the rear of the instrument. You can hear a clicking sound when the safety temperature limiter responds or when it is reset. – Check that the safety temperature limiter is set according to your measurement requirements.	Fig. 3 [► 10]
Temperature control does not work. The temperature of the measuring cell stays below the set temperature.	Check the temperature set on the safety temperature limiter.	Fig. 3 [► 10]
A low temperature (15 °C / 59 °F) cannot be reached.	Check for condensation in the measuring cell block. In this case connect a dry air supply.	Section 8.5 [► 30]
Temperature stability cannot be achieved for accurate measurements (e.g. calibrations): deviations from set temperature >0.05 °C (0.09 °F)	– Check that the conditions for accurate measurements are met. – The cell illumination is switched off when no user interaction has been detected for 20 minutes. As the cell illumination is on during measurements, take care that it also stays on during temperature conditioning of the sample. In case sample conditioning lasts longer than 20 minutes, it may be necessary to touch the screen periodically to avoid the power-save function.	Section 8 [► 26]
Filling errors	– Check for bubbles during filling. – Consider special sample treatment.	Section 8.2 [► 27] Section 8.3 [► 28]
Warning that the storage for measurement data or check results will soon be full / is full	When storage capacity comes close to its limit, you are warned in advance before you start a measurement.	Appendix A.2 [► 57]

Problem	Cause / Corrective action	Refer to
	– With system security deactivated: If you continue with your measurements, stored data will be overwritten, starting with oldest data. – With system security activated: When the limit is reached, you will not be able to perform a measurement. In this case clear the storage: export your data and remove them from the instrument.	
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  <i>Settings</i> in the menu, then under <i>Hardware</i> select  <i>Instrument settings</i>. – Switch <i>Keep network share open</i> to <i>Yes</i> 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 reset the instrument's current status

1. Switch the instrument off.
2. Wait for 10 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 [► 56].

