Anton Paar

Instruction Manual and Safety Information

Litesizer DLS 701
Litesizer DLS 501
Litesizer DLS 301
Litesizer DLS 101

Published and printed by Anton Paar

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1 Safety instructions

Read the documentation

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

1.1 General safety instructions

General

- The present manual is termed "Instruction Manual and Safety Information" (IMSI). It is designed as a quick guide providing you with the most important information regarding the safe installation and use of the product. Refer to the Reference Guide D51IB010EN for a comprehensive description of the instrument. Download Anton Paar documents for free from the Anton Paar website: https://www.anton-paar.com
- 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.
- 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.
- The proper function of the instrument's protective devices is only guaranteed when operated correctly within the specified scope of applications.

Cybersecurity

- For software products, the customer must ensure proper access control to the host PC. The installer directory must be restricted to administrators.
- Only approved and conformant third-party components must be used. Secure implementation of connections to such components remains the responsibility of Anton Paar.
- Security policies must ensure that users protect authenticators: keep them in their possession, do not share them, and report lost or compromised authenticators immediately. The user must not leave the product unlocked or unattended while authenticated.
- Security settings delivered by Anton Paar (e.g., authentication, PIN, encryption, logging) must remain enabled. Disabling or modifying them shifts responsibility and risk to the user and requires the customer to perform their own risk assessment.
- The product must be installed in a physically restricted and access-controlled environment (e.g., non-public area, behind a firewall). Attacks requiring disassembly or hardware modification are out of scope.
- The product must operate only on a managed, regularly updated, and trusted operating system. It cannot protect against a compromised operating system.
- The user must change or refresh passwords / PINs periodically.
- The user must configure the product in accordance with their company's recommended network and security policies.
- The user must recognize that deviations from the Anton Paar–defined intended product use, environment, or documented security settings may introduce additional risks not covered by the provided security measures.
- The user must regularly check for product updates and must install them (either independently or through Anton Paar processes).
- The user must use strong, unique passwords for each device and must keep them confidential, ensuring access is limited to authorized personnel only.

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.
- Check the wetted parts of the product for chemical resistance to all samples and cleaning liquids.

- Connect the product to the electrical supply via a safety switch located at a safe distance. In an emergency, turn off the power using this switch.
- 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.

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.
- Do not expose the product to direct sunlight for extended periods of time.

Using the product

- Keep potential sources of ignition, like sparks or open flames, at a safe distance from the product.
- Ensure that all operators have been trained beforehand to use the product safely and correctly.
- 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.

Precautions for flammable samples and cleaning agents

- Place the product in a well-ventilated area.
- Always use the purge port with nitrogen as purge gas when measuring flammable samples (min. flow rate: 2 L/min).
- Do not measure any sample with a spontaneous ignition temperature lower than 279.87 °C.
- Flammable samples should be measured in quartz or glass cuvettes at the lowest feasible measuring temperature.
- Fill the cuvette at a safe distance from the product in a well-ventilated area, using only the minimum sample volume, and close the cuvette.
- Check the drain hole at the bottom of the cuvette module periodically using a pipe cleaner.
- Safely dispose of the sample as soon as possible after the measurement.
- If a flammable sample is spilled in or near the product:
  - Switch off and unplug the product
  - Remove cuvette module
  - If necessary let it cool down in a well-ventilated place
  - Remove the cuvette from the module
  - Remove any visible sample residue from the module with a dry cloth
  - Remove any remaining sample residue by blowing the module with nitrogen or dry air
  - Do not reassemble the product nor turn it on until all residues have been removed.
  - If in doubt, contact your Anton Paar service representative.
- Store only the minimum required amount of sample, cleaning liquids, and other hazardous materials near the product.
- Provide fire-extinguishing equipment.

Operator's skills

- All personnel involved in the operation and/or maintenance of the product must be qualified or properly instructed in its use.
- Operators must be able to read and understand the instructions within the manual.
- It is the owner's responsibility that all operators are sufficiently trained in the correct and safe use of the product.
- Operators must be able to judge dangerous situations and take the right measures to prevent accidents, injury and damage.
- Operators must have knowledge of chemistry and its rules.

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. Contact your Anton Paar representative for further questions.

1.2 Conventions of safety messages and typography

Conventions for safety messages

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

WARNING

Description of risk

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

CAUTION

Description of risk

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

NOTICE

Description of risk

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

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

Typographical conventions

The following typographical conventions are used in this instruction manual:

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

Software screenshots

The screenshots depicted in this manual are representative only. They may not reflect the latest version of the software.

1.3 Safety signs on the instrument

NOTICE

It is imperative that the warning signs remain clearly legible.

Fig. 1: *Safety signs and laser aperture on the front surface of the module cavity*

1 Safety signs

2 Laser aperture

CAUTION

Laser radiation

The instrument is equipped with a laser of class 3B, which is integrated into the optical bench and therefore conforms to laser class 1 regulations. There is no exposure to laser radiation during normal operation of this instrument.

– Follow your national safety regulations.

WARNING

Danger of laser radiation

Switch the instrument off before handling any tools containing metal or other conducting materials in this area.

Fig. 2: *Safety sign at the rear of the instrument*

CAUTION

Risk of damage to the instrument

Use dry air (ISO 8573.1, class 1.3.1) or nitrogen at 0.4 to 0.8 bar overpressure (1.4 to 1.8 bar total input). Use a 6 x 4 mm hose to connect the air/nitrogen. Failure to adhere to these specifications may result in damage to the instrument.

Fig. 3: *Safety signs on the BM 11, FM 11 and FM 11 on-line module and on the thermal insulation cover*

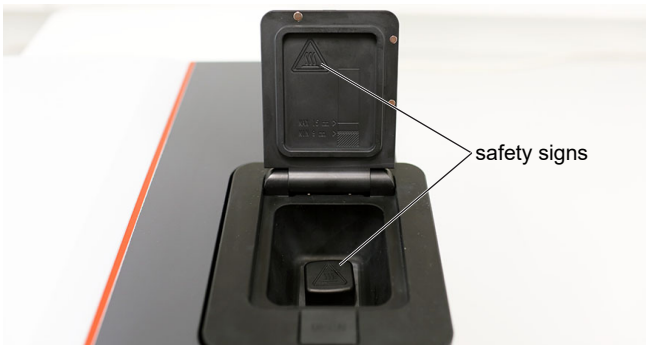


Fig. 4: *Safety signs inside the BM 11 module and on the thermal insulation cover*

Fig. 5: Safety signs inside FM 11 and FM 11 on-line

CAUTION

Hot surface

The inside surface of the cuvette module and on top of the thermal insulation cover can get hot when measuring at high temperatures (above 45 °C).

– Allow the cuvette area to cool before removing the thermal insulation cover and cuvette.

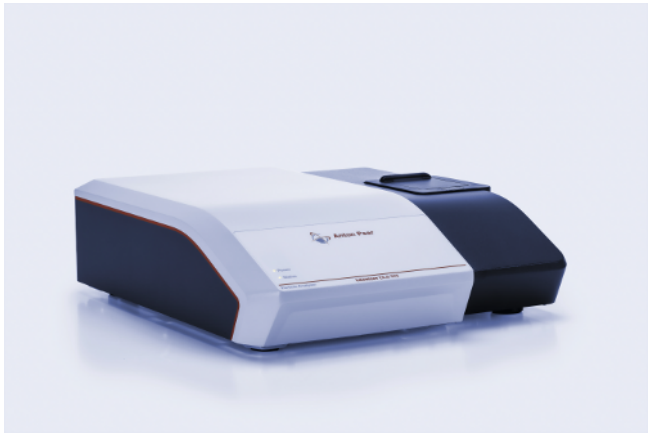
WARNING

Risk of injury and damage to property.

Always follow all specific safety warnings in this document.

Pay particular attention to warnings related to measurements **with FM 11 on-line**.

2 Overview



2.1 Intended use

Litesizer DLS series instruments are designed for characterizing particles in liquid dispersions.

Litesizer DLS 701 and Litesizer DLS 501 can determine particle size, zeta potential and molecular mass by measuring dynamic (DLS), electrophoretic (ELS) and static light scattering (SLS), respectively. Both models can also measure refractive index and sample's transmittance. Additionally, Litesizer DLS 701 can perform multiangle particle sizing (MAPS) and particle concentration (PCON) measurements.

Litesizer DLS 301 can determine particle size, zeta potential, molecular mass and sample transmittance.

Litesizer DLS 101 can determine particle size by DLS as well as sample transmittance, but cannot perform ELS nor SLS.

To compare the main features of Litesizer DLS, refer to Table 2 [▸ 9]. For full technical specifications refer to Appendix A [▸ 31].

Litesizer DLS particle analyzers should not be used in any other way than that described in this manual.

Table 1: Measurement modes

	Litesizer DLS			
	101	301	501	701
Particle Size (DLS)	✓	✓	✓	✓
Zeta Potential (ELS)		✓	✓	✓
Molecular Mass		✓	✓	✓
Transmittance	✓	✓	✓	✓
Refractive Index			✓	✓
Multi-Angle Particle Sizing (MAPS)				✓
Particle Concentration (PCON)				✓

2.2 Unique features

– **cmPALS, a new ELS technology**: Unique to Litesizer DLS is cmPALS, a novel patented PALS technology (European Patent 2 735 870) that provides unprecedented accuracy in ELS measurements. Also, the incorporation of auto-adjustment optics lends further stability to the instrument's optics, particularly in the long term. Despite these features, the instrument is especially compact and lightweight.

– **Simple software**: Particularly convenient is the accompanying software program, Kalliope, which sets a new standard in user-friendliness. The user sees all important information on a single clear display, including input parameters, results, and final calculated values, as well as expert advice. Experiments can be performed in series with DLS and ELS, allowing the user to observe changes in particle properties while varying pH, time or temperature, for example.

– **Reporting**: Litesizer DLS enables fast and customizable analysis and reporting, and complies with the US FDA's Regulation 21 CFR Part 11 concerning electronic records and signatures.

– **Transmittance**: An extra capability of Litesizer DLS series instrument includes continuous transmittance measurement. Transmittance measurements provide a fast indication of a sample's suitability for light-scattering measurements. In addition, this measurement allows the instrument to

select the best parameters for your sample. These include the focus position, the measuring angle and the measurement duration.

– **Refractive Index**: Knowledge of the solvent's refractive index is required to perform DLS and ELS. While for most particle analyzers these indices must be determined from external sources, the instrument is able to measure the refractive index for the exact wavelength and temperature of your experiment. This ensures maximum accuracy of particle size and zeta potential results under all experimental conditions. The instrument is the only DLS-based particle analyzer that is able to perform such a measurement.

– **Particle concentration based on DLS**: Litesizer DLS allows to measure the particle concentration by using the single angle DLS measurement mode. There are two available options. Either the appropriate angle is selected automatically on the basis of the transmittance measurement or a specific angle can be chosen among the back, side or forward one.

– **Advanced series**: It is possible to perform a measurement including multiple parameters (e.g. angle, temperature) in the repetition series.

– **Run selection**: This feature enables the user to select the percentage of runs used for the analysis.

– **Florescence and polarization filters**: There are three different filters available for all three angles of measurement:
- vertical polarization
- horizontal polarization
- fluorescence
They can be inserted manually when the module is removed from the main instrument. The respective filter needs to be selected manually in the measurement parameters of the Kalliope software.
For compliance with 21 CFR Part 11, the filters must be inserted by a service technician before the AISQ+ and stay with the instrument permanently.

Table 2: Main features of Litesizer DLS

	Litesizer DLS 101	Litesizer DLS 301	Litesizer DLS 501	Litesizer DLS 701
Light source	Laser light of wavelength 658 nm[a] from a single-frequency laser diode, providing 40 mW.			
Laser warm-up time	6 min			
Temperature control range	0 °C - 120 °C (32 °F – 248 °F)			
Standard accuracy	± 0.3 °C Improved accuracy may be verified if requested by a tender.			
Dynamic Light Scattering (DLS)	✓			
Measurement angle	175°	90°	3 (15°, 90°, 175°)	3 (15°, 90°, 175°, Multi-angle particle sizing MAPS)
Multi-Angle Particle Sizing (MAPS)	✗			✓
Particle size range	0.3 nm - 10 µm (diameter) [b]	0.3 nm - 15 µm (diameter) [b]	0.3 nm - 15 µm (diameter) [b]	
Min. sample volume	12 µL	1.5 µL with C-vette	1.5 µL with C-vette	
Min. sample concentration	0.1 mg/mL (lysozyme)	1 mg/mL (lysozyme)	0.1 mg/mL (lysozyme) lower than 0.00001 % (0.1 ppm, Latex 100 nm)	
Max. sample concentration	50 % w/v (sample-dependent)	40 % w/v (sample-dependent)	50 % w/v (sample-dependent)	
Electrophoretic Light Scattering (ELS)	✗	✓		
Measurement angle	✗	15°		
Particle size range	✗	1.3 nm - 125 µm (diameter)		
Zeta potential range	✗	> ± 1000 mV		
Min. sample volume	✗	50 µL (no special preparation required; viscosity-dependent)		

	Litesizer DLS 101	Litesizer DLS 301	Litesizer DLS 501	Litesizer DLS 701
Min. sample concentration	✖	0.1 mg/mL (lysozyme)		
Static Light Scattering (SLS)	✖	✓		
Measurement angle	✖	90°		
Particle size range	✖	up to 40 nm (diameter)		
Molecular mass range	✖	300 Da - 20 MDa		
Min. sample volume	✖	15 µL		
Min. sample concentration	✖	0.1 mg/mL (lysozyme)		
Transmittance	✓			
Measuring time	10 s			
Min. sample volume	15 µL	1.5 µL with C-vette		
Refractive Index	✖		✓	
Range	✖		1.28 - 1.50	
Accuracy	✖		Better than ± 0.5 % according to ISO 22412	
Min. sample volume	✖		1 mL	
Particle Concentration (PCON)	✖			✓
Measurement angle	✖			MAPS single-angle DLS
Min. sample volume	✖			12 µL
Concentration range	✖			10^8 - 10^{13} particles/mL (sample-dependent)

[a] *specified wavelength range 655 - 661 nm*

[b] *sample dependent under laboratory conditions*

3 Installation

3.1 Installation requirements

Please take time to read the safety instructions in section 1 before installing the instrument.

Technical data relating to the instrument are described in Appendix A [▶ 31].

3.1.1 Environmental requirements

NOTICE

The product should be placed in its installation position at least 24 hours before it is put into operation.

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

The product should be placed on a stable, flat lab bench in a clean environment that is free from mechanical vibrations and excessive noise. Ensure that nothing is placed on top of the product.

To ensure temperature stability and trouble-free measurement never locate your product:

- next to a heating facility
- near an air conditioning, ventilation system or an open window
- in direct sunlight

NOTICE

If the product's internal optical bench is too cold, its proper function cannot be guaranteed, and an error message will appear.

If the product is moved from a cold environment into a warmer one, it should be allowed to warm up to room temperature for at least an hour before it is put into operation.

Make sure that the power plug and the power switch are always easily accessible so that the instrument can be disconnected from the mains at all times.

A strong built-in cooling fan dissipates heat through the bottom and the back of the instrument. Ensure that the airflow is not blocked.

3.1.2 Computer requirements

The Kalliope dedicated software requires:

- Dual core system (or better)
- Windows 7 – Service pack 1 (or better)
- 5 GB HDD
- Without Dosing System: 2 GB RAM
  (Windows 7 - 32-Bit) / 4 GB RAM
  (Windows 7 - 64-Bit), or better
- With Dosing System: 6 GB RAM
  (Windows 7 - 64-Bit), or better

3.2 Opening the transport safety lock

1. Before switching on the instrument, or inserting the module, or connecting any cables, carefully lift the front of the instrument so that it stands on its rear surface.

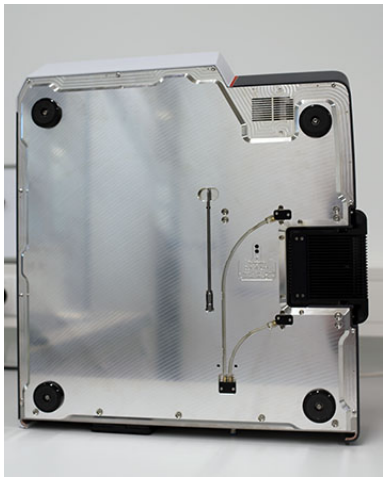


Fig. 6: *Instrument standing on its rear surface*

2. Insert the transport safety lock T6 Torx bit (mat. no. 170913, delivered with the instrument) into one of the two small holes next to the module bay.

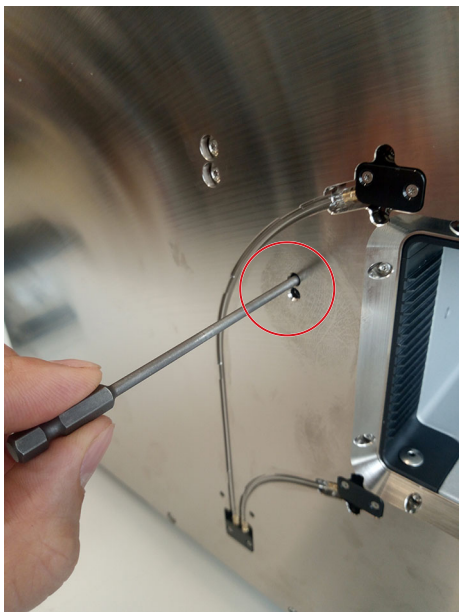


Fig. 7: *Inserting the T6 Torx bit*

3. Gently turn the screw counterclockwise until it stops turning.
4. Repeat for the second hole. The transport safety lock is now open.

3.3 Connecting the instrument

1. Make sure the power switch is turned off.
2. Make sure the transport safety lock is removed (refer to Section 3.2 [▶ 11]).
3. Connect the instrument to the computer via USB cable.
4. Connect the AC/DC adapter to the instrument at the power socket.
5. Make sure that mains voltage and frequency comply with the specified data (110/230 VAC, 50/60 Hz) of the AC/DC adapter.
6. Connect the AC/DC adapter to the mains voltage.
7. Switch on the instrument at the main switch.

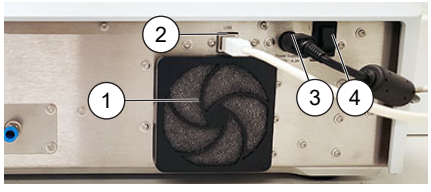


Fig. 8: *Rear panel*

1 Cooling fan
2 USB cable port
3 Power socket
4 Main switch

NOTICE

The instrument has a standby mode and a deep standby mode, which are activated after 15 min and 48 hrs of inactivity, respectively. For details, refer to Section 4.2 [▶ 12].

TIP: *One PC may be connected to one or more instruments. Still, due to technical restrictions, only one instrument can be switched on and operated at a time.*

3.4 Installing Kalliope software

Make sure to configure the network adapter of the PC before installing Kalliope software.

The Kalliope software can be found on the USB hard flash drive delivered within the scope of supply of the instrument.

Connect the USB hard drive to the instrument and follow the steps as described below:

1. Double click on the Kalliope icon in the file list of the flash drive.
2. Follow the installation instructions in the wizard.
3. Start Kalliope by selecting *Program* > *Kalliope* in the windows start menu or use the shortcut on the desktop.

TIP: *When updating to a new version of the software, the instrument must be switched off.*

TIP: *With a software activation, your copy (i.e. your license) of Kalliope is installed and registered on a single personal computer (PC) or laptop using the license code. The activation is bound to the PC or laptop, irrespective if and how many times Kalliope is un-installed or re-installed. Note, that operating system or hardware-level changes to a computer may invalidate an activation and hence lead to a loss of the activation.*

3.4.1 Activating the software license

When Kalliope is started for the first time, a license code is requested, as shown in the following figure. Kalliope's license can be activated either online or manually.

For both, a valid license code is required.

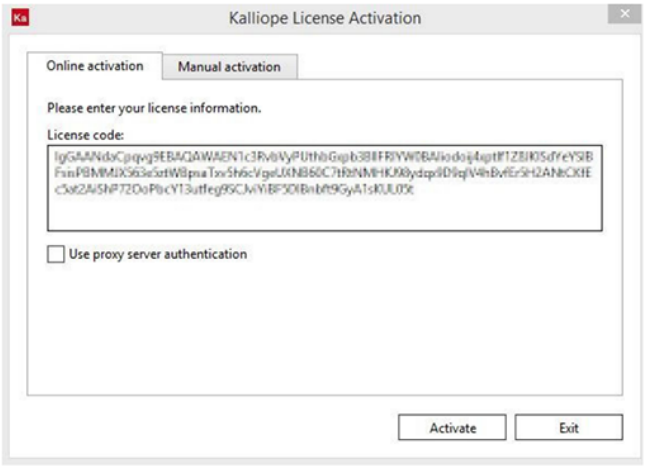


Fig. 9: *Entering the software license code*

3.4.1.1 Online license activation

For online activation, an Internet connection is required.

In the *Kalliope License Activation* dialog box, open the *Online activation* tab and enter the valid license code provided with the delivery.

Click *Activate*, then click *Exit* and restart the software.

3.4.1.2 Removing the license key

In some cases, the existing Kalliope license must be removed and replaced, e.g. when a license extension or module has been acquired after the initial Kalliope installation.

1. Open Kalliope's main menu by clicking on the *Ka* icon at the top left of the screen.
2. Open the *About* tab on the bottom left.
3. Click on the *Delete license* button.
4. Restart Kalliope.
5. Proceed as described in Section 3.4.1 [▶ 12] using your new license key.

4 Operation

4.1 Switching on

Switch on the instrument at least ten minutes before you begin measurements. The power switch is at the back of the instrument (refer to Fig. 8 [▶ 11]).

4.2 Status and standby modes

When the instrument is switched on, the POWER and STATUS indicator lights can each show two different colors, as listed in Table 7.

After 15 min of inactivity, the instrument will go into standby mode, which means the laser will be switched off. After a further 48 h of inactivity, the instrument will go into deep standby mode, in which the temperature control is also switched off.

Fig. 10: *POWER and STATUS indicator lights*

Table 3: Power and status indicator lights

Power indicator	Status indicator	Description
Blue	Green blinking	Currently booting
Green	Green	Successful boot, instrument in operation
Blue	Red blinking	Failure during boot
Blue	Off	Standby (laser off)
Blue “breathing”	Off	Deep standby (temp. control off)

The device can be woken up from standby or deep standby mode by pressing the ⏻ button, opening the module cover or removing/inserting a module.

4.3 Checking the system

Clicking on the Kalliope icon in the top left corner opens the menu.

Select *My settings* to open the menu, which allows the user to select the preferred units, the data-handling mode, the particle size dimensions that are reported (radius or diameter) and the preferred language.

Click again on the Kalliope icon to close the window and return to the measurement window.

Note that for some of the *My Settings* features (e.g., language settings), Kalliope needs to be restarted in order to apply the new selection.

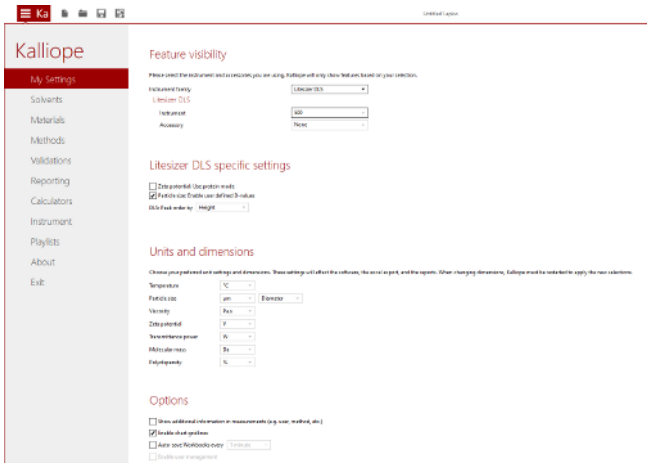


Fig. 11: *Kalliope menu: Feature visibility*

NOTE: *Kalliope will display either decimal commas or decimal points, according to the settings of your operating system. This cannot be changed in Kalliope.*

5 Performing a measurement

The present section covers the topics of sample preparation/measurement in a shortened format. For a full description of sample preparation methods, and a full description of the Litesizer DLS’s measurement functions, refer to the reference guide of the instrument(delivered as electronic copy with the instrument).

5.1 Four golden rules

Keep it clean

Work in a clean environment (sterile if possible) and wear powder-free gloves and protective clothing throughout the procedure. Wash cuvettes prior to the measurement and avoid unnecessary contact with the surfaces that must transmit the laser beam. Remove all fingerprints or traces on the cuvette windows prior to measurement.

Disperse the particles

Choose a solvent that yields a sufficient colloidal stability over a time long enough to allow measurement.

Avoid air bubbles in the cuvette

It is good practice to inject the sample down the inner wall of the cuvette.

Select the right concentration

For DLS, good practice is to prepare several samples at different concentrations and analyze them. The optimum concentration is in the range of concentrations exhibiting a plateau in the measured particle size.

5.2 Choosing the right cuvette

Fig. 12: *Litesizer DLS Cuvettes*

1 *Disposable macro cuvette*
2 *Glass cuvette*
3 *Quartz cuvette*
4 *Quartz low volume cuvette*
5 *UVette®*
6 *Omega cuvette*
7 *Univette*
8 *C-vette*

Choosing the right cuvette not only depends on the measurement you intend to perform but also on the nature of the solvent and on the amount of sample available.

Also note that the Anton Paar cuvettes are not resistant to fluoric acid.

Table 4: Overview cuvettes - sample volumes and measurement types

Cuvettes	Sample volume	Particle size	Zeta potential	Molecular mass	Transmittance	Refractive index	Multi-angle particle sizing (MAPS) Particle concentration (MAPS based)	Particle concentration (single angle)
Disposable cuvette	0.85 mL - 3 mL	✓ [a]	✗	✗	✓ [a]	✗	✓	✓
UVette® low-volume disposable cuvette	50 µL - 2 mL	✓ [a, b]	✗	✗	✓ [a]	✗	✗	✗
Glass cuvette	0.85 mL - 3 mL	✓	✗	✓	✓	✗	✓	✓
Quartz cuvette	0.85 mL - 3 mL	✓	✗	✓	✓	✓	✓	✓
Low-volume quartz cuvette[c]	15 µL - 45 µL	✓	✗	✓	✓	✗	✓	✓

Cuvettes	Sample volume	Particle size	Zeta potential	Molecular mass	Transmittance	Refractive index	Multi-angle particle sizing (MAPS) Particle concentration (MAPS based)	Particle concentration (single angle)
Omega cuvette for zeta & size (mat. no. 225288)	650 µL - 900 µL	✓ a, d	✓ a	✖	✓ a	✖	✖	✖
Univette[e]	50 µL - 900 µL	✓ d	✓	✖	✓	✖	✖	✓ f
C-vette	1.5 µL – 30 µL	✓ b	✖	✖	✓ b	✖	✖	✖

[a] *for aqueous solvents only*

[b] *for side scattering only*

[c] *Particle size measurements with 12 µL are possible in combination with the support plate (mat. no. 179434)*

[d] *15° and 175° measurement angles only*

[e] *As a standard quartz cuvette is included in the Univette delivery, ordering the Univette will also give you access to the measuring capabilities of the quartz cuvette*

[f] *only back and forward angle*

5.3 Filling and inserting the cuvette

5.3.1 Standard cuvettes: quartz, glass and disposable

5.3.1.1 Filling the cuvette

The standard cuvettes – quartz, glass and disposable – have inner dimensions of 10 mm x 10 mm x 45 mm. Ideally, the sample volume should be approximately 1 mL, but it must not be less than 0.85 mL or greater than 3 mL, as explained below.

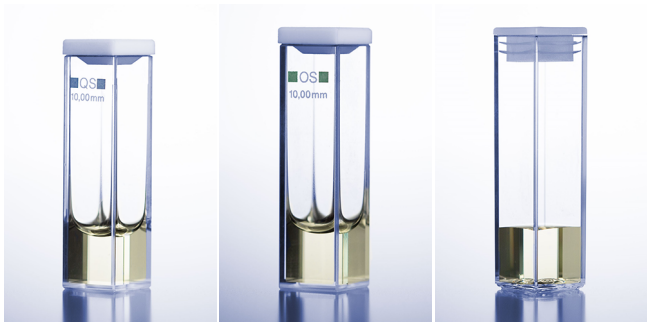


Fig. 13: *Standard cuvettes (left to right: quartz, glass and disposable) showing the ideal sample volume*

The measurement is made 6.5 mm from the bottom of the cuvette, and the meniscus must be at least 2 mm above the measurement height (8.5 mm). For reliable measurements, the depth must be between 8.5 and 30 mm, and thus, the volume must be between 0.85 and 3 mL. If the sample volume is <0.85 mL, then the laser may be too close to the meniscus; if the sample volume is >3 mL, then the thermal equilibrium may not be stable.

5.3.1.2 Inserting the cuvette

Open the module by pushing the OPEN button.

Insert the cuvette firmly as far as it will go.

Close the module.

Note that the figure below depicts a BM 11 batch module, but that the procedure is strictly identical when using the FM 11 module in "batch" mode.

Fig. 14: *Inserting the cuvette*

NOTICE

Inserting the standard cuvettes may cause minor scratches near the edges of the cuvette walls.

These scratches do not affect the measurements.

5.3.2 Low-volume quartz cuvette and support plate

5.3.2.1 Filling the low-volume quartz cuvette

The low-volume quartz cuvette is designed to be used with small sample volumes. The cuvette can hold up to 45 µL.

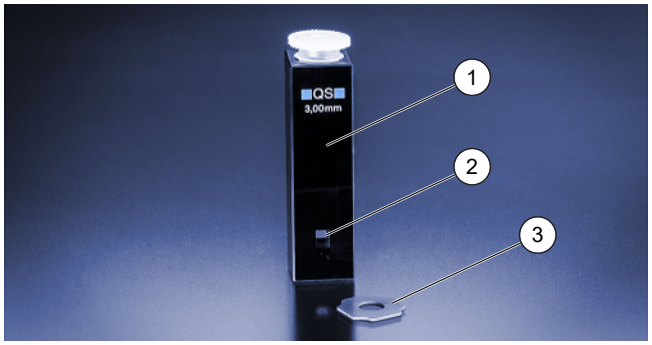


Fig. 15: *Low volume quartz cuvette with support plate*

1 *Low-volume quartz cuvette*
2 *Min. sample volume of 12 µL*
3 *Support plate*

The minimum measurable sample volume of the cuvette used alone is 15 µL. To reduce the sample volume further, a support plate can be introduced in the cuvette holder before the cuvette. In that case the minimum measurable sample volume is 12 µL for particle size measurements.

5.3.2.2 Inserting the low-volume quartz cuvette

If you are using the low-volume quartz cuvette together with the support plate, first introduce the support plate into the cuvette holder. Make sure it lies flat.

Then insert the cuvette firmly as far as it will go.

Make sure to direct the cell's window opening directly opposite the detectors (i.e., facing the front of the instrument).

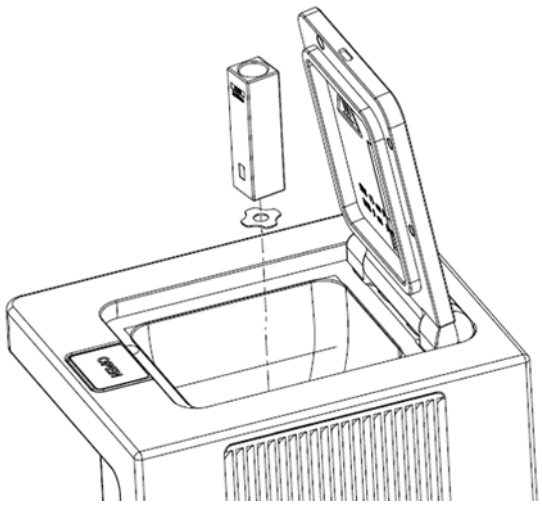


Fig. 16: *Inserting the support plate and the low-volume quartz cuvette into the cuvette holder*

Use tweezers to remove the support plate after operation.

Note that the figure below depicts a BM 11 batch module, but that the procedure is strictly identical when using the FM 11 module in "batch" mode.

5.3.3 UVette® (low-volume disposable cuvette)

The UVette® (low-volume disposable cuvette) is designed to be used when little sample is available.

The UVette® can only be used with aqueous solutions. The minimum volume is 50 µL, the maximum volume is 2 mL.

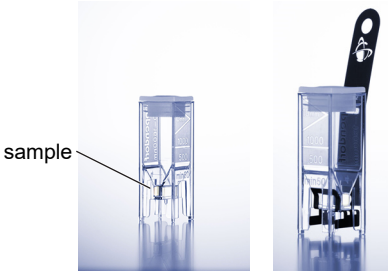


Fig. 17: *The low-volume disposable cuvette, the UVette®, showing the minimum sample volume*

5.3.3.1 Inserting the UVette®

The UVette® must first be placed into its accompanying lifter before it is inserted into the instrument:

To insert the UVette® into the lifter, hold the back of the lifter with the thumb and forefinger of your left hand (if you are right-handed), supporting it from underneath with your smallest finger. Use your right hand to insert the UVette®. Ensure that the marked windows are facing and opposite the back of the lifter, and the clear windows on the sides. Use your forefinger to press the UVette® into place.

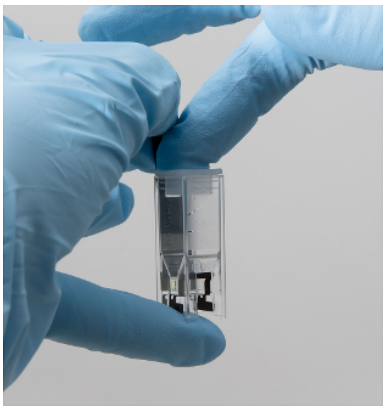


Fig. 18: *Inserting the UVette® into the lifter*

The narrow part of the UVette® containing the sample should be sitting firmly between the two small brackets of the lifter.

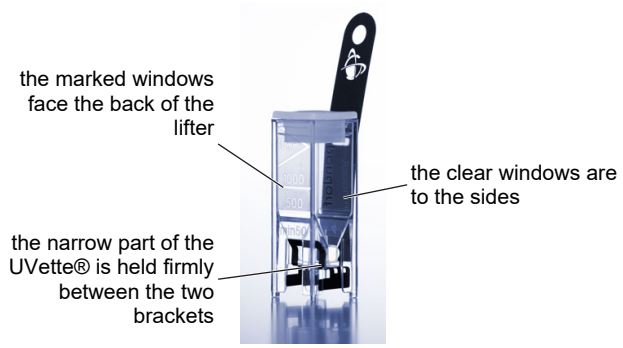


Fig. 19: *The UVette® in the lifter*

To insert the Uvette® into the cuvette holder, hold it by the back of the lifter and insert it so that the window with volumes graduations faces the open door and the OPEN button. Use your forefinger to push the UVette® in as far as it will go. The top of the UVette® should be deeper than the top of the cuvette holder.

Note that the figure below depicts a BM 11 batch module, but that the procedure is strictly identical when using the FM 11 module in "batch" mode.

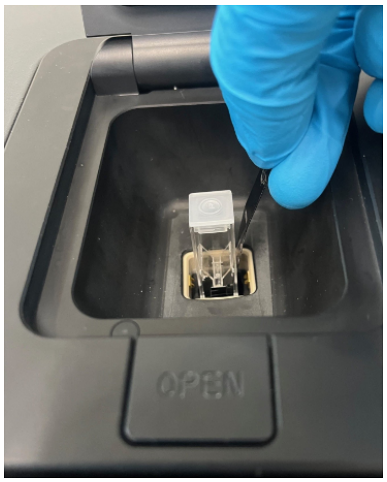


Fig. 20: *Inserting the UVette®*

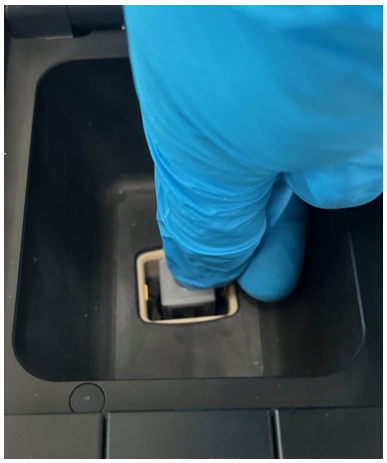


Fig. 21: *Pressing the UVette® into place*

5.3.4 Omega cuvettes

The Omega cuvette can be used to perform particle size and zeta potential measurements.

The Omega cuvettes are made of polycarbonate and thus are only suitable for aqueous samples. Refer to Section 5.2 [▸ 14] for a full description of the cuvette capabilities.

5.3.4.1 Omega cuvette conditioning

Conditioning the cuvette before every zeta potential measurement with a new sample is strongly recommended.

This consists in filling the cuvette a first time with sample (see procedure below), letting it sit for 2 minutes at room temperature, then discarding the sample and refilling the cuvette with fresh sample.

The measurement should then be performed on the newly filled cuvette.

5.3.4.2 Filling the Omega cuvettes

Both electrodes need to be in contact with the sample to ensure proper measurement. This means that a minimum sample volume of 650 µL is required to perform a measurement with the Omega cuvette (mat. no. 225288). To ensure that both electrodes are completely covered by the sample, it is however recommended to use a sample volume of 700 µL.

For the Omega cuvette Z (mat. no. 189417, discontinued), a minimum sample volume of 370 µL is required, while the minimum sample volume for the discontinued Omega cuvette (mat. no. 155765) is 350 µL.

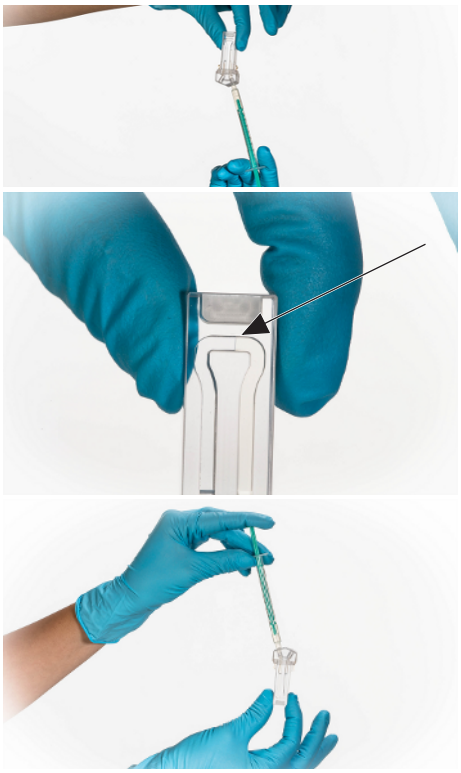


Fig. 22: *Filling the Omega cuvette: The cuvette should be held upside down until it is half full, so that the filling direction is always upwards. Note that the figure refers to a discontinued version of the Omega cuvette, but that the filling procedure is identical for all types of Omega cuvettes.*

To fill an Omega cuvette, place the tip of the syringe snugly inside one of the sample ports.

To stop bubbles forming, the filling direction should always be upwards. Thus, for the first half, the cuvette should be upside down. Gently inject the sample into the cuvette.

Once the liquid reaches halfway, carefully turn the cuvette upright and continue to inject the sample until the cuvette is full.

Ensure that both electrodes are covered by the sample. Check for tiny air bubbles and tap the cuvette to dislodge any that have formed. Insert the Luer plugs.

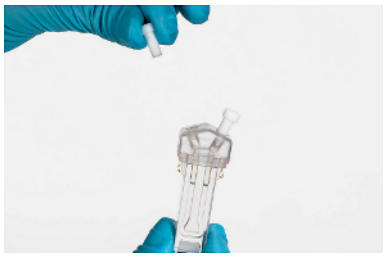


Fig. 23: *Inserting the Luer plugs. Note that the figure refers to a discontinued version of the Omega cuvette, but that the procedure is identical for all types of Omega cuvettes.*

5.3.4.3 Identifying and dislodging air bubbles

After the filling procedure, the cuvette's sample channel should be free of air bubbles. However, air bubbles can still form after a successful filling, by degassing of the sample. Hence is it recommended to let the cuvette rest for a few minutes at room temperature before performing the measurement. This results in significantly larger air bubbles, which are then easier to identify and to dislodge.

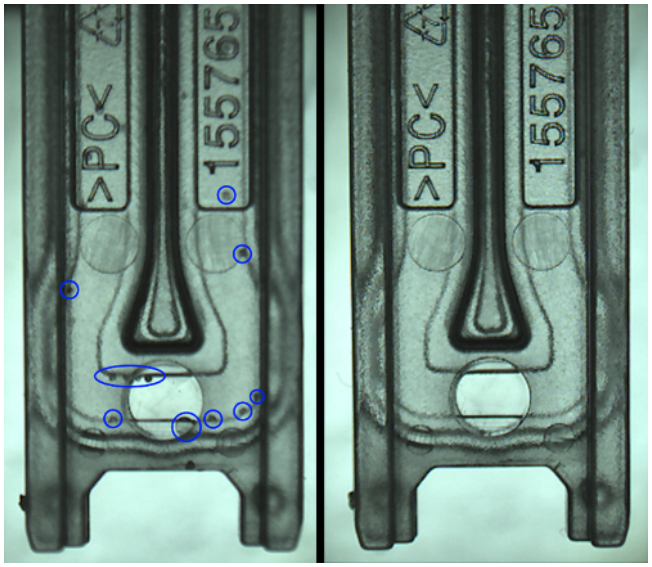


Fig. 24: *Left: sample channel after air bubble formation; Right: bubbles removed. Note that the figure refers to a discontinued version of the Omega cuvette, but that the filling procedure is identical for all types of Omega cuvettes.*

Air bubbles can usually be dislodged by gently tapping the cuvette, in an upward position, onto the bench surface. However, bubbles that have formed in the horizontal portion of the sample channel might remain trapped. In that case, tapping the cuvette against the bench at an oblique angle might help.

Bubbles that cannot be dislodged by tapping can usually be removed by gently moving the sample back and forth in the cuvette using a 1 mL syringe. Should bubbles still form after such a procedure, consider performing an additional round of cuvette conditioning (refer to Section 5.3.4.1 [▸ 17]) or degassing your sample before filling the cuvette.

5.3.4.4 Inserting the Omega cuvette

Ensure that the outer surface of the cuvette is clean and dry before inserting it into the instrument. Open the module by pushing the OPEN button on its top.

Insert the cuvette firmly until it stops, with the electrodes and sample ports pointing to the sides.

Close the module.

Note that the figure below depicts a BM 11 batch module, but that the procedure is strictly identical when using an FM 11 module in "batch" mode, and for all Omega cuvette types.

Fig. 25: *Inserting the Omega cuvette in the module*

For advice on how to clean Omega cuvettes, refer to Section 8.3 [▸ 27].

5.3.5 Univette

The Univette is an accessory for Litesizer DLS 701 and Litesizer DLS 501 designed to measure the zeta potential of particles in both aqueous and organic solvents (high and low dielectric constants).

In addition, it can also be used to perform particle size measurements (using the 15° and 175° measurement angles only).

Measurements with the Univette can be performed in quartz cuvettes using the corresponding spacer. A standard quartz cuvette is delivered with the Univette for this purpose, but standard glass cuvettes may also be used. However, it is not recommended to use the Univette in combination with disposable plastic cuvettes due to the less accurate positioning of the Univette body in these cuvettes.

When the sample is available in limiting volumes, the Univette can also be used in combination with the low-volume accessory. In that case no additional quartz or glass cuvette is required.

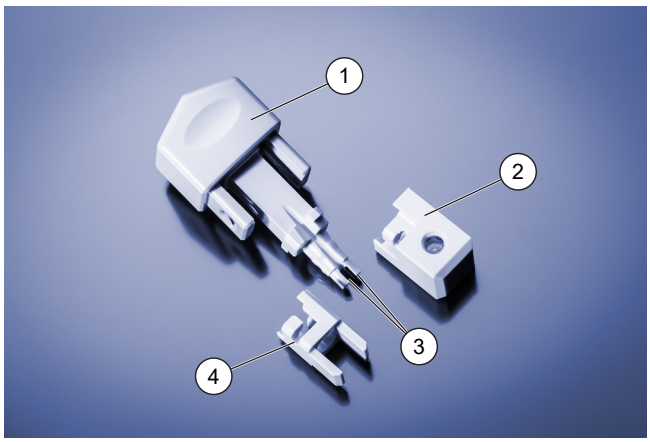


Fig. 26: *Univette and accessories. The Univette is also delivered with a standard quartz cuvette.*

1 *Univette body*
2 *Spacer*
3 *Palladium electrodes*
4 *Low-volume accessory*

5.3.5.1 Univette conditioning

Conditioning the Univette before every zeta potential measurement with a new sample is strongly recommended.

This consists in filling the Univette a first time with sample (see procedures below), letting it sit for 5 minutes at room temperature, then discarding the sample and refilling the Univette with fresh sample.

The measurement should then be performed on the newly filled Univette.

5.3.5.2 Using the Univette with a quartz cuvette

1. Attach the spacer to the Univette.

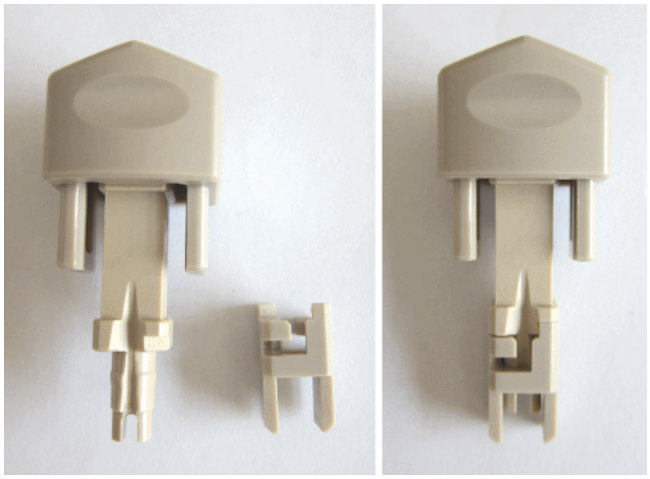


Fig. 27: *Attaching the spacer to the Univette body*

2. Fill a minimum of 650 µL and a maximum of 900 µL of sample in the quartz cuvette.
3. Dip the Univette (with spacer attached) into the sample and ensure that no bubbles remain between the electrodes of the Univette. If that is the case, tap gently on the cuvette to dislodge the bubble.

Fig. 28: *Inserting the Univette (with spacer) into the quartz cuvette*

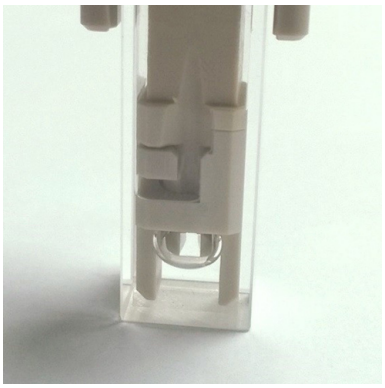


Fig. 29: *Air bubble trapped between the palladium electrodes. This makes a reliable measurement impossible.*

4. Grasp the Univette **together with the quartz cuvette** and place it into the instrument. The Univette is positioned correctly when its upper electrodes snap to the module's electrodes with a click.

Fig. 30: *Inserting the Univette with the quartz cuvette*

5.3.5.3 Using the Univette with the low-volume accessory

1. Fill a minimum of 50 µL (sample viscositydependent) and a maximum of 70 µL of sample in Univette low-volume accessory.

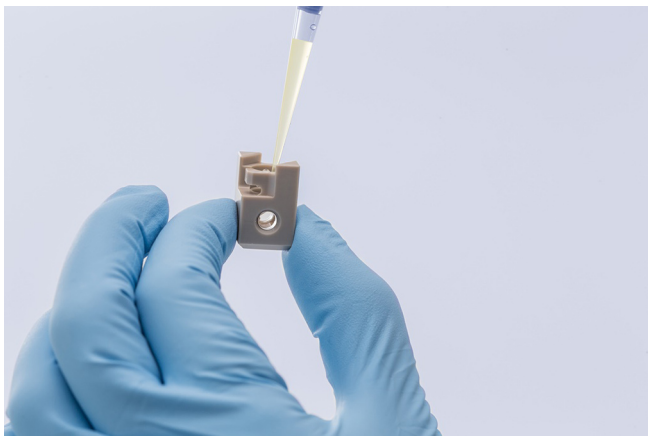


Fig. 31: *Filling the low-volume accessory with a micropipette*

2. Carefully attach the filled low-volume accessory to the Univette and ensure that no bubbles are trapped between the palladium electrodes.

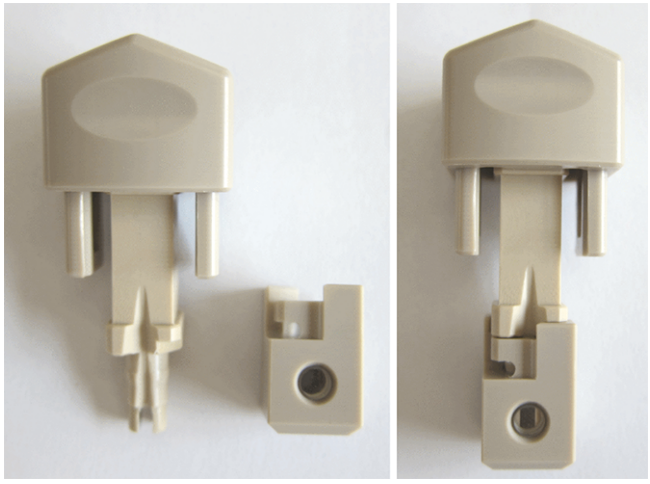


Fig. 32: *Attaching the low-volume accessory to the Univette body*

3. Place the Univette with the attached low-volume accessory into the instrument. The Univette is positioned correctly when its upper electrodes snap to the module's electrodes with a click.

Fig. 33: *Inserting the Univette and low-volume accessory*

After measurement, clean the Univette as described in Section 8.3 [▶ 27].

NOTICE

Univette compatibility with strong acids

The Univette should not be used with the following acids:

- Fluoric acid (risk of damage to the quartz cuvette)
- Sulfuric acid (risk of damage to the Univette body)
- Hydrochloric acid (risk of damage to the Univette electrodes)

5.4 Particle size

In Kalliope's start-up screen, click on the + icon to create a new measurement. Select *Particle Size* to perform a single DLS measurement or *Particle size series* to perform a series of DLS measurements.

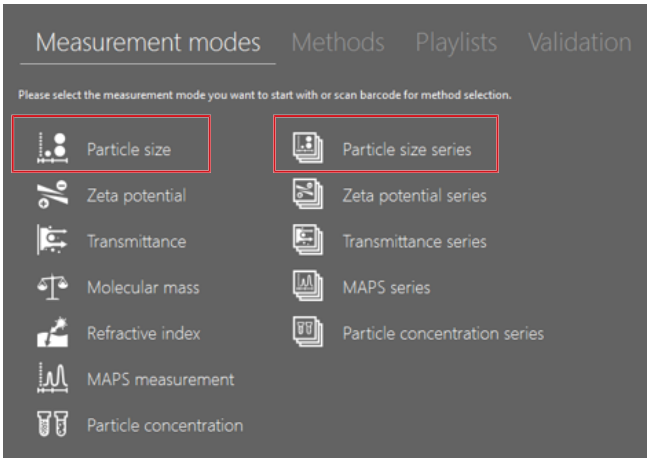


Fig. 34: *Creating a new particle size or particle size series measurement*

5.4.1 Input parameters for particle size

Enter the input parameters on the left-hand side of the display.

Find a detailed description of the input parameters in the reference guide.

5.4.2 Starting a measurement

Once all parameters have been defined the *Start* icon in the bottom right-hand corner of the screen will be activated (turns red), and can be clicked to start the measurement.

Before running the measurement, the instrument carries out the same preparation.

Following temperature adjustment, equilibration and optical adjustment, the measurement will be displayed on the screen while it is running, as shown below, while the run number is displayed at the bottom of the screen. The instrument will keep performing runs until a threshold number of counts has been accumulated (10×10^6 for automatic, or 3×10^6 for Quick), or until the specified number of runs has been reached. Once the measurements are finished, all the measured and

calculated values appear in the gray boxes to the right of the graphs, with the Mean hydrodynamic radius box appearing in green.

5.4.3 Measurement output screen

The measurement output screen retains a display of the input parameters on the left, a series of action icons at the top right, and the results on the main part of the screen at the right (plots, automatic values and calculated values).

5.4.4 Particle size results

A detailed description of all results and how to interpret them is included in the reference guide.

5.5 Zeta potential

Litesizer DLS 301/501/701 only

5.5.1 Input parameters for zeta potential

On the start-up screen, click on the + icon to select a new measurement. Select *Zeta Potential*.

Input parameters can be entered on the left-hand side of the display. The parameters required to set up a zeta potential measurement are listed in the reference guide.

One crucial parameter for zeta potential measurement is the Henry factor (in the *General* menu). Refer to the reference guide for a detailed explanation of how to choose an appropriate approximation or calculate an experiment-specific Henry factor.

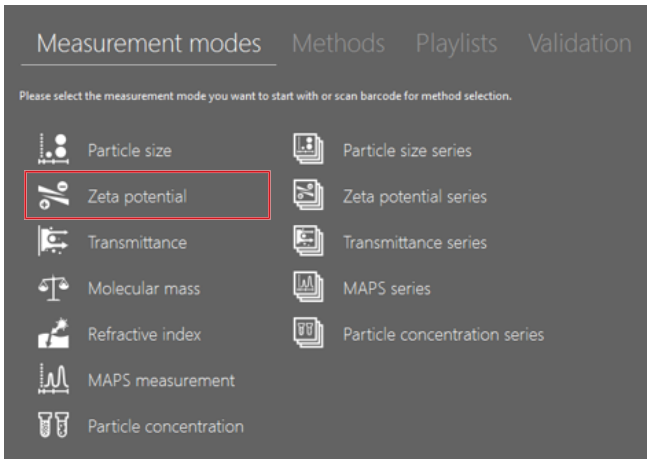


Fig. 36: *Creating a new zeta potential measurement*

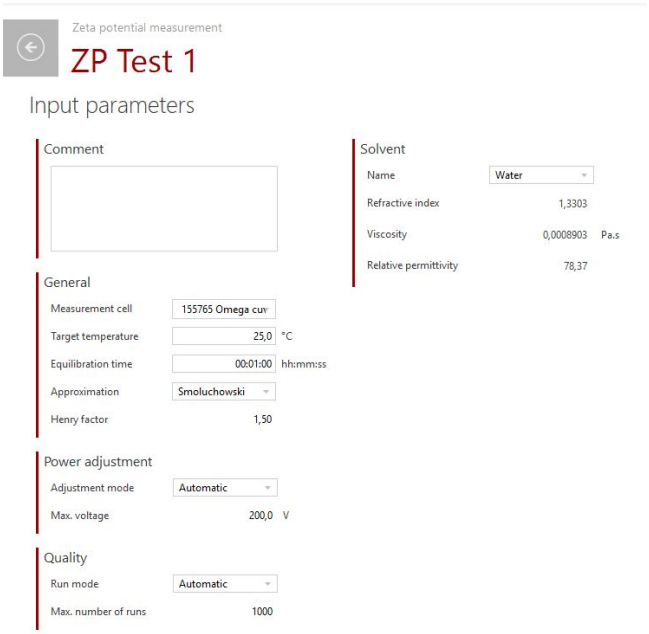


Fig. 36: *Zeta potential input parameters*

5.5.2 Starting the measurement

Once the input parameters are complete, the *Start* icon in the bottom right-hand corner of the screen will be activated, and can be clicked to start the measurement.

Following temperature adjustment, equilibration and optical adjustment, the measurement will be displayed on the screen while it is running, as shown below, while the run number is displayed at the bottom of the screen. Litesizer DLS 501/701 will keep performing runs until the standard deviation reaches the threshold value, or until the specified maximum number of runs has been reached. Once the measurements are finished, all the measured and calculated values appear in the gray boxes to the right of the graphs, with the zeta potential box appearing in green.

5.5.3 Measurement output screen

The measurement output screen retains a display of the input parameters on the left, a series of action icons at the top right, and the results on the main part of the screen at the right (plots, automatic values and calculated values).

5.5.4 Zeta potential results - intensity trace and related values

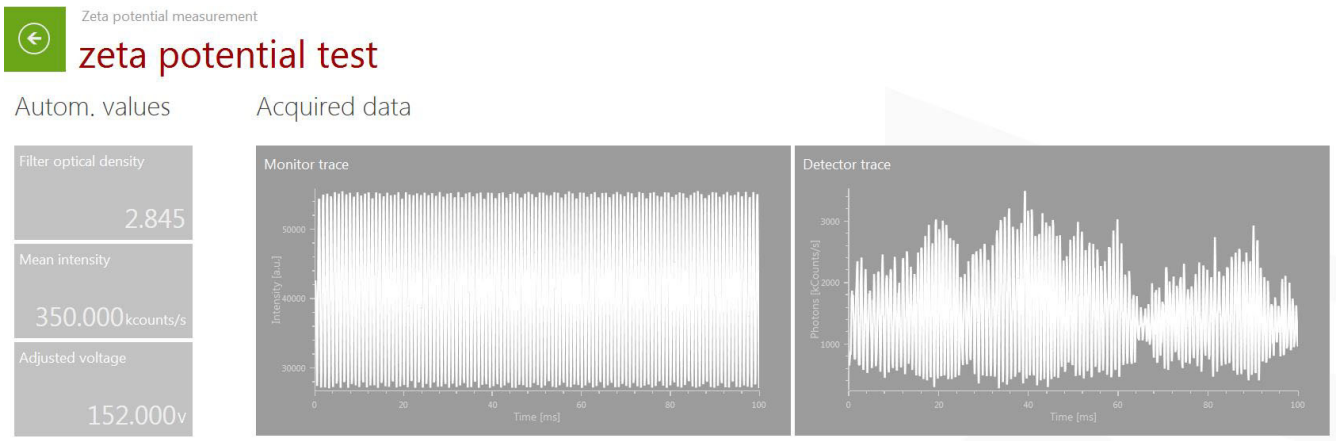


Fig. 37: *Zeta potential output I*

A detailed description of all results and how to interpret them is included in the reference guide.

5.5.5 Zeta potential results - phase plot and zeta potential distribution

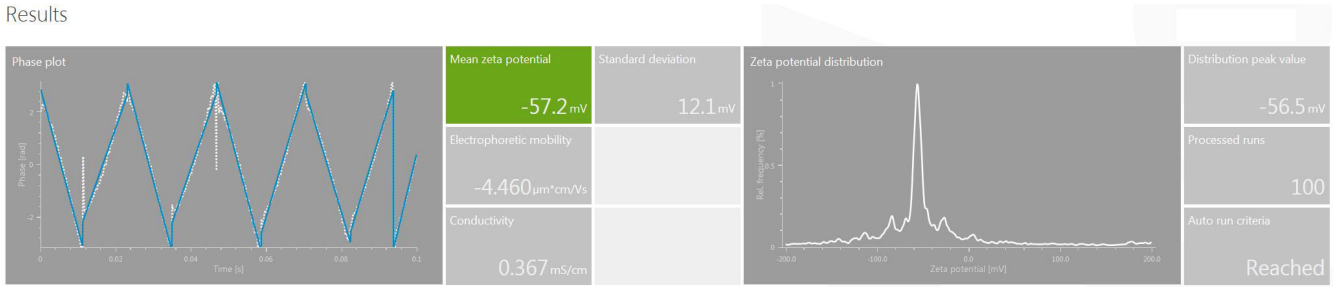


Fig. 38: *Zeta potential output II*

5.6 Raw data export for LIMS

Raw data can be exported automatically as .csv, Excel or JSON files to a chosen destination, when the option *My Settings > Export > Raw data export* is checked.

Use .json files for further data processing and analysis in your company's laboratory information management system (LIMS).

6 Using the instrument at high and low temperatures

The instrument is capable of making measurements at any temperature from 0 to 120 °C. Nonetheless, to ensure reliable measurements at temperatures other than room temperature, it is important to incorporate extra equilibration time, and to use the thermal insulation cover, which will help to maintain a constant temperature throughout the sample and cuvette, thereby minimizing thermal currents in the sample.

Fig. 39: *Thermal insulation cover*

Once the cuvette is in place in the module, insert the thermal insulation cover into the module above the cuvette until it clicks into place.

The thermal insulation cover cannot be used with the zeta potential cuvette.

6.1 Equilibration time

For a 1 mL sample, add one minute extra equilibration time for every °C different from ambient temperature. E.g., if a measurement is to be carried out at 35 °C when the room temperature is 25 °C, then an extra 10 min equilibration time should be incorporated into the experiment.

6.2 Special considerations for low-temperature measurements

When making measurements below room temperature, there is a risk of atmospheric water vapor condensing on the cuvette windows, which could significantly affect measurement results. Thus, it is advisable to connect a dry air source (ISO 8573.1, class 1.3.1, 0.4 to 0.8 bar overpressure, or 1.4 to 1.8 bar total input) to the port, which will keep the air in the module dry, and thereby prevent condensation.

Fig. 40: *Rear panel with purge port*

CAUTION

Use dry air (ISO 8573.1, class 1.3.1) or nitrogen at 0.4 to 0.8 bar overpressure (1.4 to 1.8 bar total input). Failure to adhere to these specifications may damage the instrument.

CAUTION

The purge air must not be too cold, or condensation can occur inside the instrument, which may damage the instrument.

The purge air temperature can easily be checked by visually inspecting the compressed air supply hose; if there is no condensation visible on the outside of the hose for at least the last two meters of hosing before the purge port, then the air temperature is OK.

6.3 Special considerations for high-temperature measurements

For particle size measurements performed between +70 °C and +120 °C, a quartz cuvette, glass cuvette or Univette must be used.

Zeta potential measurements performed between +70 °C and +120 °C must be made in the Univette.

If flammable solvents are to be used at high temperature, it is recommended that the purge port be used with nitrogen as purge gas to prevent any buildup of flammable vapors in the module. Read the relevant safety instructions under Section 1.1 [▶ 5] before using flammable solvents.

CAUTION

Hot surface

When performing high-temperature measurements (above 45 °C), allow the cuvette area to cool before removing the thermal insulation cover and cuvette.

7 Using the instrument in on-line mode

This section describes using Litesizer DLS with Omega cuvettes in continuous (on-line) measurement mode.

Litesizer DLS supports multiple sample feeding options. Samples may be introduced by manually exchanging the cuvette or automatically using the Litesizer Cuvette Sampler.

Flow modules are **additionally** intended for flushing the sample while the omega cuvette remains inside the module. This can be done using the dosing system or a user-configured setup as described in this section.

The ports on the flow module can be used to automatically transfer sample from a feed into the measurement zone of the instrument to monitor processes by repeated measurements.

WARNING

Risk of death or serious injury

The on-line use of the instrument requires special precautions, which must be implemented by the user. Make sure all safety requirements and instrument specifications are fulfilled.

WARNING

Risk of explosion, severe burns and fire

Never use the instrument in on-line mode with flammable samples.

WARNING

Risk of severe injury and damage to property

The sample feed temperature must not exceed 70 °C (158 F).

Prerequisite for the use of Litesizer DLS in on-line mode:

- FM 11 module or FM 11 on-line
- Kalliope (dedicated license might be required)
- USB relay (optional)
- Liquid pump or -valve (optional)

7.1 Using the module's rear port with hose ID = 1/32" OD = 3/32" C-FLEX

The two available FM flow modules (FM 11 and FM 11 on-line) are equipped with the same gaskets and drain solutions and with a pinch valve that ensures measurement stability by squeezing the hose that is fed through the back-side lower port of the flow module. Proper function of the pinch valve is crucial for the safe operation of the flow modules. Therefore, the user must check the correct pinch valve function once a day before a measurement is started.

Installation:

1. Connect the flow module to the instrument.
2. Switch on the instrument.

3. When the instrument is ready for measurement (refer to Section 4 [▶ 12]), open the module lid. This forces the pinch valve to open for 2 minutes. If the pinch valve closes, it can be reopened again by closing and opening the module lid.
4. Feed the inlet hose, a C-Flex® hose ID = 1/32" OD = 3/32", through the lower port of the flow module.
   The hose should be able to move freely through the port when the pinch valve is open.
5. Close the module lid.
   The pinch valve squeezes the hose and prevents it from moving. Check that this is the case by gently pulling the hose from outside the instrument.
6. Open the module lid again and feed the outlet hose, a C-Flex® hose ID = 1/32" OD = 3/32", through the upper port (no pinch valve) of the flow module.
   Make sure that the outlet hose always remains open and is never blocked to avoid pressure buildup inside the instrument.
7. Attach 2 Luer-hose barb adapters 1/16'' to an Anton Paar Omega cuvette.
8. Attach the two C-Flex® hoses to the hose barb adapters of the Omega cuvette.
9. Connect the open end of the inlet hose to the sample supply line.
   Refer to Section 7.3 [▶ 25] to introduce an external valve between the sample supply line and the instrument. Nevertheless, if the supply pressure is very low, the pinch valve's force alone might be sufficient to block the flow during the measurement.

TIP: *If the sample flow is not interrupted properly during a measurement, results are not accurate.*

WARNING

Risk of electric shock

If the in-build pinch valve does not block the liquid flow properly, there is a risk of electric shock for the user when touching the hose.
Always ensure that the pinch valve operates properly and blocks all liquid flow during a measurement.

10. Connect the open end of the outlet hose to a waste container.
11. Fill the system with liquid from the feed while the pinch valve is open. If the lower port is blocked by the pinch valve, make sure that the instrument is ready for operation, then close and open the module lid again.
12. Once the system is fully filled, insert the Omega Cuvette and close the module lid.

7.2 Using FM 11 on-line module with hose ID = 4 mm OD = 6 mm

WARNING

Risk of electric shock

Touching the hoses risks electric shock of the user. To prevent electric shock, during measurement, the inlet and outlet hoses must have a minimum non touchable length. The inner diameter of the hose must not exceed 4 mm. The required non-touchable length depends on the maximum electrical conductivity of the liquid used: l [cm] = σ [mS/cm] x 50 (Example: min. 100 cm for 2 mS/cm).
The inlet must not exceed max. pressure of 0.5 bar and max. flow rate of 3.60 L/min.

WARNING

Risk of electric shock

Touching the hoses risks electric shock of the user. The system setup must ensure that no hose outside the module can be touched over the specified length while a measurement is in progress. This shall be ensured by installing the instrument in a **suitable safety enclosure** that interrupts the power supply via a safety switch when the housing door is opened. The safety enclosure must be electrically grounded.

NOTICE

Risk of damage to property

The safety enclosure requires a **drain** to prevent flooding in the event of leakage under maximum feed conditions. Make sure that it provides enough space around the instrument to allow proper installation.

Installation:

1. Connect the flow module to the instrument.
2. Switch on the instrument.
3. When the instrument is ready for measurement (refer to Section 4 [▶ 12]), open the module lid.

WARNING

Risk of electric shock

Touching the hoses while a measurement is running risks of electric shock of the user.
When cutting the hoses, consider the minimum non-touchable length of hose from the Omega cuvette.

4. Feed the inlet- and outlet hose, a silicone hose ID = 4 mm OD = 6 mm, through the two ports in the lid of the FM 11 on-line flow module.
5. Attach the two hoses to the Luer-hose barb adapters and secure them with spring wire clamps.

6. Attach 2 Luer-hose barb adapters to an Anton Paar Omega cuvette.
   Turn the left Luer-hose barb adapter ½ turn counterclockwise and the right Luer-hose barb adapter ½ turn clockwise to introduce a slight twist, before plugging them into the Omega Cuvette.
   This helps hoses fold smoothly inside the FM11 on-line module.
   Ensure that the hoses are never kinked or squeezed.

Fig. 41: *Correct installation of the hoses for FM 11 on-line*

7. Connect the open end of the inlet hose via an external valve or pump to the sample supply line. Refer to Section 7.3 [▶ 25].
8. Connect the open end of the outlet hose to a waste container.
9. Fill the system with liquid from the feed
10. Once the system is fully filled, insert the Omega Cuvette and close the module lid.

7.3 Connecting an external valve or pump to the USB relay

WARNING

Risk of electric shock

Electrical wiring must be carried out by a qualified professional. All local safety requirements must be complied with.

NOTICE

Risk of damage to property

Mind the electrical specifications of the USB relay when selecting your external valve or pump and power supply.

Installation:

1. Install the USB relay drivers using the provided installer file
   (Administrator rights are required).
2. Connect the external valve or pump electrically so it can be switched by port 5 of the USB relay.
3. Connect the USB relay to a free USB port of your computer.

TIP: *There is always a 500 ms delay between the module's pinch valve and the relay opening or closing.*

7.4 Setting up Kalliope in on-line (endless measurement) mode

TIP: *A dedicated Kalliope license might be required.*

Set-up:

1. Open *Kalliope*.
2. Set up a *Zeta potential method*.
3. Enable the automated data export functions in the *General settings* and the *Method setup* to make the measurement data available to other systems.
4. Test the method.
5. Close *Kalliope* afterwards.
6. Check if there is a *Kalliope* shortcut already created on the desktop. If not refer to Section 3.4 [▶ 12].
7. Go to your PC's desktop.
   Copy and paste the *Kalliope* shortcut to create two versions, one for the *standard* startup and one for the *endless mode* startup. Rename the shortcuts accordingly.
8. Right-click on the *endless mode* shortcut.
9. Click on *Properties*.
10. In the *Target* field of the pop-up window, add */onlinemode* after *…AntonPaar.Calliope.exe*: (add the desired configuration): …**`AntonPaar.Calliope.exe" /onlinemode:"[configuration]"`**
    Parameters may be entered in any order. Separate each parameter with a semicolon (;). Separate parameter name and parameter value by a colon (:).
    Minimal exemplary configuration: **`"C:\Program Files\Anton Paar\Kalliope\AntonPaar.Calliope.exe" /onlinemode:"MethodId:#?61755AF1-0F94?#;MeasurementsToKeepInWorkbook:3;ValveOpenTime:2"`**

Table 5: `Parameters`

Option	Format	Mandatory	Description
MethodId	As copied to the clipboard by Kalliope.	Yes	The ID of the method to be used[a]
MeasurementsToKeepInWorkbook	Integer > 0 (seconds)	Yes	How many measurements to keep in the workbook. When new measurements are added the oldest ones are deleted.
ValveOpenTime	Integer > 0 (seconds)	Yes	How long to open the pinch valve (and activate USB-relais port 5) between measurements.
PauseTime	Integer > 0 (seconds)	No	How long to pause after the measurement has finished.
UseRelay	True/False	No (default: False)	Whether to use a USB relay to switch a pump or valve in addition to the module's pinch valve. Defaults to False.

[a] *To obtain the method ID, navigate to the Methods menu in Kalliope, select the method and click on Barcode ID to clipboard. The ID is now copied to the clipboard.*

11. Click *Save* to close the pop-up window.
12. Start *Kalliope* with a double-click on the *endless mode* shortcut. The first measurement cycle starts automatically.
13. Measurement data is shown in *Kalliope* and exported according to the settings.

7.5 Using FM 11 on-line as a standard module

FM 11 on-line module may also be used as a regular BM 11 or FM 11.

Use the two provided plugs as shown and refer to Section 5 [▸ 13].

Fig. 42: *FM 11 on-line with plugs for in standard use*

8 Upkeep and cleaning

8.1 General considerations

- To assure a high and constant measurement accuracy, operate and store the instrument under the specified conditions and perform the recommended tasks regularly.
- Ensure that all environmental requirements from the installation section (Section 3.1.1 [▸ 10]) as well as the specifications section in Appendix A [▸ 31] are always fulfilled.
- Always handle the instrument with care. Even minor damage may cause serious measurement errors.
- Employ a regular optical check if there is no contamination on the outside and inside the instrument and perform an effective cleaning routine.
- Also make sure to follow the maintenance instructions provided with any third-party products.

8.2 Cleaning the instrument

- To clean the instrument housing, use a soft cloth wetted with lukewarm water and, if necessary, with a mild cleaning agent (pH < 10). Do not scratch the surface.
- Refrain from using cleaning agents or any other liquids inside the module of Litesizer DLS .
- In case of a spillage inside the cuvette module, use a lens cleaning cloth or an equivalent material that does not leave fibers behind. Wet the lens cloth or lens tissue with water and gently wipe out the module. Wet a further cloth with ethanol to remove any residual water, as well as any water-insoluble residue.

– The module's electrical contacts (gold-plated, situated inside the cuvette module as well as on the module's main connector) can be wiped gently using an ethanol-soaked Q-tip.

NOTICE

Never use the following compounds to clean the instrument:

– organic solvents (e.g. toluene, hexane, acetone, chloroform)
– strong acids or bases (e.g. nitric acid, sulfuric acid, hydrochloric acid, caustic soda)
– strong mechanical action (steel brush)

8.3 Cleaning the cuvette holder

Ensure that the cuvette holder is always clean, dry and free of contamination.

Due to the possible abrasion of the disposable cuvette, residues of the material can remain on the edges of the cuvette holder and this might cause scratch marks on new disposable cuvettes. Therefore, it is recommended, that you clean the edges with a cotton swab and some ethanol.

Important: Remove the module before cleaning!

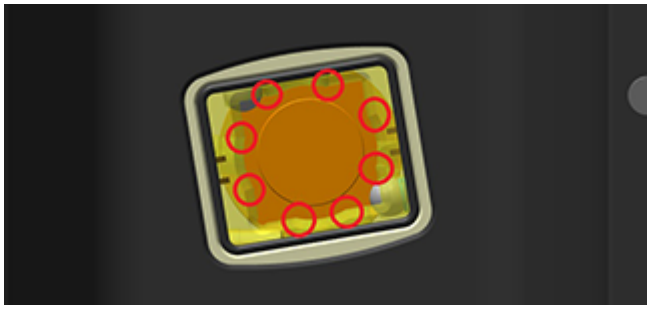


Fig. 43: *Cleaning the cuvette holder*

8.4 Cleaning cuvettes

8.4.1 Disposable cuvettes

Do not clean and reuse the disposable cuvettes.

They are likely to give erroneous results on subsequent uses.

8.4.2 Quartz and glass cuvettes

1. Rinse with the solvent that was used for the measurement.
2. Rinse with purified water.
3. Rinse with acetone or ethanol and dry in a warm oven (50 – 60 °C).
4. If any residue remains, a pipe cleaner may be used to dislodge the residue before repeating steps 2 and 3.

8.4.3 Omega cuvettes

1. Flush three times with 5 mL purified water by using a syringe with the tip inserted into one of the sample ports.
2. Flush with dry, clean air.

Fig. 44: *Flushing the Omega cuvette*

NOTICE

– Never use organic solvents (e.g. toluene, hexane, acetone, chloroform) to clean an Omega cuvette.
– Never use ultrasound to clean an Omega cuvette.

8.4.4 Univette

Highly conductive protein and salt samples can lead to residues on the Univette electrodes (Fig. 45 [▶ 27] and Fig. 46 [▶ 27]). Therefore, the Univette and the low-volume accessory should be cleaned regularly to avoid sample cross contamination and poor results.

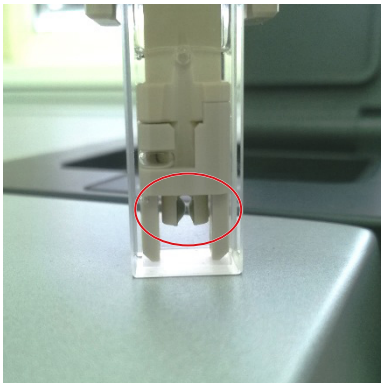


Fig. 45: *Protein deposits on the palladium electrodes*

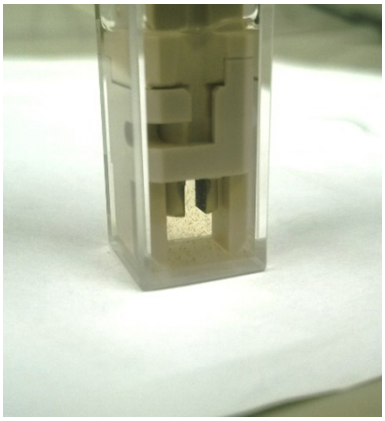


Fig. 46: *Palladium electrodes stained black after a measurement in 100 mM NaCl solution*

The electrodes are made from palladium, which is robust enough to resist to mechanical cleaning with bottle cleaning-type brushes (Fig. 47 [▶ 28]) and to ultrasonic cleaning. Ultrasound treatment can be performed safely by putting the Univette and its accessories in an ethanol-filled container (Fig. 48 [▶ 28] and Fig. 49 [▶ 28]).

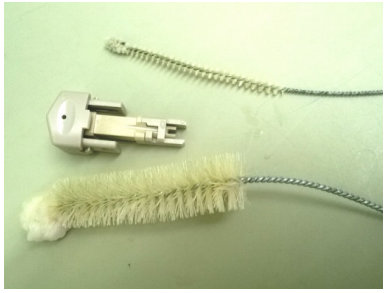


Fig. 47: *The Univette electrodes can be cleaned with bottle cleaning brushes to remove protein and salt residues*

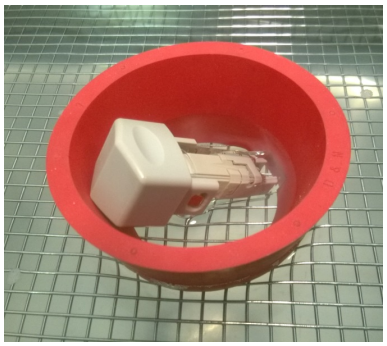


Fig. 48: *The Univette was placed in an ethanol-filled quartz cuvette and ultrasonicated.*

Fig. 49: *Low-volume accessory undergoing ultrasonic treatment in an ethanol-filled glass bottle*

8.5 Cleaning the fan filter

Ensure that the airflow of the built-in cooling fan is not blocked and remove dust from the fan-filter on the back of the instrument regularly. If the fan filter cannot be properly cleaned, contact you local Anton Paar representative for replacement.

8.6 Software administration

– Ensure that the computer connected to the instrument meets the specified minimum requirements.

– Stow the software data storage device delivered with the instrument in a safe place.

– Install mandatory software and firmware updates when provided by your local Anton Paar representative.

8.7 Moving the instrument

1. Switch off the instrument and unplug all cables.
2. Open the cuvette module - it makes it much easier to remove.
3. Remove the module.

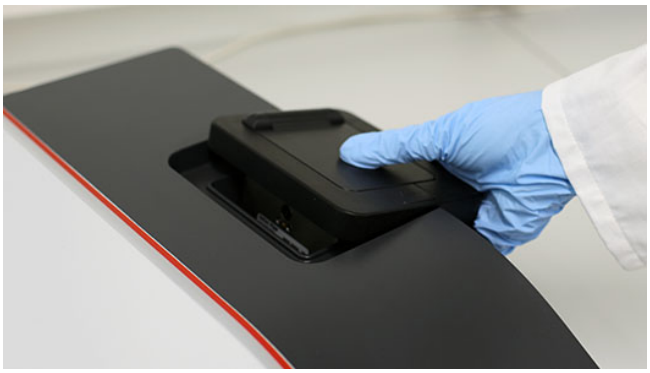


Fig. 50: *Removing the cuvette module. This procedure is identical for the BM 11 cuvette module (depicted here) and the FM 11 cuvette module.*

4. Lift the instrument by placing hands in the middle of each side under the base plate.
5. Place the module back into its holder by first reinserting it (with the lid open) as shown in Fig. 50 [▶ 28], and then with a tilting action, firmly push it into place so that it properly engages.

Do not lift the instrument by the module or leads or other external plastic parts. The instrument could be damaged and injury may arise.

Fig. 51: *The correct way to lift the instrument*

8.8 Packing the instrument for transport

NOTICE

Before packing the instrument for transport, the transport safety lock must be engaged. Failure to do so might result in irreversible damage to the instrument.

1. Switch off the instrument, remove the cuvette module and unplug all cables.
2. Carefully lift the front of the instrument so that it stands on its rear surface.

Fig. 52: *Instrument standing on its rear surface*

3. Insert the supplied transport safety lock T6 Torx bit into one of the two small holes next to the module bay.

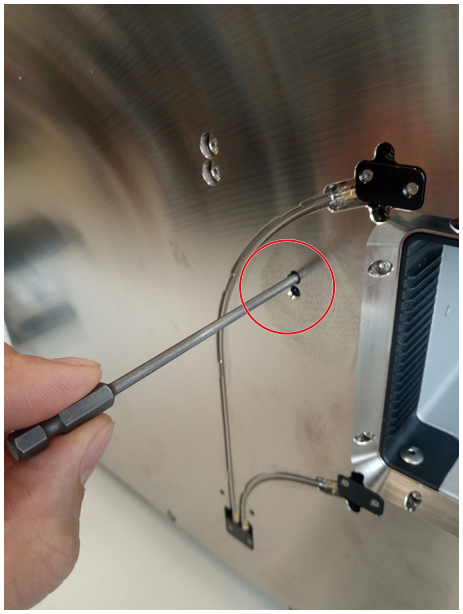


Fig. 53: *Inserting the T6 Torx bit*

4. Gently turn the screw clockwise until it stops turning.
5. Repeat for the second hole. The transport safety lock is now engaged.

8.9 Storing and transporting the instrument

– Store the instrument under clean conditions that fulfill the ambient conditions provided in the specifications in Appendix A [▸ 31].
– If you need to move the instrument, please follow the steps described in Section 8.7 [▸ 28].
– Remove any cuvette from the module before you move or lift the instrument.
– The instrument must be transported in the original package and packed according to the supplier's instructions. During transport, the instrument must not be exposed to intense shocks or high forces.

8.10 Wetted parts

The following materials are in contact with samples and cleaning liquids. The wetted parts are organized by cuvette type and module of the instrument.

Part	Material
Disposable cuvette (mat. no. 164435)	Polystyrene
Disposable cuvette lid (mat. no. 243334)	Polypropylene
Quartz cuvette (mat. no. 163390)	Body: fused glass Lid: polytetrafluoroethylene (PTFE)
Glass cuvette (mat. no. 177389)	Body: glass (SCHOTT type N-K) Lid: polytetrafluoroethylene (PTFE)
Low-volume quartz cuvette (mat. no. 163391)	Body: fused quartz Lid: low density polyethylene (LD-PE, Purell 2007H)
UVette® low-volume disposable cuvette (mat. no. 175573)	UV-transparent plastic
Omega cuvette (mat. no. 225288)	Body: polycarbonate - Makrolon® Electrodes: gold-plated over nickel-sulfamate-plated brass Luer plugs: poly(ethene-co-tetrafluoroethene) (ETFE)
Univette (mat. no. 183578)	Body, spacer, low-volume accessory: polyether ether ketone (PEEK) Low-volume accessory windows: glass (SCHOTT type N-K5)

Part	Material
	Electrodes: palladium
C-vette (mat. no. 325392)	Body: borosilicate glass Sealing: haematocrit sealing compound (vinyl plastic)
Module BM 11 / FM 11 (mat. no. 155764 / 162931)	Body: polyether ether ketone (PEEK), polyvinylidene fluoride (PVDF) Electrical contacts: gold-plated over nickel-plated brass

9 Maintenance and Repair

9.1 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.

If the product is no longer performing optimally (e.g., sensor performance), consider ordering product maintenance.

Please contact your local Anton Paar representative for more information about service options (e.g., service, possible warranty extension).

Table 6: Maintenance and repair

Component	Action	Interval	Classification
Fan filter	Replace	12 months	Recommended

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)

- Filters
- Fuses
- Glass parts
- Hoses
- Lubricants
- O-Rings
- Seals and gaskets
- Cuvettes

9.2 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

Table 7: Litesizer DLS series - Technical data

Feature	Litesizer DLS 101	Litesizer DLS 301	Litesizer DLS 501	Litesizer DLS 701
Instrument data				
Dimensions (D x W x H)	505 mm x 450 mm x 135 mm			
Weight	16.3 kg (35.9 lb)	18 kg (39.6 lb)		
Voltage				
Power supply at instrument	12 V via external adapter			
Power supply for AC adapter	230 VAC, 50/60 Hz			
Input voltage range	90 - 264VAC (47 - 63Hz)			
Input current	2A at 90VAC, Full Load			
Power consumption	50 W			
Max. power consumption	90 W			
Over-voltage category	II			
Safety class	I			
Air / gas supply				
Quality	Clean, dry and oil-free according to ISO 8573.1, class 1.3.1			
Pressure	0.4 to 0.8 bar overpressure or 1.4 to 1.8 bar total input			
Environmental conditions (EN 61010)				
Temperature	10 °C - 35 °C			
Humidity	35 % - 80 % non-condensing			
Altitude	up to 3000 m			
Degree of pollution	2			
Indoor/outdoor	Indoor use only			
Airborne noise emission	< 70 dB			
Housing material				
Front, top and side cover	PS UL94 V-0 (Edistir RK 451G)			
Back, bottom	Stainless steel			
Module	Polyether ether ketone (PEEK), black, Polyvinylidene fluoride (PVDF), black			

Appendix B Declaration of conformity

Docusign Envelope ID: 54561BDF-6912-48A2-A41E-02619BE888D5

EU Declaration of Conformity

(original)

The Manufacturer **Anton Paar GmbH,** Anton-Paar-Str. 20, 8054 Graz, Austria – Europe hereby declares that the product listed below

Product designation:	**Particle Analyzer**
Model:	**Litesizer DLS 701, Litesizer DLS 501, Litesizer DLS 301, Litesizer DLS 101**
Material number:	**317781, 317782, 394443, 317783**

is in conformity with the relevant European Union harmonisation legislation. This declaration of conformity is issued under the sole responsibility of the manufacturer.

Low Voltage Directive (2014/35/EU, OJ L 96/357 of 29.3.2014)

Applied harmonised standards:

- EN 61010-1:2010 + A1:2019 + A1:2019/AC:2019
- EN IEC 61010-2-010:2020
- EN 60825-1:2014 + A11:2021

Electromagnetic Compatibility (2014/30/EU, OJ L 96/79 of 29.3.2014)

Applied harmonised standard:

- EN 61326-1:2013

RoHS Directive (2011/65/EU, OJ L 174/88 of 1.7.2011)

Place and date of issue: Graz, 15 December 2025

Signed by:
E1A52CE5F1F84EF...
Alfred Freiberger
Executive Director
Business Unit Characterization

DocuSigned by:
C1A34D3D9BBC458...
Andreas Kautsch
Head of Particle Characterization & Surface Charge
Business Unit Characterization

D51IB001EN-Y

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