Malvern

PARTICLE SIZE

MOLECULAR SIZE

ZETASIZER **APS**
BASIC GUIDE

Zetasizer APS
Basic Guide

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English

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Introduction to this manual

Introduction

This manual covers the operation and maintenance of the Zetasizer APS particle analyser.

Zetasizer instrument	Model number	Measurement types
Zetasizer APS	APS2000	Particle size
Zetasizer APS + PTC-1000	APS5000	Particle size

Note
For the Zetasizer serial number double-click the APS icon in the status bar.

Using this manual

Read the Health and Safety information in **Chapter 3** before using the instrument.

For more detail on the Zetasizer software, use its **Help** system. Each window has a **Help** button giving information about it. **Advice** buttons present sample-related content.

Menu commands

Software menu commands are referred to in the form **main menu-menu item**. As an example, the command **Measure-Plate Scheduler** refers to selecting the **Plate Scheduler** item from the **Measure** menu. Menu commands are shown in bold text.

Access to the instrument

Malvern personnel

Malvern personnel (service engineers, representatives, etc.) have full access to the instrument and are the only people authorised to perform all service procedures that may require the removal of the main covers.

Warning!
Removal of the main covers by unauthorized personnel, even a supervisor, will invalidate the warranty of the instrument. It is however permissible to lift off the front cover, which provides internal access to the user-serviceable tubes and needle. Refer to **Chapter 5** for more information on this.

Supervisor

The supervisor is responsible for the management and safety of the instrument and its operation. The supervisor also trains the operators. They can perform all user maintenance routines identified in **Chapter 5**.

The supervisor has access to a more detailed manual in English.

Operator

An operator is a person trained in the use of the system. The operator can perform all user maintenance routines identified in **Chapter 5**, except changing the fuse.

Warning!
Failure to follow these guidelines could result in exposure to hazardous voltages and laser radiation.

Where to get help

Help desk

Direct all queries regarding the system to the local Malvern representative initially. Please quote the following information:

- Model and serial number of the instrument (located on the rear panel).
- The Zetasizer software version (select **Help-About** within the software).

Contact the United Kingdom help desk if the local Malvern representative is not available. The direct line to the United Kingdom Helpdesk is +44 (0) 1684 891800. This help line is primarily English speaking.

Remote support

Malvern Instruments offers a remote support service over the Internet. (A direct Internet connection must be available.)

Benefits include fast and efficient fault diagnosis, reducing downtime and costs. Online user training is also available, plus software updates.

Malvern website - www.malvern.com

The Malvern website offers a comprehensive range of particle characterization resources for use by customers 24 hours a day, seven days a week.

Resources include software downloads, frequently asked questions, a knowledge base and **Application Notes**, plus information on other particle characterization solutions that Malvern can provide.

Site requirements

Introduction

This document outlines site requirements for a Zetasizer APS. Ensure all these are met **before** the instrument is delivered.

Environmental conditions

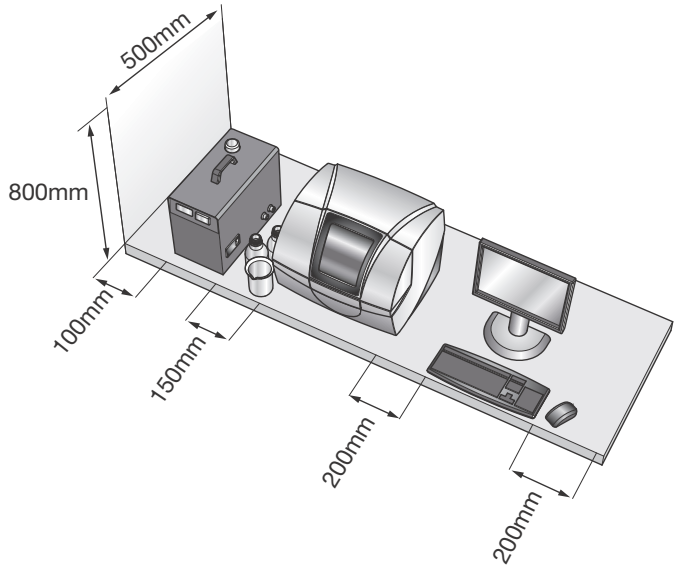
The site must be:

- Indoors and away from strong light (windows).
- Away from heat sources like radiators.
- Well ventilated (for noxious materials).
- On a horizontal vibration-free bench.

We recommend that the computer is positioned to the right of the instrument.

Space required

Provide enough space to allow easy access to all components and connections. This diagram shows the recommended space for a system. Always place the (optional) PTC-1000 to the left of the instrument as the heat output is from the left side of the PTC-1000 and this will prevent hot air being directed towards the APS.



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Allow at least **800mm** above the bench surface for access to the plate holder area. The system dimensions are given below:

Component	Width	Depth	Height
Zetasizer APS	500mm	410mm	420mm
PTC-1000	195mm	351mm	304mm
Computer	Refer to manufacturer's literature.		

Power requirements

The mains power supply must be clean and filtered. If necessary, fit an Un-interruptible Power Supply (UPS) to remove any spikes or noise. The power requirements are:

Component	Power requirement	Power sockets required
Zetasizer APS	90-260V AC, 50-60Hz, 150W	1
PTC-1000	115-230V AC, 50-60Hz, 294W	1
Computer	See manufacturer's documentation	
Computer monitor	See manufacturer's documentation	
Printer	See manufacturer's documentation	

Power cords and Power safety

The notes in this section indicate best practice. Adhere to these when connecting the instrument to the power supply.

Warning!
Do not operate this product with a damaged power cord set. If the power cord set is damaged in any way, replace it immediately.

Warning!
Do not use the power cord supplied with this product on any other products.

Power cord set requirements

Power cord sets must meet the requirements of the country where the product is used. For more information, contact a Malvern representative.

General requirements

The following requirements apply to all countries:

- The power cord must be approved by an acceptable accredited agency responsible for evaluation in the country where the power cord set will be installed.

- The power cord set must have a minimum current capacity of 10A (7A in Japan only) and a nominal voltage rating of 125 or 250 volts AC, as required by each country's power system.
- The area of the wire must be a minimum of 0.75mm^2 or 18AWG, and the length of the cord must be less than 3m.
- The power cord must be routed so it will not be walked on, pinched by items placed on or against it, or become wet. Pay particular attention to the plug, the electrical outlet and the point where the cord exits the product.

Computer specification

As with any software, running other applications at the same time may affect the speed of the Zetasizer software.

Minimum recommended specification

Contact the Malvern Helpdesk or website for the recommended computer specification, otherwise consult the Software update notification document supplied on the software CD.

Note:
A laptop computer must have a free USB port to operate with the system.

Networks

The PC running the Zetasizer software can be connected to a network, but the Zetasizer software must be run locally.

Additional services

Purge specification

If measuring samples at low temperatures there is a risk of condensation occurring on the cell; this occurs when the measurement temperature is less than the 'dew point' of the ambient air surrounding the cell being measured. This is particularly likely in humid climates.

If this may be a problem the purge inlet port can be used to connect a dry air supply i.e. a supply with a dew point below the target temperature. This removes any

moisture in the air immediately surrounding the cell and prevents condensation. If using the purge inlet connector, the air or Nitrogen supply must conform to the following specification:

- Compressed air to DIN 8573-1
- Oil = Class 1
- Water = Class 3
- Particulate = Class 3
- Pressure = 100 kPa

Caution!
The purge air line supply must conform to the above specification. Failure to meet this specification may result in permanent damage to the instrument and invalidate the warranty.

Telephone socket specification

The telephone socket for remote support needs a direct Internet connection.

Laser safety

Zetasizer APS instruments are Class 1 laser products and as such, require no special laser safety considerations during normal operation. However, during servicing (which must be performed by a qualified Malvern representative), the servicing engineer may be exposed to class 3b or above laser radiation. We therefore recommend that the administrative controls recommendations of the Laser Safety Regulations (IEC 60825-1(1993) +A1(1997)+A2(2001) are implemented.

Health and safety

General warnings and Safety regulations

Warning!
The instrument or samples to be measured may be hazardous if misused. Read and fully understand this section before operating the system.

Warning!
Use of the system in a manner not specified by Malvern Instruments Ltd may impair the protection provided by the system.

The instrument must only be stored or operated in environmental conditions conforming to **Chapter 2**.

Positioning the Instrument

Warning!
Do not position the instrument such that the power cord, where it exits the product, is unreachable for disconnection.

Warning!
Do not obstruct the ventilation slots underneath the instrument, nor the fans on the rear panel. Restricting airflow can damage the instrument or cause overheating.

Electrical warnings and Safety regulations

Warning!
The Zetasizer APS contains high voltage components. Only Malvern trained personnel are permitted to remove its main cover.

The instrument is mains powered and all power cables and electrical sockets should be treated accordingly. Do not place cables where they may become wet.

Should the instrument become wet (e.g. sample or dispersant is spilt), switch it off and disconnect it from the mains power supply immediately. Scrupulously clean and dry the instrument before re-applying power.

Warning!
This product **must** be connected to a protective earth.
The metal parts of the optical unit and the accessories are earthed via a protective earth connection.

PAT testing

If PAT testing is required, connect the earth lead to the earth stud underneath the rear right-hand corner of the instrument. We recommend that the product is PAT tested annually, or if it is suspected that its electrical safety has been compromised.

Power cords and Power safety

The notes in this section indicate best practice. Follow these when connecting the instrument to the power supply.

Warning!
Do not operate this product with a damaged power cord set. Replace a damaged power cord set immediately.

Warning!
Do not use the supplied power cord on any other products.

Power cord set requirements

Power cord sets must meet the requirements of the country where the product is used. For further information on the requirements, contact a Malvern representative.

General requirements

These requirements apply to all countries:

- The power cord must be approved by an acceptable accredited agency responsible for evaluation in the country where the power cord set will be installed.
- The power cord set must have a minimum current capacity of 10A (7A in Japan only) and a nominal voltage rating of 125 or 250 volts AC, as required by each country's power system.
- The area of the wire must be a minimum of 0.75mm^2 or 18AWG, and the length of the cord must be less than 3m.
- The power cord must be routed so it will not be walked on, pinched by items placed on or against it, or become wet. Pay particular attention to the plug, the electrical outlet, and the point where the cord exits the product.

Power safety information

The following notes are guidelines for connecting the Malvern Instruments power supply using single and multiple extension leads, connection via AC Adapters and use of Uninterruptible Power Supplies (UPS).

Warning!
To prevent electric shock, plug the instrument or accessory into correctly earthed electrical outlets.
The power cord supplied is equipped with a grounding connection to ensure grounding integrity is maintained.

Advice on use of Extension leads

Follow this advice when using **single or multiple socket extension leads**. These are also called ‘trailing sockets’.

- Ensure the lead is connected to a wall power outlet and **not** to **another** extension lead. The extension lead **must** be designed for grounding plugs and plugged into a grounded wall outlet.
- Ensure that the total ampere rating of the products being plugged into the extension lead **does not exceed** the ampere rating of the extension lead.
- Use **caution** when plugging a power cord into a multiple socket extension lead. Some extension leads may allow a plug to be inserted incorrectly.

  Incorrect insertion of the power plug could result in permanent damage to the instrument or accessory, as well as risk of electric shock and/or fire. Ensure that the ground connection (prong/pin) of the power cord plug is inserted into the mating ground contact of the extension lead

Advice on use of AC adapters (when used)

Warning!
Do not use adapter plugs that bypass the grounding feature, or remove the grounding feature from the plug or adapter.

- Place the AC adapter in a ventilated area, such as a desk top or on the floor.
- The AC adapter may become hot during normal operation. Take care when handling the adapter during or immediately after operation.
- Use only the Malvern-provided AC adapter approved for use with the instrument and/or accessory. Using another AC adapter may cause a fire or explosion.

Advice on use of Uninterruptible Power Supplies (UPS)

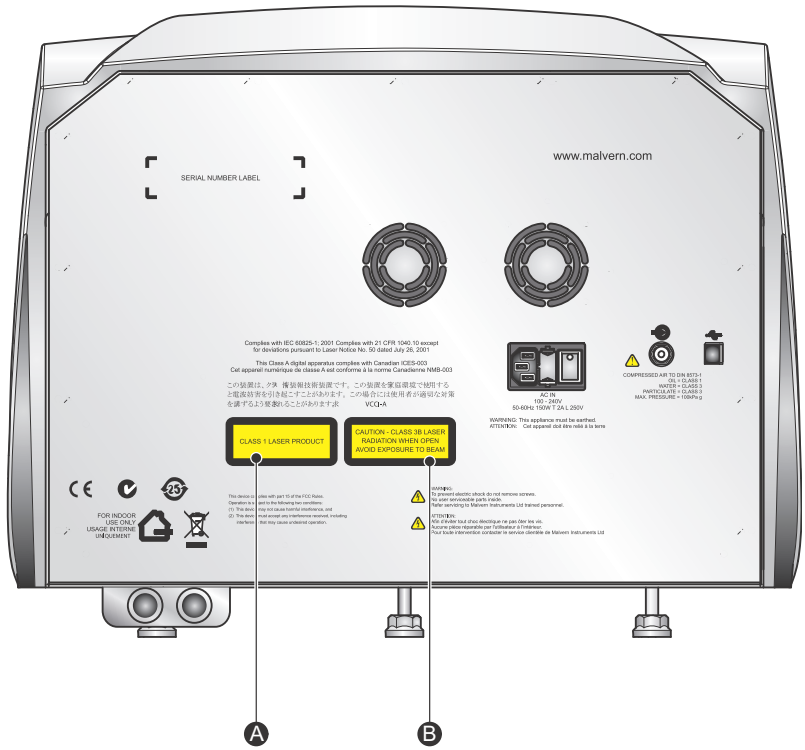
- To help protect the instrument and/or accessory from sudden, transient increases/decreases in electrical power, use a surge suppressor, line conditioner or UPS.

Laser safety regulations

The Zetasizer APS is a Class 1 laser product. As such, there is no exposure to laser radiation in normal operation of the instrument. The standard laser has a maximum cw-power of 60mW at 830nm (invisible, near infrared).

Caution!
The use of controls or adjustments or performance of procedures other than those specified in this document may result in hazardous exposure to laser radiation.

This diagram shows the location of the laser warning labels ⒶⒷ:



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Temperature warnings

Warning!
The temperature range of the measurement area is 2°C to 90°C. The optional PTC-1000 Plate Temperature Control unit can control the plate holder in the range 2°C to 40°C.

Sample handling warnings

- Always handle all substances in accordance with the **COSHH (Control Of Substances Hazardous to Health) regulations** (UK) or any local regulations concerning sample handling safety.
- Before using any substance, check the **Material Safety Data Sheets** for safe handling information.
- Use the instrument in a well ventilated room, or preferably a fume cupboard, if fumes from the sample or dispersant are toxic or noxious.
- Wear personal protective equipment as recommended by the **Material Safety Data Sheets** if toxic or hazardous samples are being handled, particularly during sample preparation and measurement.
- Wear protective gloves when handling hazardous materials, or those that cause skin infections or irritations.
- Do not smoke during measurement procedures, particularly where inflammable samples are used or stored.
- Do not eat or drink during measurement procedures, particularly where hazardous samples are used or stored.
- Take care when handling glass (e.g. beakers). Hazardous materials may enter a wound caused by broken glass.
- Always test a new sample or solvent for chemical compatibility before use.
- After measuring hazardous samples, scrupulously clean the system to remove any contaminants before making another measurement.
- Always label samples for analysis using industry standard labelling, particularly if they are handled by a number of staff or stored for long periods. Clearly mark any operator hazard and associated safety precautions that are required for the handling of dangerous materials.
- It is important to keep a record of all hazardous substances used in the system for protection of service and maintenance personnel.
- Always adopt responsible procedures for the disposal of waste samples. Most local laws forbid the disposal of many chemicals in such a manner as to allow their entry into the water system. The user is advised to seek local advice as to the means available for disposal of chemical wastes in the area of use. For recommendations see the **Materials Safety Data Sheets**.
- The surfaces of the system may be permanently damaged if samples are spilt onto them. If a spillage occurs, disconnect the system from the power supply before scrupulously cleaning it up.

Moving the system

If it is necessary to move the system, follow these guidelines:

- Always disconnect the computer and power supply before attempting to move the system.
- Always adopt proper lifting techniques to avoid back injury.
- Always lift the instrument by holding the under its base. Never lift an instrument by its covers. Refer to the **Unpacking instructions** provided.
- If the system is moved large distances, we recommend that it is repacked in its original packaging.

Disposal of the instrument

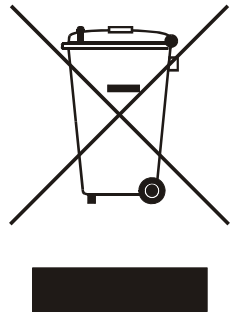
Dispose of the system responsibly. Follow these guidelines:

- Disable the laser in such a way as to make it impossible for it to be powered up. Ask the local Malvern representative for advice.
- Decontaminate the instrument if hazardous materials have been used in the system.
- Refer to any local regulations on disposal of equipment.

European Union and other European countries

This regulation applies in the European Union and other European countries with separate collection systems.

Here the system must be disposed of in accordance with the European **Disposal of Electrical & Electronic Equipment** regulations.



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This symbol on the product or on its packaging indicates that when the last user wishes to discard this product it must not be treated as general waste. Instead it shall be handed over to the appropriate facility for the recovery and recycling of electrical and electronic equipment.

By not discarding this product along with other household-type waste, the volume of waste sent to incinerators or landfills will be reduced and natural resources will be conserved.

For more detailed information about recycling of this product, please contact the local city office, a waste disposal service, or the Malvern representative.

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Making a measurement

Introduction

This chapter provides a quick overview of how to get started with making measurements, and covers the following:

- Switching on and starting the software
- Making a measurement
- Viewing the results

For more detailed information on how to make measurements, refer to the **Zetasizer APS User Manual** and software help system.

Switching on & starting the software

1. Turn on the instrument by pressing the power switch on the back of the instrument.
2. Double-click the  icon on the desktop.
3. If this dialogue appears, it will show your Windows login name. Click **OK**.

4. The instrument **must be powered up for 30 minutes before a measurement is made** to ensure its temperature has stabilized

The icon in the lower right corner of the Zetasizer software's main screen is displayed as shown (right) if the instrument has been connected correctly.

If the icon is greyed out, re-check all connections, ensure that the power supply to the instrument is turned on and that the power switch on the instrument is in the On position. Then close and re-start the software. If the icon is still greyed out, contact Malvern Instruments.

Instrument connected correctly

Instrument not connected (or malfunction)

Making a measurement

This section provides simple overview information on how to fill and insert a plate, and then run a measurement by using a plate schedule and an SOP.

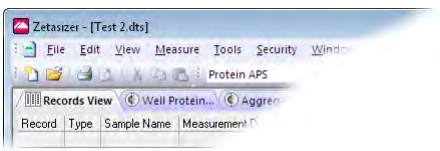
1. Load a plate with sample:

Prepare a sample, for example 60nm latex or BSA 2-3 mg/ml. Fill the wells with a **minimum sample volume of 20µL for a 384 well plate and 50µL for a 96 well plate**.

Caution!
Do not overfill the wells - this could lead to cross-contamination or spillage.

2. Create a new measurement file:

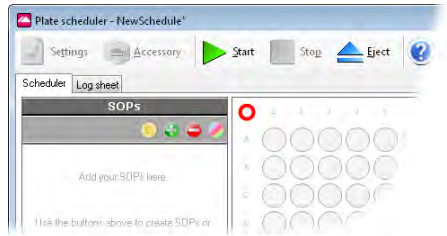
It is necessary to create a new measurement file into which measurement data can be saved. To do this, choose File-New from the menu and type a name for the new measurement file - in this example the file has been named "Test 2.dts" (measurement files all use the ".dts" file extension).



3. Start the Plate Scheduler:

Once the instrument is set up, measurements are made by creating a plate schedule that identifies which wells to measure with which SOP. Malvern Instruments supplies a number of default SOPs, but you can also create your own.

- Select **Measure-Plate Scheduler** from the menu bar. The Plate Scheduler is displayed:



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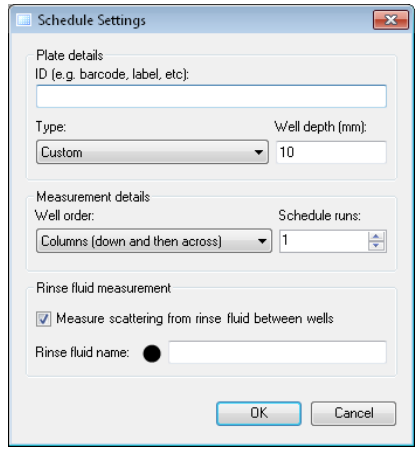
4. Set up the Schedule Settings:

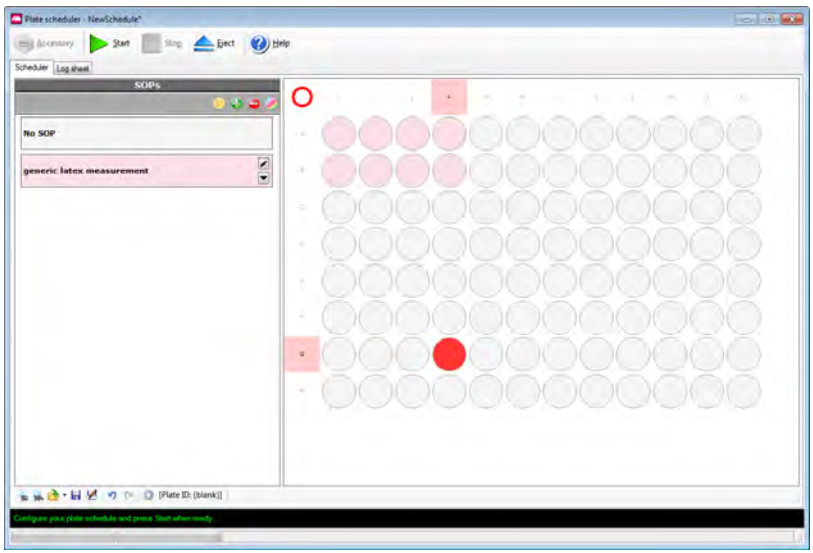
1. Click the **Schedule Settings** button on the lower toolbar to display the Schedule Settings window:



2. Enter any identifying text, such as barcode or plate label etc. in the **Plate ID** field. This information is then visible in the **Records View** as long as **Plate ID** has been enabled as a parameter for that view (listed under the **Measurement–Details** section).
3. Click **OK** when the Schedule Settings have been completed.

5. Create plate schedule - allocate SOPs to wells:

1. Click the Add existing SOPs button and then select the "Typical Protein - general purpose.sop" from the Protein folder.
2. Select the well(s) containing the sample by clicking on them. A red outline shows that the well is selected.

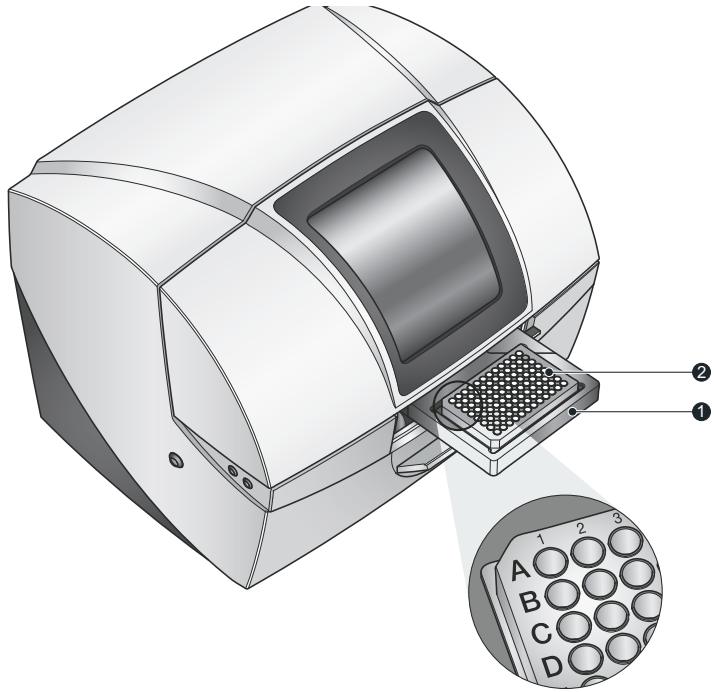


3. Click on the name of the SOP in the left panel to allocate that SOP to the selected well(s). The well(s) will change colour to that of the SOP.

6. Load the plate into the instrument:

1. If the plate holder is not in the ejected position, click **Eject** on the toolbar.

2. Load the plate ② into the plate holder ① using the illustration for reference.



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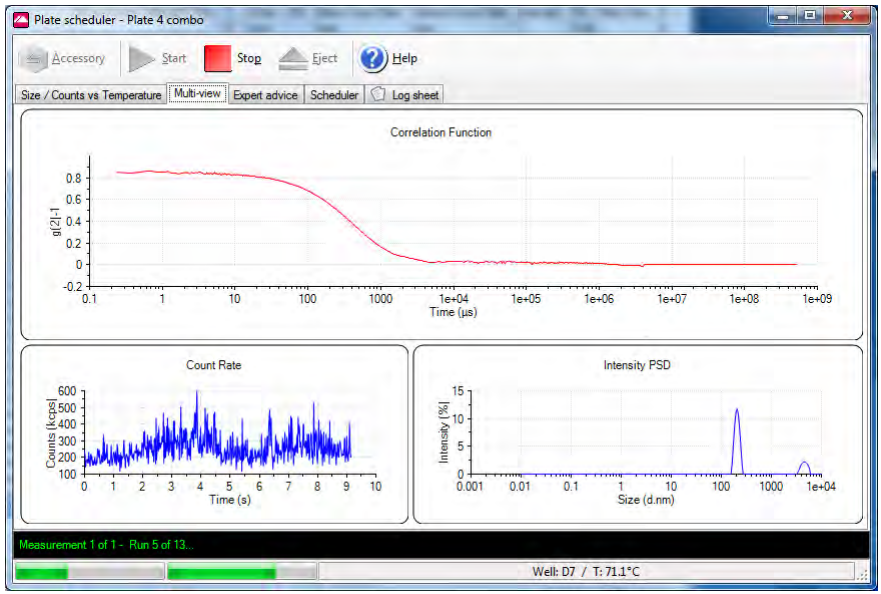
3. Ensure that the plate is oriented correctly in the plate holder, with the top-left of the plate (i.e. the origin of the plate's well identification markings) closest to the instrument. This is critical and ensures that the instrument measures the correct wells.
4. There is a little play in the plate when seated in the plate holder. This is normal - the plate holder clamps it securely when it retracts into the instrument.

7. Start the measurement:

1. Click **Start** on the toolbar.

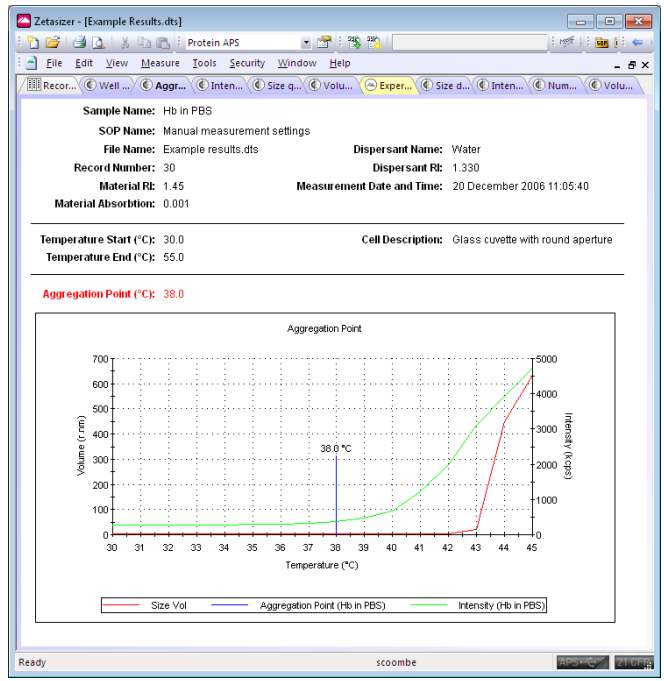
2. The system asks for the plate schedule to be saved. Select **Yes**, enter a file name and click **Save**.
3. The plate holder withdraws into the instrument and the measurement process begins. As the SOP analysis runs the results are displayed:



4. Further messages in the status bar show the progress of the measurement.
5. When the measurement has finished, close the window  .

Viewing the results

1. The results are stored as the latest record in the currently open measurement file. To view the result, select this record and then click one of the Report tabs. The following example shows the Aggregation Point (M) report.



Maintenance

Introduction

Warning!
Although the front cover lid may be removed to service the needle and tube areas of the instrument, no one except a qualified Malvern representative must remove the main casing which extends down the back of the machine.

This instrument has been designed so that supervisor/operator maintenance is kept to a minimum. This chapter explains the routine user maintenance procedures that can be performed. These procedures are:

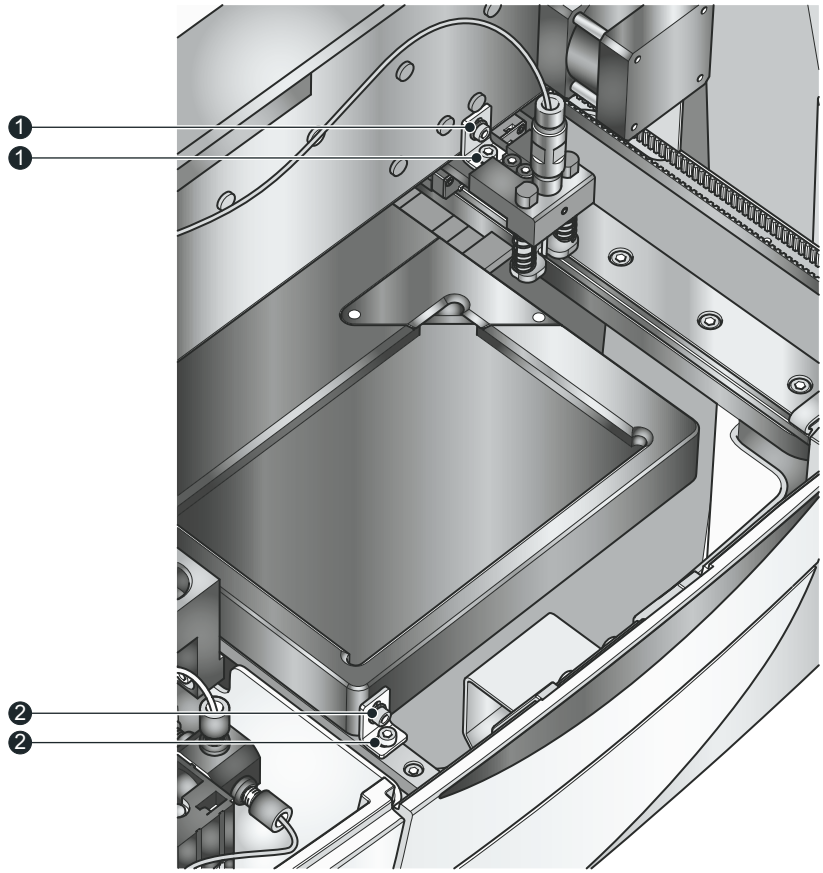
- Removing (or replacing) the transit locks.
- Cleaning the instrument.
- Replacing the system fuse.
- Cleaning and replacement of the tubing, needle and measurement block.

Transit locks

Before initial use of the system, remove the transit locks from the instrument. These locks prevent movement of the internal parts of the instrument during shipping.

Caution!
The transit locks should be re-fitted if the machine is shipped to another destination. Failure to do so could damage the instrument.

Refer to the following illustration for confirmation.



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1. Use an allen key to remove all four bolts ① and ② from the transit locks, pictured above, then remove the angle brackets.
2. Move the needle holder approximately 80mm left, to the centre of the tray, by applying light finger pressure.
3. Switch on the instrument and then start the software. The needle will move to the wash station.
4. Restart the software to initialise the needle to its correct position.
5. Retain all bolts and brackets for future shipment of the instrument. Contact the Malven Helpdesk for guidance on the procedure of refitting the transit locks.

Cleaning the instrument

The instrument should be regularly cleaned externally to remove any sample spillages, plus regular cleaning of the measurement components to ensure optimum performance.

Warning!
Before cleaning, always disconnect the instrument from the power supply and disconnect all electrical cables.

Caution!
The surfaces of the instrument may be permanently damaged if samples or solvents are spilt onto them. If a spillage occurs, disconnect the system from the power supply before cleaning it up.

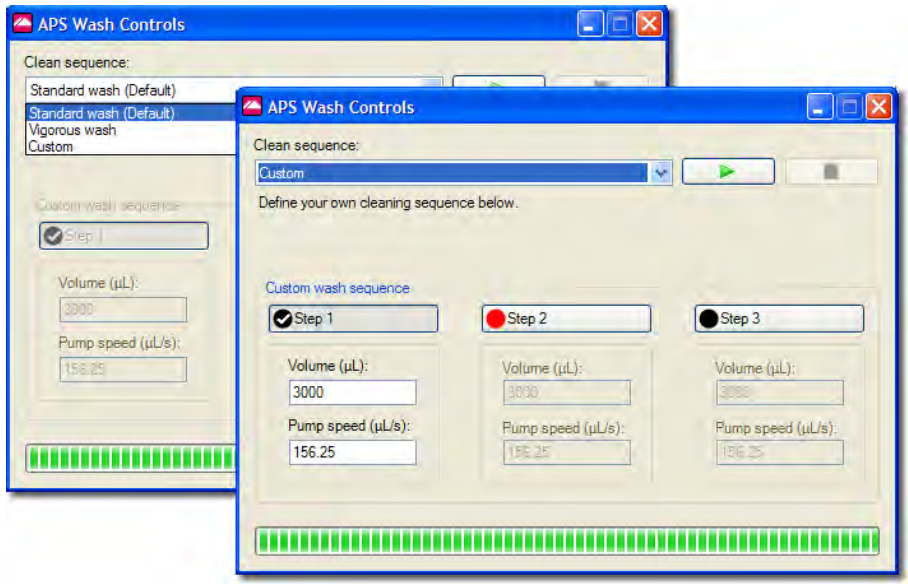
- Clean the covers periodically using a mild soap solution.
- **Never** use excessive liquid to clean the instrument and always avoid electrical components (connectors, etc.).
- **Always** ensure that the instrument is completely dry before applying power.
- The paint has a solvent resistant finish, but it is good practice never to use a solvent based solution as this may damage the painted surfaces.
- **Never** use an abrasive cleaner to clean the instrument as this may damage the painted surfaces.
- **Never** use compressed air.

Cleaning the internal measurement components

During and after each measurement session, it is important that the internal measurement components (tubing, measurement block and needle) are rinsed out and cleaned sufficiently. This is necessary to ensure consistent and accurate measurement results. Use the **APS Wash Controls** as described below.

The wash controls are used as part of the SOP sequence (refer to the **Zetasizer APS User manual** for details) and can also be accessed separately as good practice for reducing contaminants in the system. It is recommended to occasionally clean the system without initially making a measurement. This has the effect of flushing the tubing, measurement block and sample needle to ensure that any residual sample is completely removed.

The APS wash controls can be accessed by selecting **Tools-Instrument-APS-Wash controls**.



There are three **Clean sequence** options that can be used for general washing either as a separate cleaning routine, or for in between well measurement (that is set up in the SOP). Wash fluid - red inlet. Solvent - black inlet.

- **Standard wash**:
  Step 1: 600ul of DI water
  Step 2: 1250 uL (1 full syringe) of 0.1M NaOH
  Step 3: 2500uL (2 full syringes) of DI water
- **Vigorous wash**:
  Step 1: 1250uL of DI water
  Step 2: 3750 uL of 0.1M NaOH
  Step 3: 5000uL of DI water
- **Custom wash**:
  Where the volumes for the rinse and wash fluids can be set as a rinse protocol; recommendations and examples are described below.

Select ▶ to execute the selected clean sequence, and ■ to cancel. After a clean sequence it is recommended to check cleanliness using the count rate meter - refer to **Monitoring the instrument cleanliness** later in this section.

Recommended cleaning Protocols for the Zetasizer APS

The cleaning protocol necessary will depend on the type of sample, the sample concentration and the type of measurement that is performed.

In general, a size measurement of a sample requires less cleaning afterwards than a thermal trend measurement of the same sample (as the thermal trend denatures the protein which exposes hydrophobic parts which can give it a tendency to stick to the cell and tubing). The user providing the samples should be in the best position to know what could be an efficient cleaner for their sample, however the following protocols have been shown to be effective for a variety of proteins.

The rinse fluid scattering (a parameter selected in the schedule settings) should be monitored to make sure there is no build up of contamination in the optical cell.

For most protein samples tested (albumins, lysozyme, antibodies), the washing protocols outlined below have worked well for concentrations up to 200mg/ml:

For standard size measurements:

- Select Custom Wash
- Activate all three steps by clicking on them
- Choose 600µl of rinse fluid/solvent, then 1250µl of wash fluid, and finally 5000µl of rinse fluid
- Deionised water is suggested as the rinse fluid and 0.1M NaOH as the wash fluid

For thermal trend measurements:

- Use either use vigorous wash or select custom wash for concentrations of proteins <10mg/ml
- Activate all three steps by clicking on them
- Choose 1250µl of rinse fluid/solvent, then 3750µl of wash fluid, and finally 7500µl of rinse fluid
- Deionised water is suggested as the rinse fluid and 0.1M NaOH as the wash fluid. Higher concentrations up to 1M might be needed to keep the system clean.

After a longer period of non-use or as a procedure to use if the system will not be used for a long period:

- Rinse the system with 10ml of deionised water through each inlet.
- If the instrument is to be left unused for a very long period, rinse through the system extensively with water and then with 20% ethanol in water to prevent anything growing in the system.

Extensive cleaning

If the rinse fluid scattering has increased to **greater** than 50-60kcps, it is recommended that a thorough wash with 1M NaOH and 1M HCl is performed using the Wash control tools.

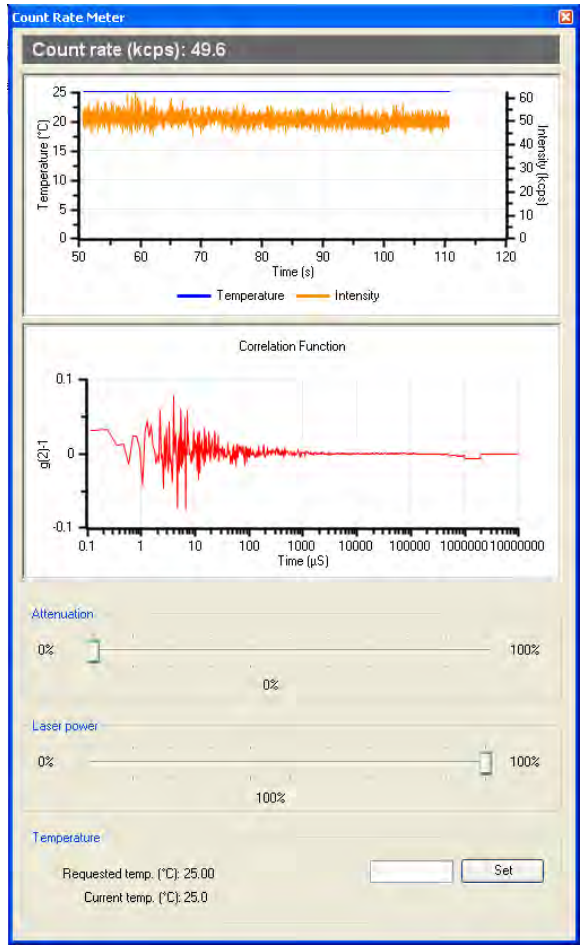
- Select **Custom Wash**.
- Activate all three steps by clicking on them.
- Choose 1250µl of rinse fluid/solvent (water), then 10000µl of wash fluid (**1M NaOH**), and finally 20000µl of rinse fluid (water).
- Exchange the wash fluid bottle for1M HCL and repeat the same settings.
- Choose 1250µl of rinse fluid/solvent (water), then 10000µl of wash fluid (**1M** HCL), and finally 20000µl of rinse fluid (water).

Monitoring the instrument cleanliness

Note:
It is recommended that a stable count rate no greater than 500kcps is achieved before any measurements are performed.

The cleanliness of the instrument can be monitored using the **Count rate meter**. This check should be done routinely and, if required a clean sequence performed, as described above.

- When checking the cleanliness of the system, first perform a clean sequence using **filtered deionised water**.
- Monitor the count rate select **Tools-Count rate meter** from the main menu; this will open the **Count rate meter** window.



- Within the attenuation section:

  Set the **top** (attenuator) slider to 0%, by selecting and dragging to the left.

  Set the **lower** (laser power) slider to 100%, by selecting and dragging to the right.

- Monitor the count rate in the top graph of the count rate window - the current count rate will be displayed.
  With a clean instrument you should see no correlation and the count rate should be more or less a straight line with random fluctuations of less than 10kcps. The count rate should be stable and less than 120kcps. For a reasonably clean system this should be less than 50kcps.

  If this is not the case check the connections, the cleanliness of the wash fluid, and finally repeat the cleaning of the flow cell itself.

Replacing the system fuse

Warning!
Fuses must not be replaced by the operator. Only the supervisor or a Malvern representative should attempt to change the fuse.

If the instrument does not power up, check the system fuses. These are located in the mains power switch on the rear panel.

Before changing a fuse, disconnect the instrument from the mains power.

Pull the fuse holders out and replace any faulty fuses with ones of the following specification:

Rating:	T 4A HRC 250V	(T = Time delay)
Size:	5mm x 20mm	

Replacing the tubing and needle

General safety

Warning!
Before replacing parts, always disconnect the instrument from the power supply and disconnect all electrical cables.

Warning!
A small volume of residual solvent or sample may remain in the tubing and spill when the tube is disconnected. Always ensure that protective gloves are worn.

Internal instrument parts

The following internal parts are all user replaceable:

- Sample needle.
- Sample needle tubing - to measurement block.
  (Includes tubing and pre-fitted ferrule connectors for connection to measurement block)

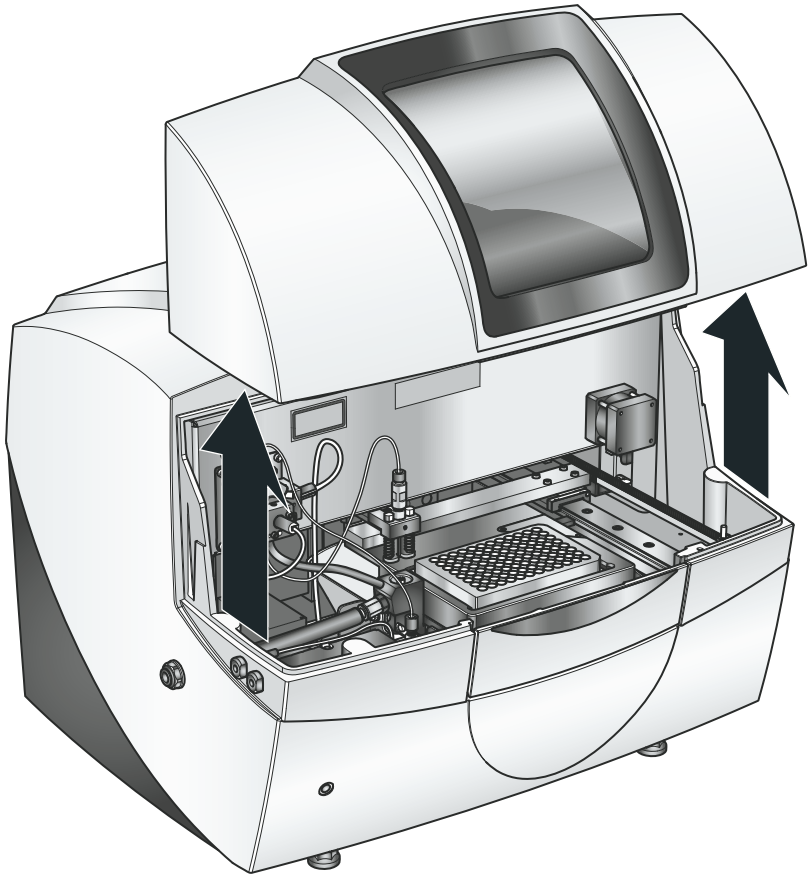
- Sample tubing - from measurement block to syringe pump.
  (Includes tubing and pre-fitted ferrule connectors for connection to measurement block)
- Rinse tubes and ferrule connectors.
- Rinse inlet filters and ferrule connectors.
- Measurement block flowcell.

The following parts can be ordered from your local Malvern Instruments distributor.

Part No.	Description
APS4000	Needle and tubing spares kit
APS4002	Consumable kit
APS0007	Flow cell

Removing the lid

To access the user-replaceable internal parts of the system remove the cover by lifting it vertically off the instrument, as shown in the illustration below:



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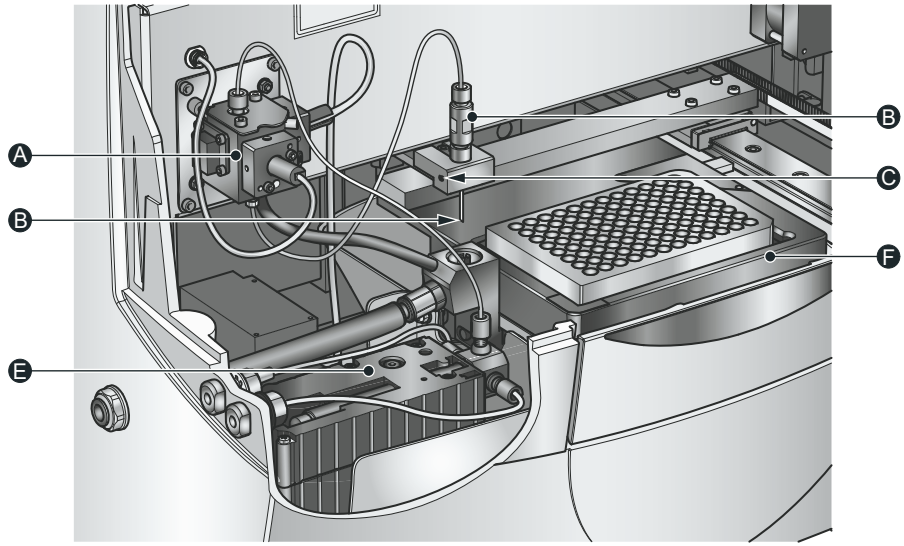
On removing the lid, a laser safety interlock is activated which prevents the machine being used whilst open.

The following image identifies the internal parts of the instrument:



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Ⓐ Measurement block

Ⓑ Needle and tube

Ⓒ Needle holder

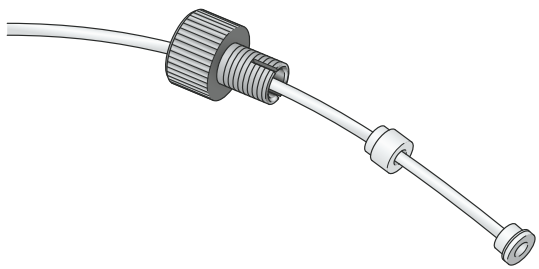
Ⓓ Rinse well

Ⓔ Syringe pump

Ⓕ Well plate holder (shown with plate in situ)

Measurement block tubing and connections

The tubing and respective connection **to** the **measurement block** are manufactured as one assembly. The assembly is not user-serviceable and must be replaced as a complete item.



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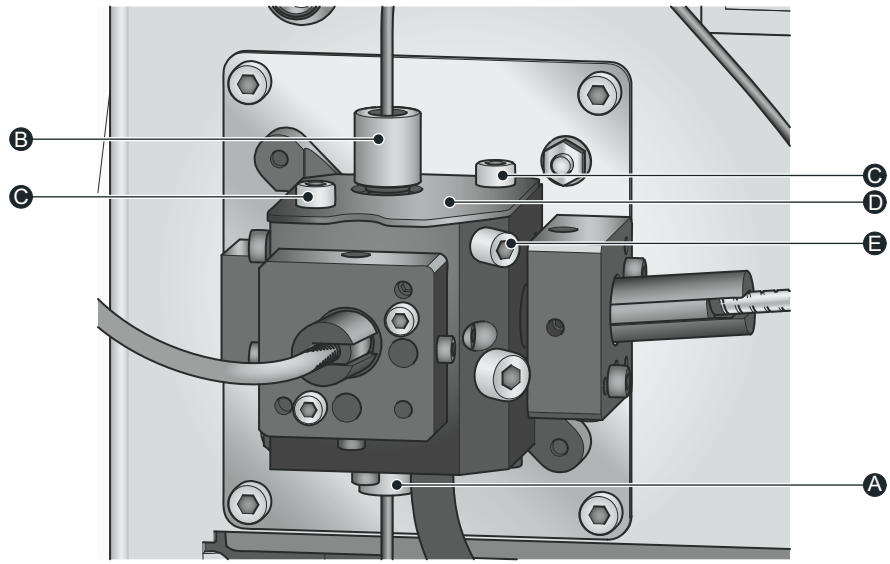
The ferrule connections **to** the **syringe** and **sample needle** are re-usable between tube changes, unless they have become damaged - refer to their respective sections.

Measurement block flowcell cleaning

With the measurement block tubing connections removed, the flowcell can then be removed for cleaning. Follow the process below:

Note:
The measurement block flowcell is a critical optical component. Utmost care must be taken on all aspects of the cleaning procedure.

1. Unscrew the sample needle (bottom Ⓐ) connection first, followed by the syringe (top Ⓑ) connection.



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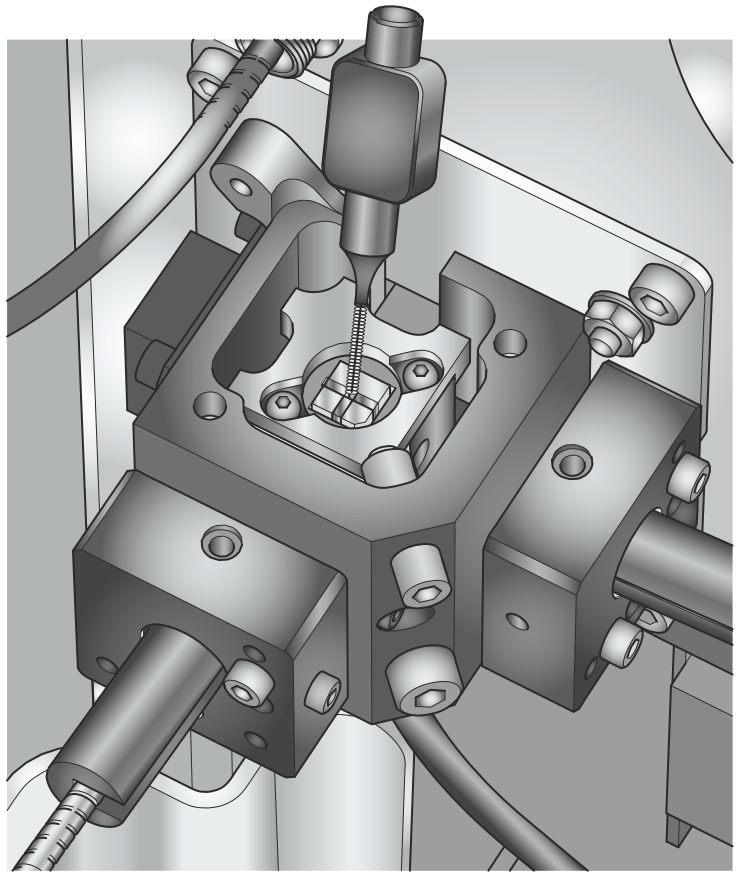
2. Loosen screw Ⓔ, then with an M3 Allen key, remove the two screws Ⓒ, and remove the measurement block top plate Ⓓ.
3. Insert a clean 0.45mm interdental brush into the central channel of the flow-cell.



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4. Holding onto the interdental brush, use a clean cotton bud to push the flowcell up out of the measurement block from below. As the flowcell exits the block, angle the brush so the flowcell does not fall off.
5. Place the flowcell onto a clean lint free cloth.
6. If sample build up is suspected inside the flowcell a wetted interdental brush can be used to gently clean the internal channel. Take great care when performing this operation as the central core of the brush is metal and could potentially damage the flowcell.
7. Remove any sample or grease by **lightly** dragging a clean lint free cloth over the flowcell; if desired the cloth can wetted with ethanol or propan-2-ol. Repeat this action for each optical side of the cell.

8. Re-insert the cell back into the measurement block. As with removing, angle the cell when re-inserting.

Note:
Ensure that the flowcell is replaced with the matt black side (side without any windows) facing the rear of the instrument and chamfered corner to the right hand side.

9. Fit lid - tighten screw Ⓔ first to push lid into corer, then tighten both lid screws Ⓒ.
10. Screw in the tubing connections. Attach the syringe (top) connection first, followed by the sample needle (bottom) connection. Screw each connection in until they '**click**' - once clicked the connection is complete.
11. Using **filtered deionised water**, perform a basic clean sequence and check the resultant count rate. This will test the block for any leakages and check that the cell is sufficiently clean for performing measurements.

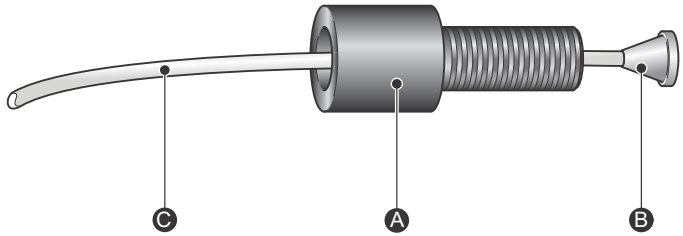
    The count rate should be stable and less than 120kcps. For a reasonably clean system, this should be less than 50kcps. If this is not the case, check the connections, the cleanliness of the wash fluid, and finally repeat the cleaning of the flow cell itself. Refer to **Cleaning the internal measurement components** and **Monitoring the instrument cleanliness** for instructions.

Syringe pump connections

Note:
Connectors are re-usable between tube changes, unless they have become damaged. Ferrules are **not** re-usable and should be discarded whenever the tubing is replaced.

All rinse tubes that terminate at the syringe pump, and the rinse inlet filters, are fitted with a standard ferrule and screw connection; if these need to be replaced or removed for tubing changes, follow the process below:

1. Insert the tube Ⓒ through the connector Ⓐ (via the large, non-threaded end).
2. Thread the ferrule Ⓑ onto the tube (i.e. the end of the tube that has just been passed through the connector). The end of the tube should be positioned flush with the end of the ferrule. See illustration below:



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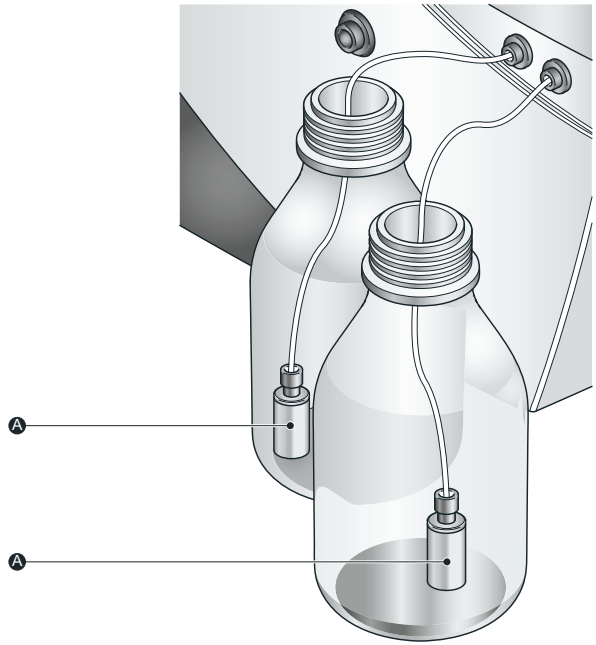
3. Push the tube and ferrule into the threaded end of the connector so that it is seated flush in the connector.

When the connector is screwed into the instrument, the tube is clamped securely.

Rinse inlet filters

The two rinse inlet filters are of microporous structure to prevent foreign particles entering the system and causing inaccurate measurements. Both external rinse tubes terminate with an inlet filter that screws onto the connector. The filters Ⓐ then rest inside the fluid within each rinse bottle:



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Note
Rinse inlet filters have a working life of approximately one year. Contact Malvern Instruments to order replacement parts.

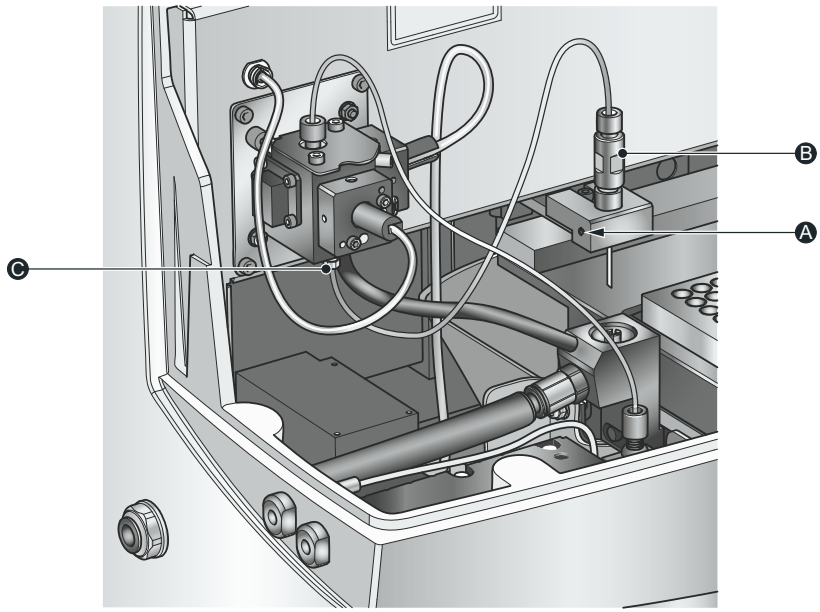
Replacing the needle

When to replace the needle

The needle will need to be replaced periodically when it can no longer be cleaned sufficiently. Additionally, the needle can be replaced to suit the kind of plate that is currently being used. The piercing needle (included) is more suited to piercing the membrane used to cover some plates, whereas a flat-tipped needle (included) could be more effective in plates with flat well bases filled with a very low sample volume.

Removing and replacing the needle

1. Remove the lid from the Zetasizer APS instrument.
2. Completely loosen the existing needle in its holder using a 2.5mm allen key in the securing bolt Ⓐ.
3. Carefully withdraw the needle Ⓑ from the holder.



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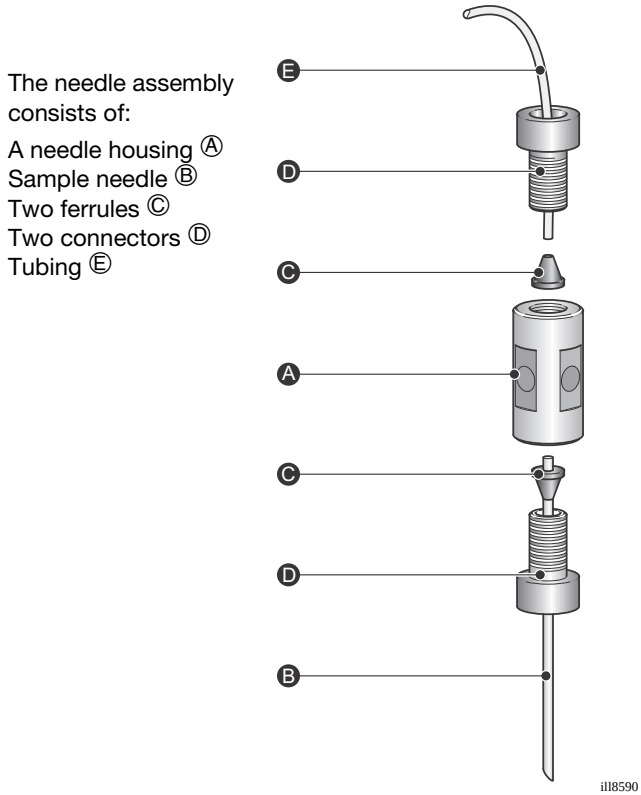
4. Unscrew the tube connector Ⓒ from the underside of the measurement block.



5. Unscrew both connectors Ⓓ from the needle housing Ⓐ. One end is connected to the tube, the other to the needle.

6. Remove the ferrule Ⓒ from the end of the needle Ⓑ and also withdraw it from the connector.

7. Pull the ferrule off the end of the tube and remove the connector from the tube Ⓔ.

8. To re-fit the needle, reverse the process described. When seating the needle in the needle holder, **ensure that the exposed needle length is precisely 50mm ± 1mm**. Failure to do this could result in damage to the needle. Do not over tighten the securing bolt as this also may damage the needle.

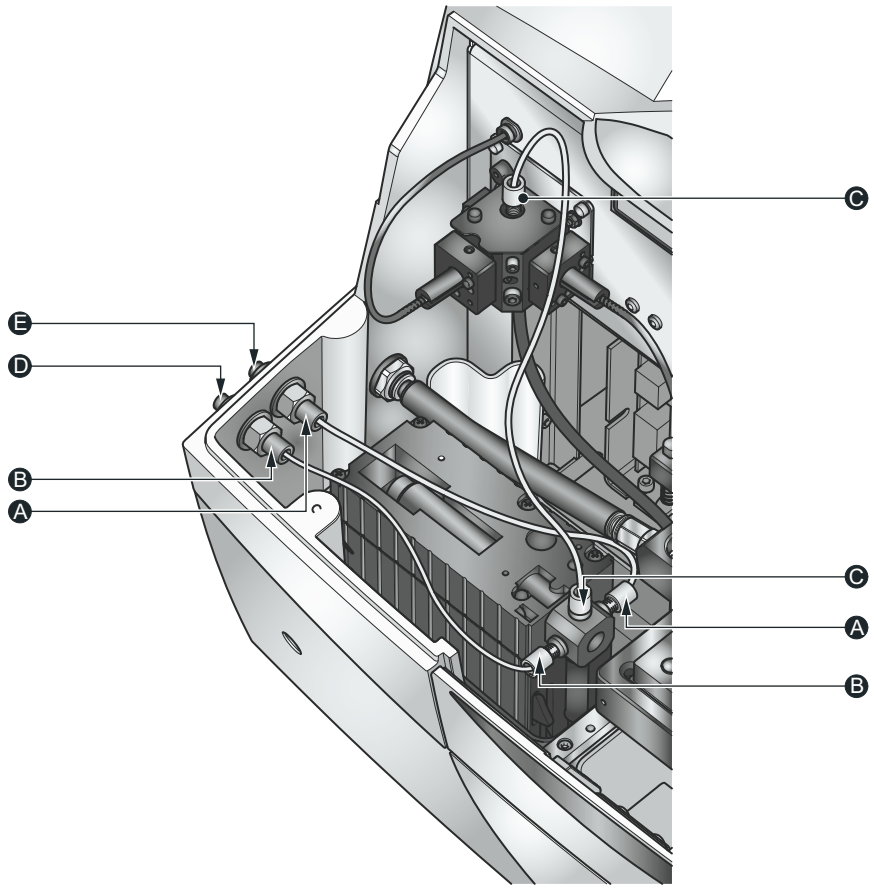
9. Referring to the **Measurement block tubing and connections** section, refit the needle tubing to the measurement block.

   Discard used needle and any tubing following the correct local waste disposal procedures.

Replacing the rinse tubing

Note:
For this section, please refer to the illustrations earlier in this chapter.

There are three rinse tubes inside the machine and two located externally.



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All tubes have connectors at both ends.

Ⓐ+Ⓑ	These two internal tubes connect the syringe pump to the inside of the external casing and are of equal length. Refer to the **Syringe pump connections** section earlier in this chapter.
Ⓒ	This tube connects the syringe pump to the measurement block. Refer to the **Syringe pump connections** and **Measurement block tubing and connections** sections earlier in this chapter.
Ⓓ+Ⓔ	These two external tubes connect to ports on the outside of the instrument - their tubes terminate in connectors that are attached to the rinse inlet filters. Refer to the **Syringe pump connections** and **Rinse inlet filters** sections earlier in this chapter.

1. Remove the lid from the Zetasizer APS instrument.
2. Unscrew all rinse tube connectors as previously described and then remove the tubes.
3. Re-fit the tubes by reversing the removal procedure.
4. Discard used tubes, following the correct local waste disposal procedures.

Installing the Zetasizer APS

The Zetasizer APS system should initially be installed and commissioned by Malvern trained personnel. This appendix shows how to re-install the system, typically required under the following circumstances:

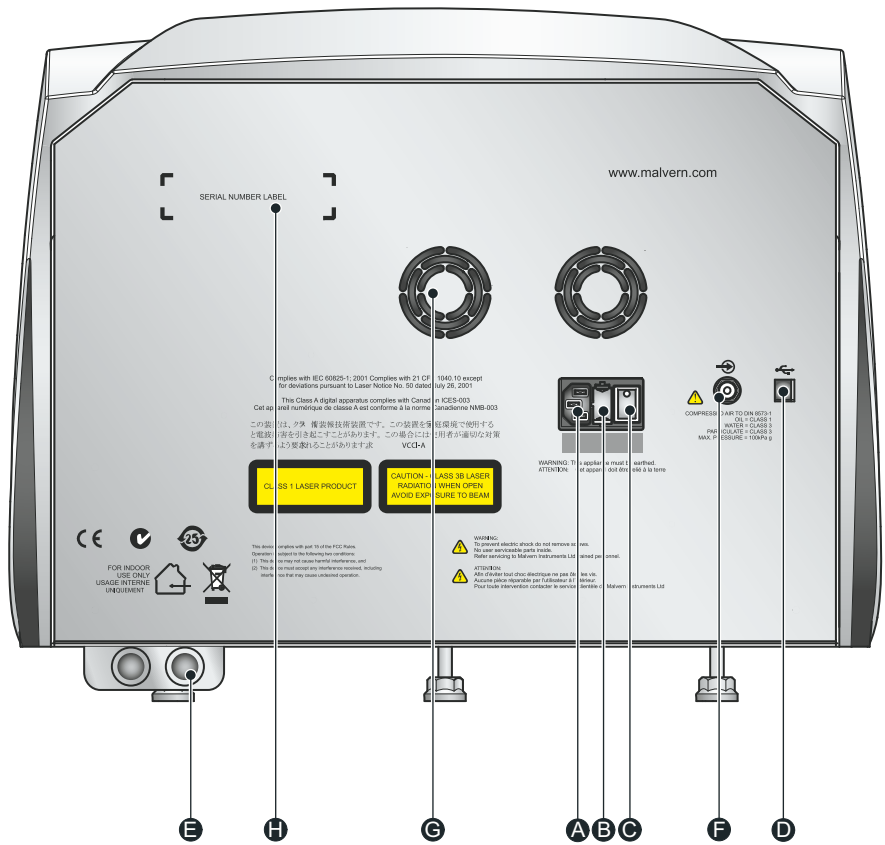
- **Moving the instrument**.
  Should it become necessary to move the system from one laboratory to another, read the information in this appendix to correctly reconnect the system.
- **Changing the computer**.
  It may be company policy to periodically upgrade computers. Detail is given on actions required.

Only install the system in a suitable environment as detailed in Site Requirements section of this document.

Warning!
Do not obstruct the ventilation slots underneath the instrument, nor the fans on the rear panel.

To install the system:

Caution!
Remove the transit locks from the instrument - refer to the **Transit Locks** section of this document. These locks should be re-fitted if the machine is shipped to another destination.



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- Connect the USB cable to the connector marked **USB** on the rear panel of the Zetasizer APS instrument Ⓓ. Connect the other end of the cable to the USB connection on the computer.
- Connect the power cable to the power socket on the rear panel of the instrument Ⓐ.

Warning!
This product must be connected to a protective earth

- Make all computer connections (mouse, keyboard, power, etc) by following the instructions provided with your computer.
- Rinse fluid: connect a bottle containing solvent to the black port on the side of the instrument. Connect a bottle containing a wash fluid to the red port on the side of the instrument.
- Place a beaker below the waste outlet.

Installation options

- If purge air is required connect to the purge air port at the base of the rear panel Ⓕ. Refer to the specification in **Appendix A**.
- If using the optional Plate Temperature Control unit, connect to input Ⓔ.

Changing the computer

If, at some point in the future, the computer used with the instrument is changed, the following actions will be required.

To install the system:

1. Insert the **Zetasizer Software** CD into the CD drive.
2. If **Autorun** is enabled on the computer, the software will start to install automatically. Follow all on-screen instructions to complete the installation.
3. If Autorun is not enabled, browse to the CD drive using Windows Explorer and double click on the file named Malvern Zetasizer Software...exe. Note: this file name changes with the version number of the software released.

Note
If the software is subsequently updated with a new version, any custom reports, parameter settings, SOPs, etc. will be preserved.

Appendix

Specification

Parameter	Specification
Size range maximum (radius) *	0.15nm to 1µm
Molecular weight range ** (est from hydrodynamic diameter)	342Da to $2x10^7$Da
Molecular weight range ** (calculated using Debye plot)	980Da to $2x10^7$Da
Minimum sample volume	20µL
Sensitivity at minimum volume	0.1mg/ml of 15kDa protein
High concentration	Yes - optically clear samples
Laser	60mW, 830nm
Temperature control	2-90°C
Temperature control accuracy	0.1°C@25°C, 0.2°C@2°C, 0.5°C@90°C
Weight	22.5kg
Dimensions	W:D:H, 500mm x 410mm x 420mm
Power	90V-260V AC, 50/60Hz ,150W
Dry air	100kPa (1bar), 4mm o.d. tubing
Computer interface	USB
Measurement technique	Dynamic light scattering (90 degrees)
Detector	Avalanche photodiode, Q.E. >50% at 830nm
Product laser class	Class 1 compliant, IEC 60825-1(1993)+A1(1997)+A2(2001)
Condensation control	Purge facility using dry air
Ambient operating conditions - Humidity	+15 to +30 °C (+59 to 86 °F) 10 to 90% (non-condensing)

* Peak mode range (radius), 0.3nm - 0.5 microns, sample and sample preparation dependent
** Sample and sample preparation dependent

PTC-1000 Thermoelectric temperature control unit (optional)

This device is referred to throughout this manual as the Plate Temperature Controller.

Parameter	Specification
Temperature range	4ºC to 40ºC +/- 0.1ºC*
Weight	12.2kg
Dimensions	W:D:H, 195mm x 351mm x 304mm
Power	115V-230V AC, 50/60 Hz, 294W
*Although the PTC-1000 is capable of maintaining its coolant within +/-0.16ºC, the plate itself is controllable within +/-2ºC.	

Chemical compatibility

Components of the Zetasizer APS that may come into contact with the sample are manufactured from materials that are considered to give the widest protection from chemical attack. However, it is important to check that any sample used is chemically compatible with the materials mentioned.

Warning!
It is advisable that the chemical compatibility is checked against the materials identified below before inserting a sample. It is also recommended that a test is performed on the material with the sample before more permanent usage is undertaken.

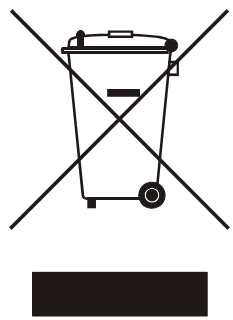
Materials used

The materials list below details all components that may come into contact with the sample or solvent.

Component	Materials
Rinse tubing	FEP
Waste tubing	FEP
Wash station	Acetal
Drain tube	Tygon
Needle	PTFE coated stainless steel
Union to hold needle	PEEK
Plate retention	Acetal and stainless steel
Plate holder	Black anodised aluminium
PTC tubing	Tygon
Microtiter plates	Variable composition

Disposal of Electrical & Electronic Equipment

This regulation is applicable in the European Union and other European countries with separate collection systems.



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This symbol on the product or on its packaging indicates that when the last user wishes to discard this product it must not be treated as general waste. Instead it shall be handed over to the appropriate facility for the recovery and recycling of electrical and electronic equipment.

By not discarding this product along with other household-type waste, the volume of waste sent to incinerators or landfills will be reduced and natural resources will be conserved.

For more detailed information about recycling of this product, please contact your local city office, your waste disposal service, or your Malvern representative.

Regulatory statements

FCC Notice (US only)

The Federal Communications Commission (FCC) mark on this product signifies conformance to FCC regulations relating to Radio Frequency Devices. These have been satisfied by testing the product against, and being found to be compliant with:

FCC CFR 47 Part 15:March 2003.Class A digital device.

The device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1) This device may not cause harmful interference, and

2) this device must accept any interference received, including interference that may cause undesired operation.

Note
This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Note
Changes or modifications not expressly approved by Malvern Instruments Limited could void the user's authority to operate the equipment.

Canadian Regulatory Information

(This applies to Canada Only.)

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

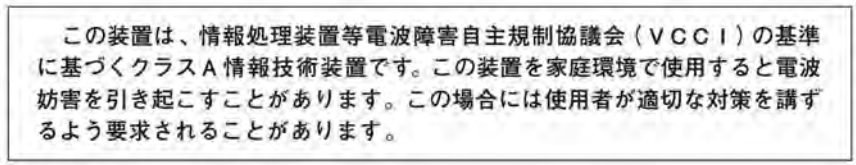
Note that Canadian Department of Communications (DOC) regulations provide, that changes or modifications not expressly approved by Malvern Instruments Limited could void your authority to operate this equipment.

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

VCCI acceptance (Japan only)

The Voluntary Control Council for Interference (VCCI) mark on this product signifies compliance to Japanese EMC regulations as specified by VCCI.



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Translation:
This is a Class A product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this equipment is used in a domestic environment, radio disturbance may occur, in which case the user may be required to take corrective actions.