Zetasizer

nano series

Basic Guide

Malvern

Zetasizer Nano 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 Nano particle analyser series.

Zetasizer Nano instrument	Model number	Measurement types
Nano S (Red badge)	ZEN1600	Particle Size and Molecular weight
Nano S (Green badge)	ZEN1500	Particle Size and Molecular weight
Nano Z (Red badge)	ZEN2600	Zeta potential
Nano Z (Green badge)	ZEN2500	Zeta potential
Nano ZS (Green badge)	ZEN3500	Particle Size, Molecular weight and Zeta potential
Nano S90 (Red badge)	ZEN1690	Particle Size - 90° optics
Nano ZS90 (Red badge)	ZEN3690	Particle Size and Zeta potential - 90° optics
Nano ZSP (Red badge)	ZEN5600	Particle Size, Molecular weight and Zeta potential

In addition, dependent upon the instrument model, the Zetasizer Nano can measure other key parameters such as Microrheology, Titration and Protein mobility.

■ Instruments with a black and red badge fitted to the instrument cover either have a 4mW 632.8nm 'red' laser or a 10mW 632.8nm 'red' laser (Nano ZSP only) fitted.

■ Instruments with a green badge have a 532nm 'green' laser.

High Temperature instruments have '**HT**' on the main instrument label. High Temperature and other build options exist for all the above instruments.

> **Note**
> For the Zetasizer model, serial number, software and firmware version, left-click the Nano icon in the right corner of the status bar.

Using this manual

> **Warning!**
> Read the **Health and Safety** chapter before operating the instrument.

Read this manual in conjunction with the main **Zetasizer Nano User manual**, the **Zetasizer Nano Accessories guide** and the appropriate dispersion unit manuals.

For more detail on the software, use its online **Help**. Each window has a **Help** button ⊘ giving further information on how to use its features.

If using the MPT-2 Titrator and Degasser, refer to the **Titrator and Degasser user manual** where necessary.

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 covers.

> **Warning!**
> Removal of the main covers by unauthorised personnel, even a supervisor, will invalidate the warranty of the instrument.

Supervisor

The supervisor is responsible for the management and safety of the instrument and its operation. The supervisor also trains the operators and can perform user maintenance routines. 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 some user maintenance routines identified.

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

Assumed information

General

The Zetasizer Nano can be used with a variety of Zetasizer Nano accessories or dispersion units that allow it to measure a variety of samples. The basic function of these is to prepare and deliver the sample to the optical unit for measurement.

For more details of any sample dispersion unit, refer to its manual.

Naming convention

Within this manual:

- The Zetasizer Nano is referred to as "the optical unit" or "the instrument".

- The accessories or sample dispersion units are referred to as "MPT-2 Titrator", "the vacuum degasser", or as "the accessory" or "the dispersion unit".

- The combination of the optical unit, one or more accessories or dispersion units and the computer is referred to as "the system".

Menu commands

Software menu commands are referred to in the form **main menu-menu item**. As an example, the command **Configure-New SOP** refers to selecting the **New SOP** item in the **Configure menu**. Menu commands are shown in bold text.

Where to get help

This section describes the available sources of information on the system. The primary sources of information on the system are instrument and accessory manuals and the software's help system. The manuals give an overview of the system as a whole, while the online help system gives more detailed information on the Zetasizer software. Some features are described in both the manuals and Help system.

Manuals

The following manuals are available for the Zetasizer Nano:

Basic Guide

A concise yet essential guide that provides an introduction to the system and its usage covering **Site requirements**, **Health and Safety** and an instrument and accessory overview. Finally **a brief guide to making a measurement and viewing the results** is included.

User Guide

The primary source of information about the Zetasizer Nano hardware and its use. See **About this manual** earlier in the chapter.

Accessory and dispersion unit guides

Separate guides are supplied with the various Nano accessories and Titrator dispersion units. These provide essential information on the connection, operation and maintenance of the dispersion units.

Help System

Each key software window has a **Help** button ![icon] giving information specific to it. Additional **Info Tips** are also available whenever ![icon] is shown - simply move the mouse pointer over this icon to see a relevant tip.

Technical support

Malvern Instruments offers several methods of technical support, which are described in this section.

Email support

> **Note**
> This is the primary support method – only use the other methods if this is not available at your location.

When contacting your local Malvern Instruments representative - details of all local telephone numbers are available at www.malvern.com. Always quote the following information:

■ **Model and serial number of the instrument**. The serial number is shown on the Zetasizer software status bar - rollover the **Nano icon** to display.

■ **The software version**. To find this select **Help-About** in the software - alternatively, move the mouse over the instrument status bar icon. The **Application Version** is the main firmware version number to note.

Additional support

Contact the International Malvern Helpdesk if the local Malvern Instruments representative is not available:

Telephone: +44 (0)1684 891800 or email: helpdesk@malvern.com.

Note
This help line is primarily English speaking.

Remote support

Malvern Instruments offers a remote support service, delivered by an internet connection. Benefits include fast and efficient fault diagnosis, as well as reducing downtime and costs.

Site requirements

Introduction

This document outlines the site requirements for a Zetasizer Nano. Ensure all these are met **before** the Malvern Instruments engineer arrives to install and commission the system.

Environmental conditions

The site must be:

- Away from strong light sources (e.g. windows).

- Away from strong heat sources (e.g. radiators).

- Well ventilated (for noxious samples).

- On a horizontal vibration-free bench built to support the weight of the system (shown below):

Unit	Weight
Zetasizer Nano	21kg
MPT-2 Titrator	5.3kg
Vacuum degasser	2.75kg

Store/operate the system in the following conditions (accurate measurements are sample-dependent, for example dry powders may stick together in high humidity):

IP rating	Designed to meet IP41B
Operational conditions	5°C to 40°C (41°F to 104°F)
Storage conditions	-20°C to 50°C (-4°F to 122°F)
Humidity	Maximum humidity 80% for temperatures up to 31°C, decreasing linearly to 50% relative humidity at 40°C
Usage	Indoor use only
Altitude	Up to 2000m
Mains supply voltage fluctuations	Up to ±10% of nominal voltage
Overvoltage category	II (IEC 60664)
Pollution degree	2 (BS EN 60664-1:2003)
Installation category	II (BS EN 60664-1:2003)

In addition:

■   Do not obstruct power sockets as they may need to be disconnected during an emergency.

■   Avoid passing electrical cables through areas where liquids can be spilt.

Space required

Provide enough space to allow easy access to all components and connections. Allow at least **800mm** above the bench surface for access to the cell area and accessories.

Component dimensions are: (the width is with the cuvette holder closed):

Component	Width	Depth	Height
Zetasizer Nano	320mm	622mm	260mm
MPT-2 Titrator	170mm	390mm	260mm
Vacuum degasser	75mm	250mm	130mm
Computer and printer	See manufacturer's documentation		

This diagram shows the minimum recommended space required for a typical system using an MPT-2 Titrator, and its computer.
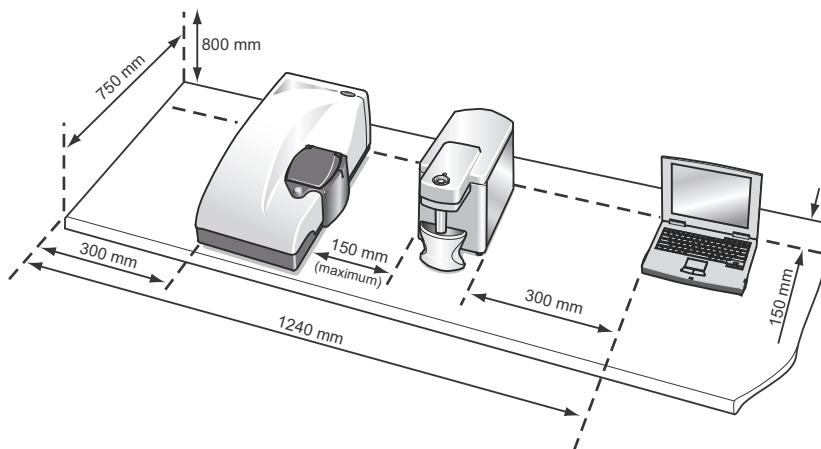
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Services

This section describes the services required.

General

The following services are required for each component:

Component	Zetasizer Nano	MPT-2 Titrator	Vacuum degasser
Power sockets	1	1	1

■   In addition, the computer system requires one or more power sockets.

Power specification

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:

Unit	Power requirement
Zetasizer Nano	~ 100-240V, 50-60Hz
MPT-2 Titrator	~ 100-240V, 50-60Hz
Vacuum degasser	~ 100-240V, 50-60Hz

> **Note**
> Only use the PSU/cables provided. Using another PSU voids any warranty and may be unsafe.

Additional services

Laser safety

Zetasizer Nano 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.

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.

The purge inlet port can be used to connect a dry air supply to the instrument, 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. The air 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 g

For connection purposes, the purge connection uses an M5 internal thread.

> **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.

MPT-2 Titrator services

Nitrogen purge specification

	Warning!
⚠️	A Nitrogen supply must be used in a well ventilated environment.

The MPT-2 Titrator has a purge connector for connection of a Nitrogen purge supply. This can be used to blanket the area directly above the sample and prevent any absorption of Oxygen that may change the pH characteristics of the sample, i.e. cause a pH drift.

If a Nitrogen supply is required it must conform to these specifications:

- The Nitrogen supply must be dry, free from oil and filtered to remove any contaminants that could affect the sample.

- The flow rate should be adjustable between 2 and 20 ml/min.

Computer specification

Contact the Malvern Helpdesk or website for the recommended computer specification. This is also provided in the Software Update Notification.

Health and safety

Introduction

This chapter provides Health and Safety information. **All users must read this section**. The topics covered are:

- General safety issues
- Laser safety issues
- Power cords and power safety
- Moving the system
- Maintenance of the instrument
- Sample handling warnings
- Disposal of the instrument

General safety issues

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

Site requirements

The system has specific site requirements that must be enforced to ensure safe operation of the instrument - refer to the **Site requirements** chapter.

Warning!
Safety may be compromised if the system is used in an environment not conforming to the site requirements.

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.

Purge warnings (MPT-2 Titrator)

Warning!
If a Nitrogen supply is used the system must be located in a well ventilated environment. Turn **off** the supply when not in use.

Temperature warnings

Warning!
The warning triangles on the cuvette lid and thermal cap warn of potentially hazardous temperatures within the cell area. The temperature range of the cell area is 2°C to 90°C for the standard instrument, 2°C to 120°C for the High Temperature option.
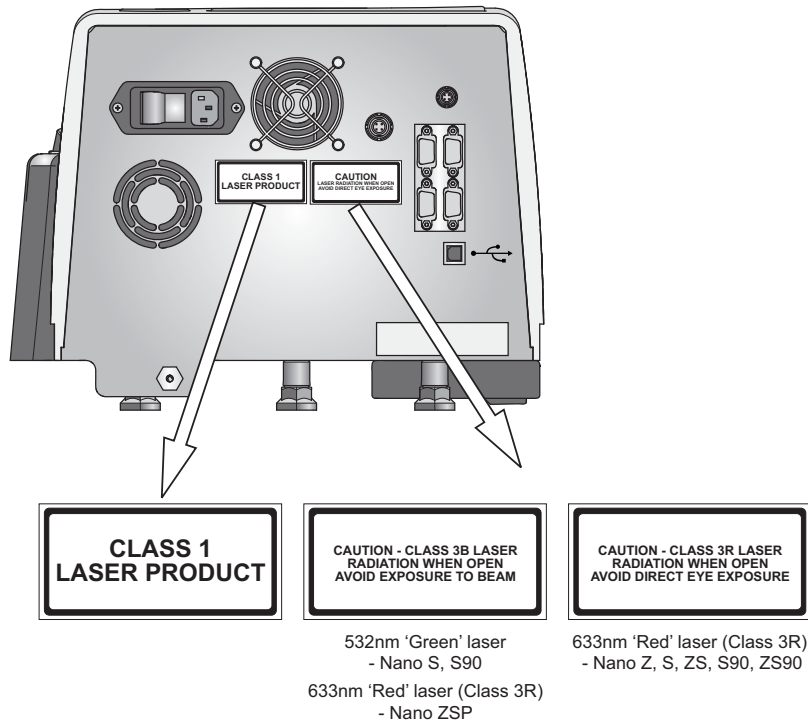
Laser safety warnings

The **Zetasizer Nano** optical unit is a **Class 1** laser product and, as such, there is no exposure to laser radiation in its normal operation. The laser passes through the cell area but this area is enclosed when the cell is fitted. When the cell is not fitted, a mechanical laser shutter prevents exposure to laser radiation.

> ⚠️ **Warning!**
> Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

This diagram shows the location of the laser warning labels:

**CLASS 1
LASER PRODUCT**

**CAUTION - CLASS 3B LASER
RADIATION WHEN OPEN
AVOID EXPOSURE TO BEAM**

532nm 'Green' laser
- Nano S, S90

633nm 'Red' laser (Class 3R)
- Nano ZSP

**CAUTION - CLASS 3R LASER
RADIATION WHEN OPEN
AVOID DIRECT EYE EXPOSURE**

633nm 'Red' laser (Class 3R)
- Nano Z, S, ZS, S90, ZS90

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Zetasizer Nano Z, S, ZS, S90, ZS90 specification - 'Red' laser

Item	Specification
Light source	He-Ne Laser
Power	Internal laser maximum output of less than 4mW (CW)
Beam wavelength	632.8nm

Zetasizer Nano S, S90 specification - 'Green' laser

Item	Specification
Light source	He-Ne Laser
Power	50.0mW
Beam wavelength	532nm

Zetasizer Nano ZSP specification

Item	Specification
Light source	He-Ne Laser
Power	10mW
Beam wavelength	633nm

Electrical safety warnings

The Zetasizer Nano and its dispersion units are mains powered; treat input power cables accordingly. The metal parts of the system are earthed via a protective earth connection.

Warning!
This product **must** be connected to a protective earth.

Take care when measuring samples not to spill liquid or powder over the system covers. Conducting materials or liquids can damage insulation and cause dangerous conditions. If a spillage occurs, disconnect the power and scrupulously clean up before re-applying power to the system. Users who suspect powder or liquid has entered the covers should call a Malvern representative to arrange a service call.

Warning!
Never attempt to remove the covers; always contact a Malvern representative.

PAT testing

If PAT testing is required, connect the earth lead to the appropriate earth stud. 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 unit.

Warning!
Only operate this product with the power supply unit provided with the instrument.

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

Warning!
Do not use the power cord received 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 further information on power cord set 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.

- Route the power cord so it is not likely to be walked on or pinched by items placed upon it 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 indicate guidelines to follow when 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 dispersion unit into a correctly earthed electrical outlet.
> 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 dispersion unit, 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

> **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 of the instrument or dispersion unit. Use care when handling the adapter during or immediately after operation.

- Use only the Malvern-provided AC adapter approved for use with the instrument/dispersion unit. Using a different adapter may cause fire or explosion.

Advice on use of Uninterruptible Power Supplies (UPS)

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

Moving the system

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

Moving the optical unit

- Disconnect the computer and power supply before trying to move the system.

> ⚠️ **Warning!**
> The optical unit weighs 21kg. Adopt proper lifting techniques to avoid back injury.

- Always lift the instrument by holding it under both of its short sides, with a firm grip on the metal base plate. Never lift an instrument by its covers.
- If moving the instrument large distances, we recommend repacking the instrument in its original packaging.

Moving sample dispersion units

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

- Disconnect the power supply before attempting to move the dispersion unit.
- Disconnect and drain or vent any tubing carrying fluids or compressed air, including sample tubing, before moving the dispersion unit.
- Lift the dispersion unit by holding it under the base.

> ⚠️ **Warning!**
> The Titrator and Degasser dispersion units weigh 5.3kg and 2.75kg respectively. Adopt proper lifting techniques to avoid back injury.

- If moving it large distances, we recommend repacking the unit in its original packaging.

Maintenance of the instrument

This section covers the user maintenance procedures for the **Zetasizer Nano optical unit**. Do not attempt any maintenance procedure not specified here.

Note
Maintenance procedures and details of consumable parts kits for the individual dispersion units are provided in their respective user manuals.

An operator can perform all procedures **except replacing fuses**.

General maintenance warnings

Warning!
Before carrying out any maintenance operation, read and observe the all other safety warnings listed in **this chapter**.

Warning!
The system contains no internal serviceable parts. Never attempt to remove the covers of the optical bench or an accessory or dispersion unit. Removal of the covers invalidates the warranty and may expose the user to dangerous laser radiation.

Warning!
Failure to follow these guidelines could result in the emission of laser radiation or exposure to hazardous voltages. Laser radiation can be harmful to the body and can cause permanent eye damage.
The Zetasizer Nano accessory units do not contain a laser but are connected to the optical bench that does.

Optical bench specific warnings

Warning!
Before cleaning, always disconnect the unit from the power supply and computer and disconnect all electrical cables.
Ensure the unit is completely dry before re-applying power.

Cleaning the covers

> ⚠️ **Caution!**
> The surfaces of the system may be permanently damaged if samples or dispersants are spilt on them. If a spillage occurs, disconnect the system from the power supply before carefully cleaning it up.

Periodically clean the covers thoroughly using a mild soap solution.

Never use excessive liquid for cleaning and always avoid electrical components (connectors etc.) and the cell windows.

Never use a solvent based solution for cleaning; it may damage the surface.

Cleaning the cells and accessories

Clean cells thoroughly between measurements, especially between different types of sample. Cross-contamination between samples can seriously affect the results.

Please refer to the **Zetasizer Nano Accessories guide** for information on cleaning and maintaining the cell and accessories associated with the Zetasizer nano instrument.

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 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 faulty fuses with others of the following specification:

- Rating – T 2A L 250v (T = Time delay)
- Size – 5mm x 20mm
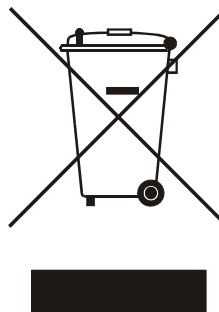
Sample handling warnings

- 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 within 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 dispersant 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. Recommendations can be found in the **Material Safety Data Sheets**.

- The surfaces of the system may be permanently damaged if samples are spilt onto them. If spillages should occur, then the system should be disconnected from the power supply before scrupulously cleaning up the spillage.

Fumes

Use the system in a fume cupboard if using dispersants that emit hazardous fumes. Consult Malvern Instruments before using dispersants with ignitable vapour.

Disposal of the instrument

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 the local city office, the waste disposal service, or the Malvern representative.

4

System Overview

Introduction

This chapter gives a brief introduction to the Zetasizer Nano instrument and describes how to do perform a simple Zeta measurement using the Zeta potential transfer standard that is included with the system.

A full description of the Zetasizer nano system, the hardware and software can be found in the following manuals:

- **Zetasizer Nano User manual**
- **Zetasizer Nano Accessories guide**
- **MPT-2 Titrator and degasser manual**

Briefly...

A typical system, shown below, comprises the Zetasizer instrument ① and a computer with the Zetasizer software installed ②. A cell ③ is filled with the sample and loaded into the cell area on the top of the instrument ④.
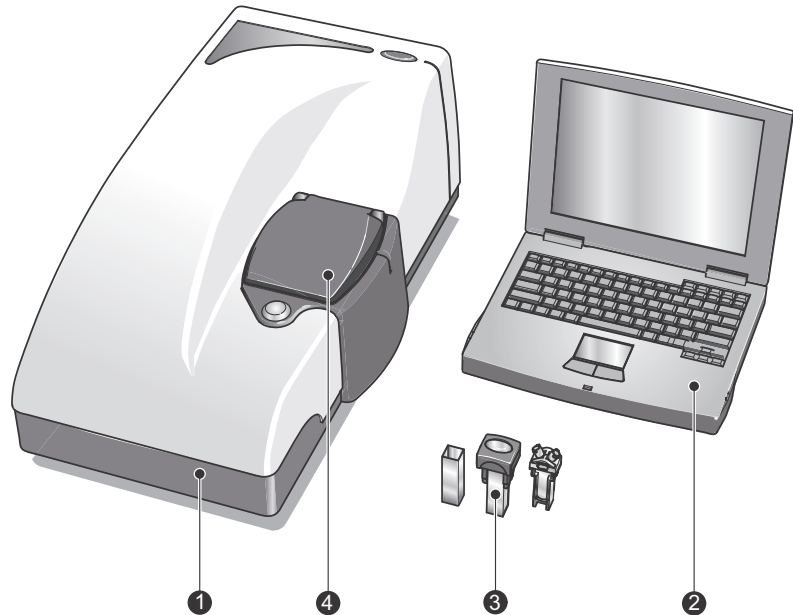
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The software is used to control the measurement of the sample, there are two basic ways to make a measurement:

■ **Manual measurements** - all of the measurement settings are specified before the measurement and some further user input is required during the running of the measurement. The measurement process is also split into key stages, which are paused after the completion of each stage.

Manual measurements tend to be used for one-off measurements or as part of method development (i.e. establishing the optimal settings for measuring the sample and then saving into an SOP file).

■ **Standard Operating Procedure (SOP) measurement**s - most of the measurement settings are stored within an SOP file which has been previously created by the user. Once an SOP has been initiated, the measurement sequence requires less user intervention than a manual measurement.

As SOPs lock-down most of the measurement settings they improve consistency and provide greater repeatability; features that are important in quality controlled environments.

The Zetasizer Nano hardware

The diagram below shows a typical system with its key modules. The MPT-2 Titrator, shown alongside, can be included to form part of the overall system.
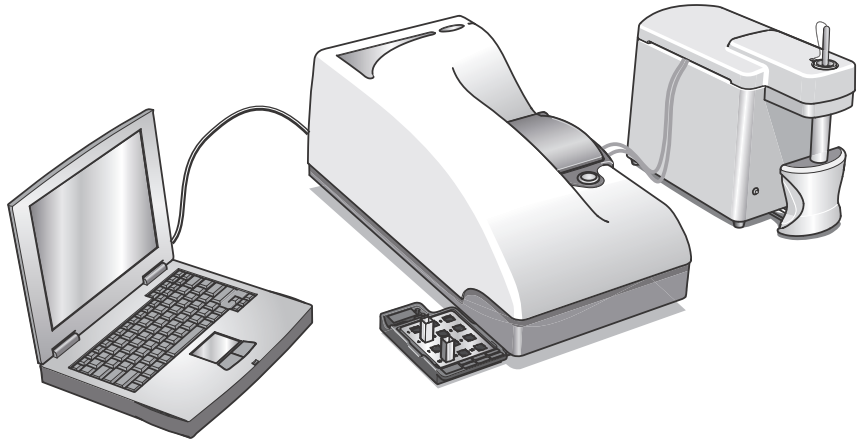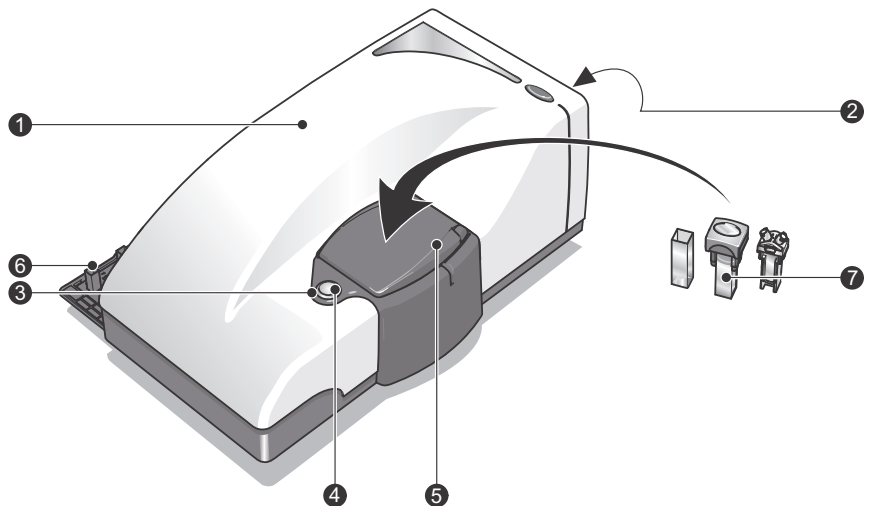
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The Zetasizer Nano instrument

Optical unit

Positioned on the cover are two labels - one to identify the instrument and another to identify the instrument model.

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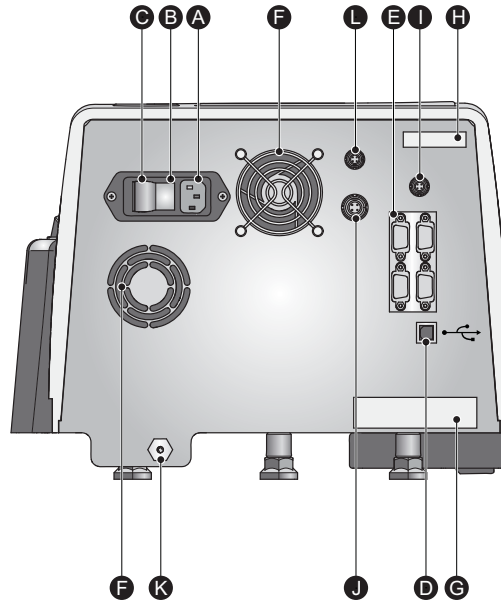① Optical unit   ⑤ Cell area

② Rear Panel   ⑥ Cuvette holder

③ Status indicator   ⑦ Cells and Cuvettes

④ Cell access button

Rear Panel

The rear panel provides all the connections. These are identified below.

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Ⓐ Power input socket   Ⓖ Serial number and Model number label

Ⓑ Fuse holder   Ⓗ Mod record

Ⓒ Power switch   Ⓘ Accessory output

Ⓓ Computer connection.   Ⓙ Green laser PSU input

Ⓔ Accessory connections   Ⓚ Purge connection

Ⓕ Cooling fans   Ⓛ Flow-mode connection

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

⚠️ **Warning!**
Only connect Malvern approved accessories.

⚠️ **Caution!**
It is important that the purge air line supply conforms to the above specification. Failure to meet this specification may result in permanent damage and invalidation of the warranty.

Status indicator

The status indicator is an illuminated ring (or bezel) positioned around the **Cell access button** ④, and shows the operational state of the instrument.

Cell access button

Positioned in the middle of the **Status indicator** ③, pressing the button will open the cell area lid.
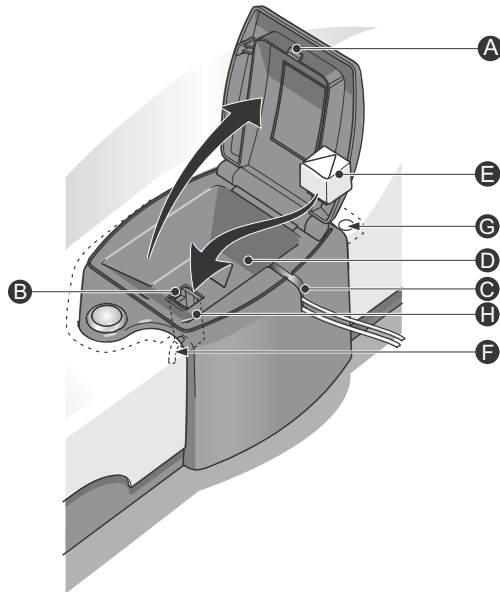
Cell area

⚠️ **Warning!**
The system is capable of heating the cell to high temperatures. Care should be taken when removing the cells if a measurement has been performed at high temperatures. It is recommended that the cell area is allowed to cool before removing the cell.
A **warning triangle** is provided in the cell basin.

The cell area is where all cells are inserted to undertake a measurement. The cell area is completely self enclosed and controls the sample temperature over the range 0°C to 90°C (up to 120°C for high temperature instruments).

Features of the cell area

Other important features of the cell area are described below.

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Ⓐ Cell area lid	Ⓔ Thermal cap
Ⓑ Electrodes	Ⓕ Drain port
Ⓒ Access channel for Titrator and flow cell tubes	Ⓖ Drain channel
Ⓓ Cell basin	Ⓗ Cell clamp

Cuvette holder

The cuvette holder is for storing the cells before and after use. the cuvette holder swings out from the instrument and up to 12 cuvettes can be stored
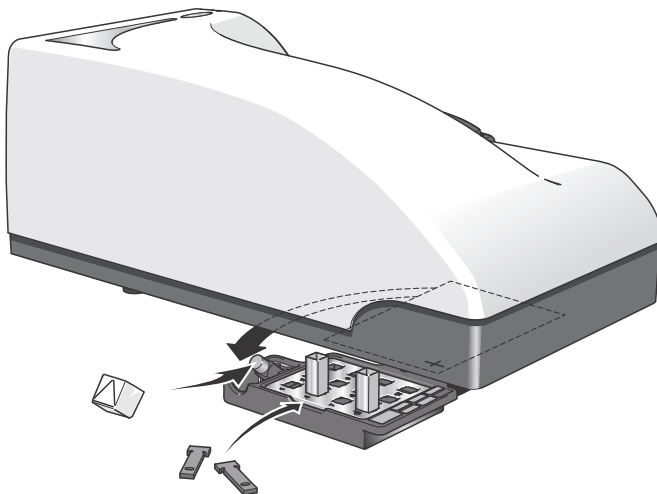
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Cells and Cuvettes

A range of cells and cuvettes are available to use with the Zetasizer instrument. Full details are given in the **Zetasizer Nano Accessories Guide**, but briefly the following cells can be used.

Cell	Application
Disposable "polystyrene" cuvettes – Standard and Small volume	Size and Zeta potential (with dip-cell)
Folded capillary cell	Size and Zeta potential
High concentration cell	Size and Zeta potential
Quartz glass cuvettes – Square, Standard, Low and ultra-low volume, flow	Size, Molecular weight and Zeta potential (with dip-cell)
Universal 'Dip' cell	Zeta potential
Surface Zeta Potential cell	Zeta potential

The Zetasizer software

The Malvern Zetasizer software controls the system during a measurement and then processes the measurement data to produce either a size, zeta potential or molecular weight result. It displays the results and allows reports to be printed.

The Zetasizer software application

A typical screen is shown below. The features and their function are described in the following sections.

ill 7792

① Menu baropo[o[o	④ Title bar
② Toolbars	⑤ Measurement display
③ Measurement file window	⑥ Status bar and Status icons

Menu bar

The menu bar contains the main menu headings for all software functions.

File Menu	The **File** menu can be used to either create a **New** Measurement or SOP file, or **Open...** an existing Measurement or SOP file.
Edit Menu	This allows movement and manipulation of records in the Measurement file window(s). Records can be **cut**, **copied**, **pasted** and **deleted** into their own or other measurement files.
View Menu	The **View** menu selects which reports will be shown in the measurement file window and which **Toolbars** are to be displayed.
Measure Menu	Select this menu when ready to perform a measurement. There is a choice of using an existing measurement SOP (**Measure-Start SOP...**) or manually setting up the measurement and sample details (**Measure-Manual**).
Tools Menu	Contains all tools that can be use to aid in the measurement, display and reporting functions of the software
Security Menu	To prevent unauthorised changes, the Malvern software has a Security installed can be configured to limit each user's access to various functions.
Window Menu	Use this menu to alter the view characteristics of any measurement file windows that are open - i.e. minimise, tile, and cascade the measurement file windows.
Help Menu	**Help Topics...** give access to the help files.

Toolbars

The toolbars contain a selection of tools that can be used to perform the most popular operations. Each tool will have its equivalent commands within the menu bar.

Measurement file window

The measurement file window displays all the information for 'one' measurement file. More than one measurement file window can be displayed at a time. The contents of the window will change when a **Record** or **Report tab** is selected.

|	
Measurement file workspace	When performing zeta potential measurements, it may be unnecessary to see parameters associated with size measurements in the measurement file window. A **measurement file workspace** called **zeta potential** is available that displays only parameters associated with zeta potential measurements.
Record and Report tabs	Measurement records are viewed with the **Records view** tab; this gives a listing of all the measurement records in any measurement file. The **Records view** tab is always shown as the prominent report tab when a new measurement file is opened.
	Selecting a **report tab** will display a predefined report as selected by the **Report pages** tab in the **workspace** windows. Malvern supplies several reports that give different views of the measurement settings and results, whilst custom reports can be generated using the **Report Designer** feature.

Title bar

The title bar displays the software name and the file name of the currently selected measurement file.

Measurement display

When a measurement is being performed the **measurement display** is shown.
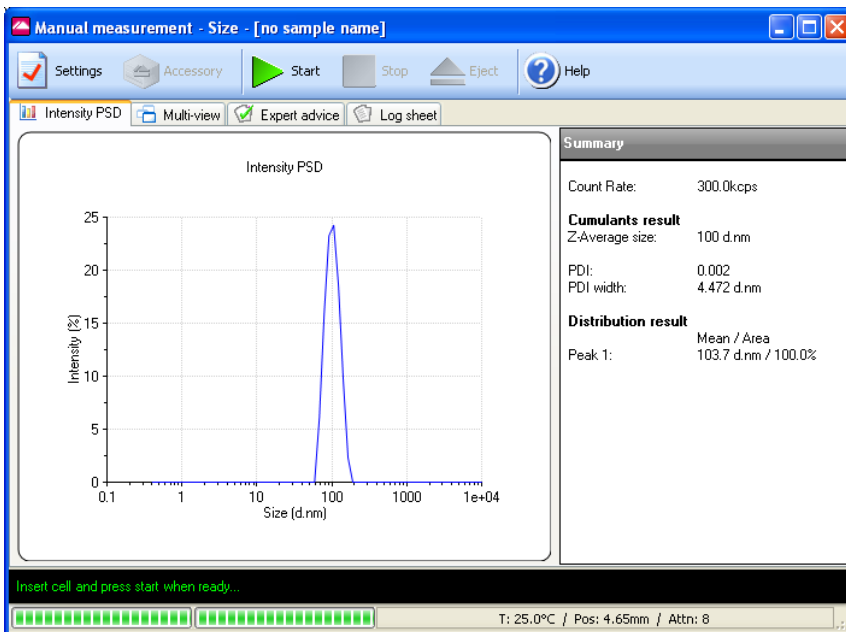
The Measurement display shows the progress of the measurement. The screen display shown changes depending on the type of measurement being performed and the view tab selected.

Status bar and Status icons

The status bar gives an indication of the instrument's current operating state and an extended description of the tool icons. If required, use the **View-Toolbars-Customise...**. window to disable it.

On the right of the status bar, icons are shown to detail which instrument is connected and what additional features may be installed. In this case a Zetasizer Nano is connected.

Connecting the Zetasizer Nano

It should be noted that the Zetasizer Nano system should initially be commissioned by Malvern trained personnel. This section will show how to re-install the system, typically required under the following circumstances:

- **Moving the instrument**.

- **Changing the computer**.

Installing the system

ill 7905
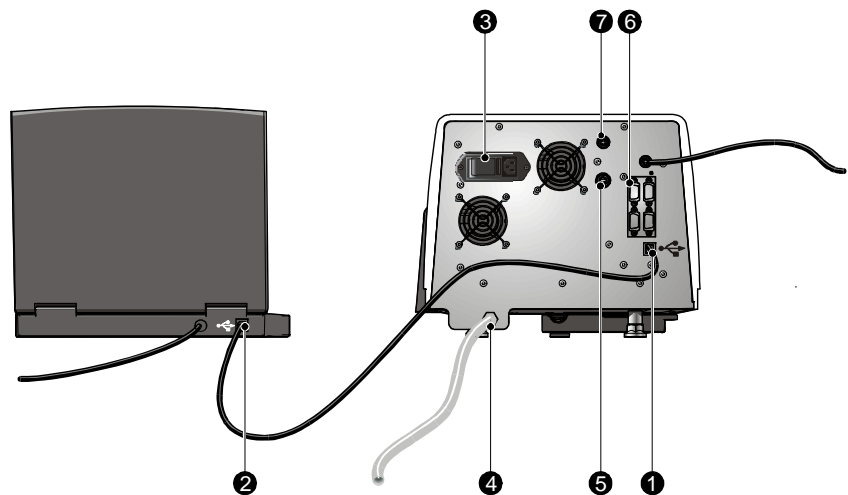
- Connect the USB cable to the connector marked **USB** on the rear panel of the Zetasizer Nano instrument ①. Connect the other end of the cable to the USB connection on the computer ②.

- Connect the power cable to the power socket on the rear panel of the instrument ③.

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.

Installation options

- If purge air is required connect to the purge air port at the base of the rear panel ④.

- If the instrument is fitted with the 532nm 'green' laser option connect the laser PSU to the PSU input on the rear panel ⑤.

- If accessories are used connect these to the appropriate ports as described in their respective user manuals ⑥. Follow any further in their respective user manuals

- If the instrument is connected to an external detector and the flow-mode facility is used; connect the input signal cable to this connection ⑦.

Changing the computer

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

Consult the software update notification supplied with the software.

Installing the software

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, select **Start-Run-Setup** and follow the on-screen instructions.

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

Power on

If it is not already switched on, turn on the instrument and start the software, as described in the previous chapter. Remember that the instrument **must be powered up for 30 minutes before a measurement is made**.

Performing a quick measurement

Enclosed with the System is an installation test is the Zeta potential transfer standard plus an installation macro that allows both a **Sizing** and **Zeta** measurement to be performed.

This can be used run through the processes involved with preparing a sample and running a measurement, and also to see that the system performs correctly.
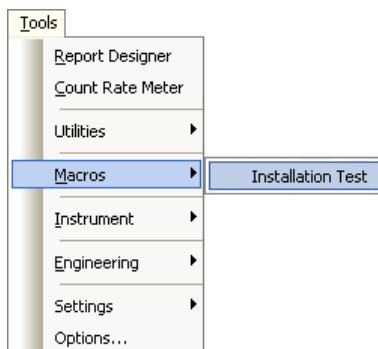
Unpack the Zeta standard

Take the **Zeta potential transfer standard** syringe from the pack this document was in.

Run the Installation test macro
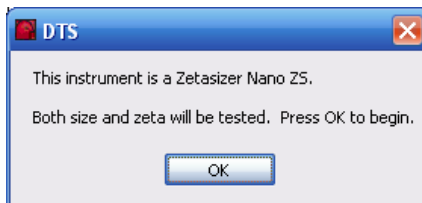
Enclosed with the System is an installation test

When the software has been started, select **Tools-Macros-Installation Test**:

> **Note**
> The results are saved to a measurement file named **Installation Test.dts** which opens automatically.

The instrument reports what it is going to test: size, zeta potential or both. Use this information to decide which cell(s) to prepare.

DTS

This instrument is a Zetasizer Nano ZS.

Both size and zeta will be tested. Press OK to begin.

OK

Note

This is the instrument confirming which type it is. In brief, if the instrument name contains an **S** it tests **size** and if it contains a **Z** it tests **zeta potential**. A Zetasizer Nano **ZS** or **ZS**90 tests both.

Fill the cuvette and/or cell

Prepare the appropriate cuvette/cell for size and/or zeta potential measurement as described here. For example, if the instrument reported just now that it will test only zeta potential measurement, skip the **Size test** procedure below.


Important

Always hold the cuvette or cell near its top, not the optical area near its base. Fingerprints, grease or dust on the lower area will cause the test to fail.

---
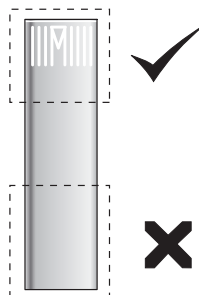
ill 8486

Size test

a. Take a square plastic cuvette (not a glass one) from the consumables pack.

b. Fill it with between 1.0mL and 1.5mL of the supplied **Zeta potential transfer standard** from the syringe, as follows.

c. Tilt the cuvette and allow it to fill slowly. To stop bubbles forming, let the sample flow down the inside.
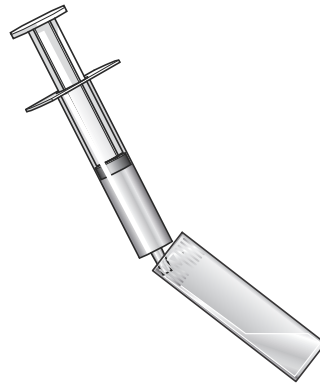
ill 7935

d. The sample depth should be between 10 and 15 mm. This can be checked by placing the cuvette against the diagram on the inside of the cell area lid.

Max: 15mm

Min: 10mm
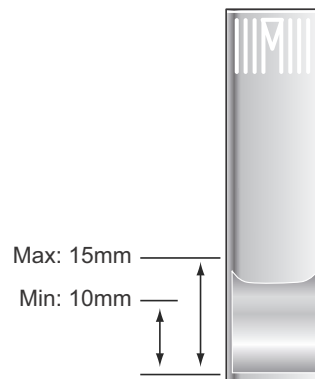
ill 7936

**e.** Push the lid securely onto the cuvette:
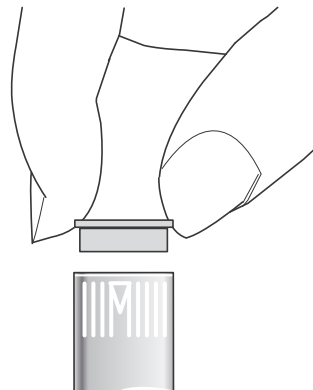
ill 7937

Zeta potential test

a. Take a supplied **Folded capillary cell** and rinse internally with ethanol or methanol. A syringe or wash bottle can be used. Use sufficient fluid to just wet the inside surface of the cell and the electrodes.

b. Flush the cell through with de-ionised water to clean. Flushing a few 10ml syringe full through the cell should suffice.

c. Invert the cell ①:

ill 7938
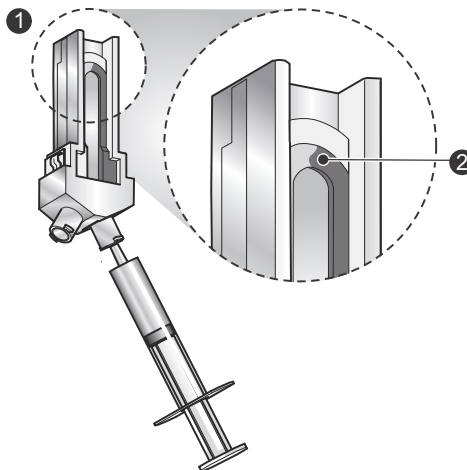
d. Slowly inject the **Zeta potential transfer standard** from its syringe into the cell, filling the U tube to just over half way ②.

e. Check no air bubbles form in the cell. Tap the cell gently to dislodge any that do form.

f. Turn the cell upright and continue to inject slowly until the sample is at the top of the electrodes ③.

ill 8485
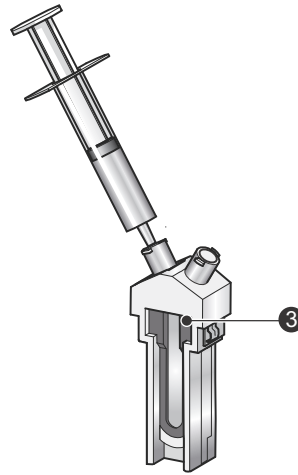
g.   Check again for bubbles in the cell. Tap the cell gently to dislodge these.

h.   Ensure that both electrodes on the inside of the cell are completely immersed in the sample.

i.   Remove the syringe and insert a cell stopper in each port:
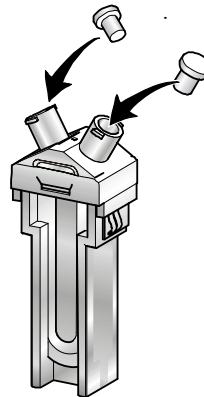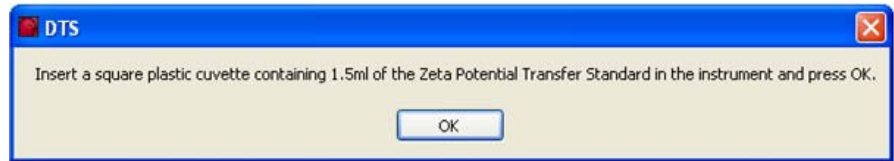

ill 7940

j.   Remove any liquid spilt on the outer part of the electrodes and the outside of the cell.
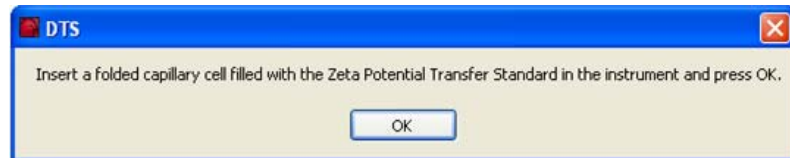
Load the cell

Depending on the test being run, one of these prompts is displayed:

For a **Size test**:

DTS   ☒

Insert a square plastic cuvette containing 1.5ml of the Zeta Potential Transfer Standard in the instrument and press OK.

OK

For a **Zeta potential test**:

DTS   ☒

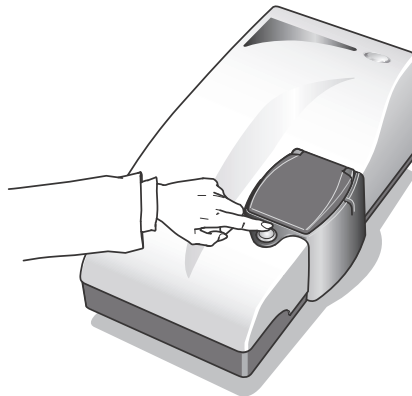Insert a folded capillary cell filled with the Zeta Potential Transfer Standard in the instrument and press OK.

OK

Load the appropriate cell in the instrument, following the procedure below, then click **OK**.

Size test

a. Press the button to open the measurement chamber lid:

ill 7942

b. Most cuvettes have a triangle or spot mark. This must face towards the **front** of the Nano:

ill 8487

c. Push the cuvette down so it is firmly located then push down the chamber lid:
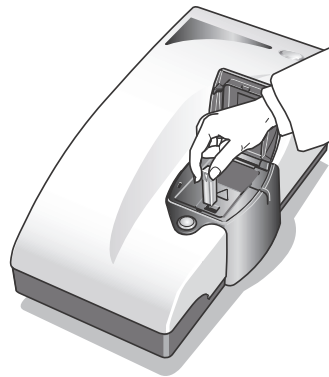
ill7944

Zeta potential test

a. Press the button to open the measurement chamber:
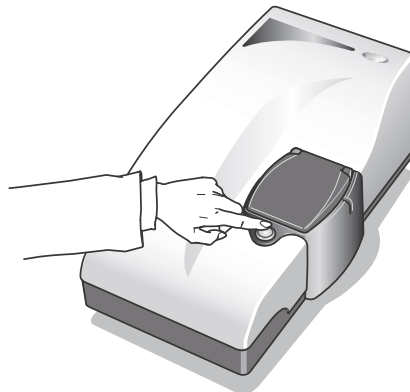
ill7942

b. The cell has a weld line just behind the front surface, as shown here:
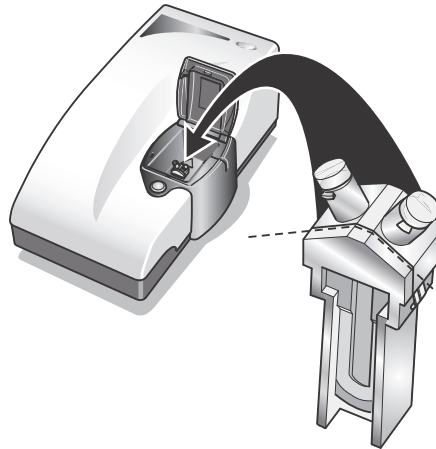
ill 7945

c. Holding the cell near its top, turn the weld towards the front of the instrument. It **must** face the front of the Nano when inserted.

d. Push the cell into the cell holder until it stops.

ill 7946

e. Close the measurement chamber lid to cover the cell.

The test runs - pass or fail?

Each test should take no longer than about six minutes.

a. After a two minute thermal equilibration period, the window will show the test running, like this:
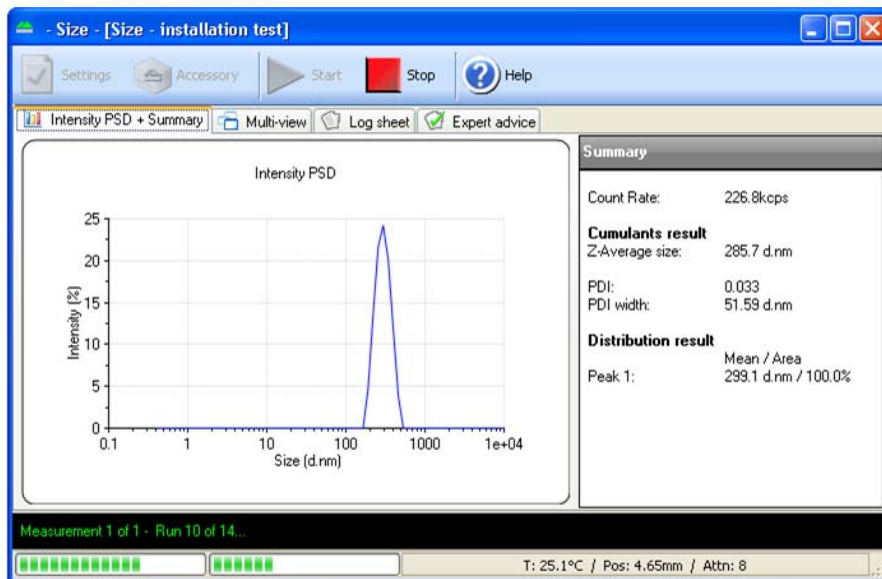
b. The test reports whether the system passed or failed, thus:
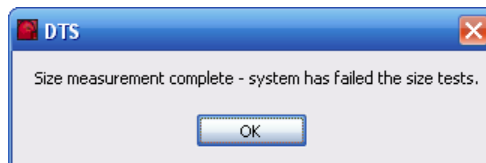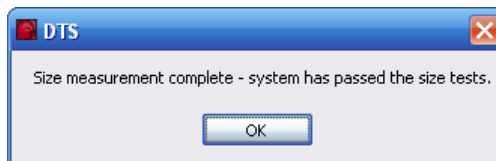
■ The instrument is **setup correctly** if the performed test or tests **pass**.

■ If testing **both** size and zeta potential, after the Size test the instrument prompts for the capillary cell for the Zeta potential test.
The instrument is only set up correctly if both tests pass.

> **Note**
> The results will be stored as a record in the measurement file **Installation test.dts**.

In case of failure....

If a **failure** message is displayed for either test type, repeat the measurement as described here.

a.   Insert a new sample in a new cuvette/cell and measure it, **ensuring that**:

- The correct cell type is used.

- The measurement chamber lid is closed properly.

- There are no bubbles in the sample.

- The cell is clean and free from fingerprints, grease and dust.

b.   In addition, for a **Size test**:

- Check that between 1.0mL and 1.5mL is injected into the cuvette (giving a sample depth of 10mm to 15mm as shown in Step 4 above).

- Check that the triangle on the cuvette faces forward (see step 5 above).

c.   In addition, for a **Zeta potential test**:

- Wet another cell thoroughly using ethanol or methanol as described earlier, then check that there are no scratches on it. Wipe it dry with a lint-free cloth (we recommend camera lens cleaning pads). **Do not try to clean the optical area on the front of the "U" part of the cell as this will cause small scratches which can distort the result**.

- Check that the capillary cell is full.

- Ensure that the cell plugs are inserted firmly.

Finally....

If the test continues to fail, contact the local Malvern representative (before calling make a note of the instrument's serial number.)

Viewing the results

To view the result, select one of the Installation tests **records** – Size or Zeta – and then click one of the **Report** tabs. The following examples displayed on the next page show:

- The **Intensity PSD (M)** report for a **size** test (top report).

- The **Zeta potential (M)** report for a **zeta potential** test (lower report).

⊙ Intensity PSD (M)

Sample Name:	200nm Polystyrene Latex
SOP Name:	200 size plastic cell.sop
File Name:	Example Results S.dts
Record Number:	62
Material RI:	1.59
Material Absorbtion:	0.01

Dispersant Name:	Water
Dispersant RI:	1.330
Viscosity (cP):	0.8872
Measurement Date and Time:	30 May 2008 16:25:25

Temperature (°C):	25.0
Count Rate (kcps):	317.9
Cell Description:	Glass cuvette with round aperture

Duration Used (s):	60
Measurement Position (mm):	1.05
Attenuator:	3

		Diam. (nm)	% Intensity	Width (nm)
Z-Average (d.nm): 200.0	**Peak 1:**	208.9	100.0	48.08
Pdl: 0.012	**Peak 2:**	0.000	0.0	0.000
Intercept: 0.945	**Peak 3:**	0.000	0.0	0.000
Result quality : Good				

Intensity PSD (M) report for a size test
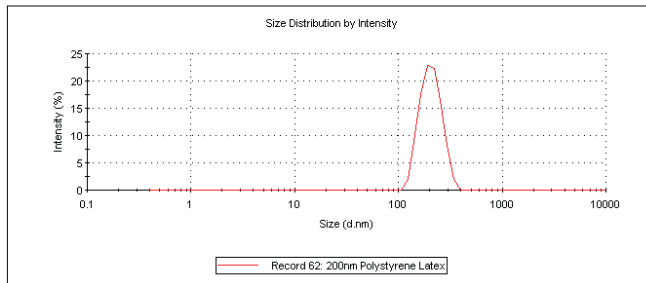
ill 8488

⚙ Zeta potential (M)

Sample Name:	DTS1230 Zeta Potential Transfer Standard
SOP Name:	Test Zeta standard.sop
File Name:	Example Results S.dts
Record Number:	69
Date and Time:	30 May 2008 15:08:15

Dispersant Name:	Water
Dispersant RI:	1.330
Viscosity (cP):	0.8872
Dispersant Dielectric Constant:	78.5

Temperature (°C):	25.0
Count Rate (kcps):	165.6
Cell Description:	Clear disposable zeta cell

Zeta Runs:	12
Measurement Position (mm):	2.00
Attenuator:	8

		Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV): -69.4	**Peak 1:**	-69.4	100.0	8.23
Zeta Deviation (mV): 8.23	**Peak 2:**	0.00	0.0	0.00
Conductivity (mS/cm): 0.331	**Peak 3:**	0.00	0.0	0.00
Result quality : Good				

Zeta potential (M) report for a zeta potential test
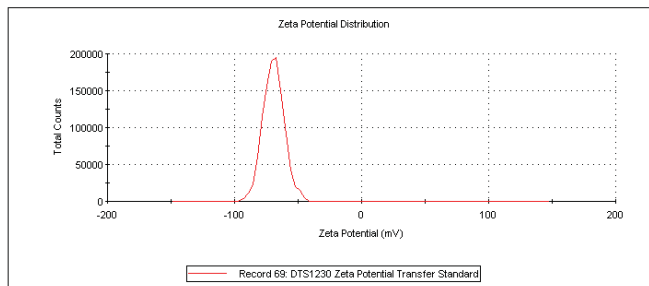
ill 8189

Next...

Once the instrument is setup and its performance validated with the Zeta transfer standard, it is ready for use. Measurements are made using **Standard Operating Procedures** (SOPs) as described in this chapter.

Malvern Instruments supplies some default SOPs, others may be created by supervisors/advanced users.

To run an SOP:

1. Select the command **Measure-Start SOP**:

2. Available SOPs are listed in a selection window. Select the SOP to use and click the **Open** button.

3. Follow any on-screen instructions to run the SOP. Clean and load the cuvette or cell exactly as described above for the self-installation test.

4. As the SOP analysis runs, results will be displayed, as in the following example:
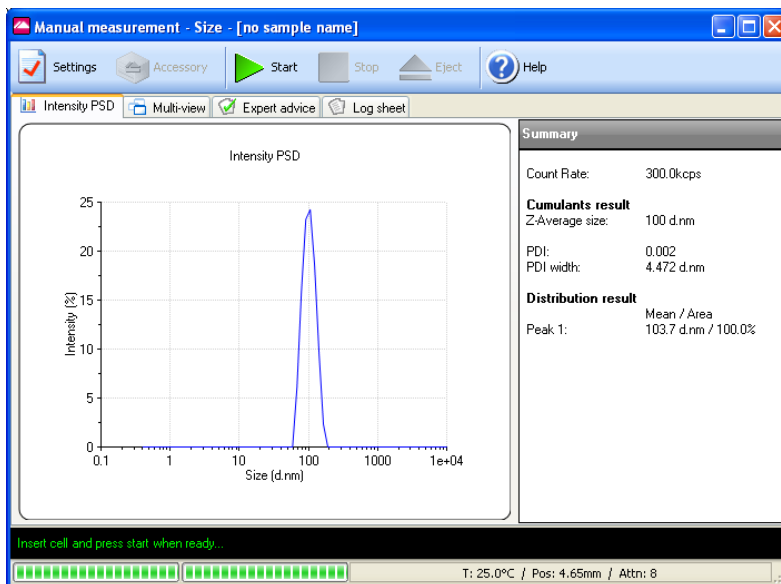
5. Note the messages in the black status bar (near the base of the window) which show the progress of the measurement.

6. When the measurement finishes, close the window using its ✖ button.

7. The results will be stored as the latest record in the measurement file currently open.

A

Appendices

Specifications - Optical unit

The following table details the specification of the Zetasizer Nano optical unit. Full specifications of the Zetasizer Nano accessories can be found in their respective user manuals.

All specifications correct at time of publication, but may be subject to alteration.

Parameter	Specification
Size	
- Nano S, ZS and ZSP	
Range (maximum diameter)	0.3nm - 10 microns *
Minimum sample volume	12μL
Concentration - minimum	10 mg/ml 15KDa protein
Maximum concentration	40%w/v †
Measurement angles	175° (S), 13° and 175° (ZS, ZSP)
- (water as sample dispersant)	
- Nano S90 and ZS90	
Range (maximum diameter)	
Minimum sample volume	0.3nm - 5 microns **
Minimum concentration (protein)	20μL
Maximum concentration	10 mg/ml 15KDa protein
Measurement angles	Dilute
- (water as sample dispersant)	90° (S90), 13° and 90° (ZS90)
Zeta potential	
Sensitivity	1 mg/ml 15KDa protein (ZSP)
	10 mg/ml 66KDa protein (Z, ZS, ZS90
Zeta potential range	> +/- 500mV
Mobility range	> +/- 20 μ.cm/V.s
Maximum sample concentration	40%w/v †
Minimum sample volume	20μl (using diffusion barrier)
Maximum sample conductivity	200mS/cm
Conductivity accuracy	+/-10%

Molecular weight *

Molecular weight range - (estimated from DLS)	1000Da to 2x10^{7}Da (S, ZS, ZSP, S90, ZS90) †
Molecular weight range - (calculated using Debye plot)	1000Da to 2x10^{7}Da (S, ZS, ZSP) † 10,000Da to 2x10^{7}Da (S90 & ZS90) †

Measurement technique	
Size	
- Nano S, ZS and ZSP	Dynamic light scattering (NIBS®)
- Nano S90 and ZS90	Dynamic light scattering (90 degrees)
Zeta potential	M3 - PALS®
Molecular weight	Static light scattering

Product laser class	Class 1 compliant, IEC 60825-1(1993)+A1(1997)+A2(2001)

Laser attenuation	Automatic, transmission 100% to 0.0003%

Laser (Nano S, Z, ZS, Z90, ZS90)	
Standard - Red	CDRH and CE compliant (Class IIIa laser-product (CDRH) / Class 3R laser product (IEC60825-1(1993)+A1(1997)+A2(2001)) . Type: HeNe gas laser. . Max. output power: 4mW. . Beam diameter: 0.63mm (1/e²). . Beam divergence: 1.5mrad. . Beam wavelength: 632.8nm.
Option - Green	CDRH and CE compliant (Class IIIB laser-product (CDRH) / Class 3B laser product (IEC60825-1(1993)+A1(1997)+A2(2001)) . Type: Frequency doubled DPSS. . Max. typical output power: 50mW. . Beam diameter: 0.32mm (1/e²). . Beam divergence: < 2.5mrad. . Beam wavelength: 532nm.
Laser (Nano ZSP)	
Standard - Red	CDRH and CE compliant (Class IIIa laser-product (CDRH) / Class 3B laser product (IEC60825-1(1993)+A1(1997)+A2(2001)) . Type: HeNe gas laser. . Max. output power: 10mW. . Beam wavelength: 632.8nm.

Detector	Avalanche photodiode, Q.E. >50% at 633nm

Condensation control	Purge facility using dry air

Temperature control range	0ºC to 90ºC (to 120ºC with High Temperature option)
Temperature accuracy	+/- 0.1°C at 25°C, +/- 0.2°C at 0°C, +/- 0.5°C at 90°C
Compatible cell temperatures	0°C to 120°C -- Glass and Quartz cells, High concentration cell 0°C to 70°C -- Folded capillary cell, plastic disposable cells 0°C to 50°C -- Dip cell
Dimensions	W:D:H, 320mm x 600mm x 260mm - with cuvette holder closed
Weight	19kg
Power requirements	AC 100-240V, 50-60Hz
Power consumption	Max. 100W
Ambient operating conditions Humidity	+10 to +35 °C (+50 to 95 °F) 10 to 90% (non-condensing)
Recommended computer specification	Contact the Malvern Helpdesk or website for the recommended computer specification, otherwise consult the Software Update Notification document supplied on the software CD.

 * Peak mode range (diameter), 0.6nm - 8.9 microns, sample dependent
** Peak mode range (diameter), 0.6nm - 3 microns, sample dependent
 † Sample dependent

Chemical compatibility

Components of the Zetasizer Nano 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 or titrant 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.

Any cleaning and maintenance procedures necessary are described in the **Maintenance** section of the **Health and safety** chapter.

Cell area

As the sample measured is held within the cuvette or cell used, all components within the cell area will only come into contact with the sample if spillage occurs. The materials list below details all components that may comes into contact if this occurs.

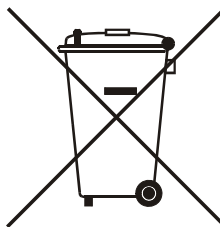| Component	Materials
Cell basin assembly (lid, basin and drain channel)	Polypropylene The outside of the cell basin and top of the cell lid is coated with a solvent resistant paint. This paint displays similar resistance properties to polypropylene. The inside of the cell basin and drain channel are not coated.
Drain tube	Tygon, F-4040-A
Electrodes	Gold plated beryllium/copper
Cell holder	Aluminium (anodised)

Cells and Cuvettes

Refer to the descriptions in the **Zetasizer Nano Accessories guide** for the materials used for each of the available cells.

Regulatory Statements

Disposal of Electrical & Electronic Equipment

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

ill 7610

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.

CE Declaration of Conformity

The CE badge on this product signifies conformance to European Commission Directives.

- EMC directive 2004/108/EC {BS EN 61326-1: 2006}

- Low Voltage Directive 2006/95/EC {BS EN 31010-1: 2010}

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.

この装置は、情報処理装置等電波障害自主規制協議会（ＶＣＣＩ）の基準に基づくクラスＡ情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

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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.

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