Malvern Panalytical
a spectris company

MASTERSIZER 3000

Smarter particle sizing

WELCOME TO THE **NEXT GENERATION**

Rapid, reliable particle size measurements made easy.

The Mastersizer 3000 is the latest generation of the world's most widespread particle sizing instrument, used by many thousands of companies and research institutes across a wide range of industries.

Malvern Panalytical's considerable experience and applications know-how has gone into every stage of the design of the Mastersizer 3000 instrument, from fundamental particle sizing performance right through to user ergonomics and method advice.

Innovative design

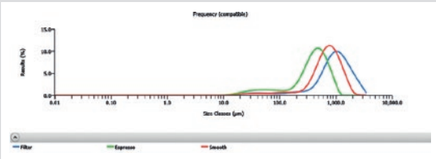
Industry-leading design and ergonomics means the Mastersizer 3000 combines a stylish modern look with practicality in a compact footprint, giving maximum value from both your instrument investment and precious laboratory space.

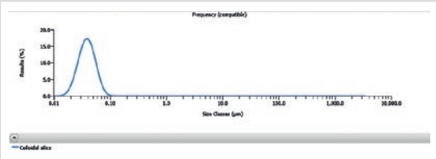
Impressive particle sizing performance

A completely new optical core design delivers fast measurement times for high sample throughput and a measurement size range from 10nm to 3.5mm. Combined with a range of wet and dry dispersion accessories this opens up more applications than ever before.

Software that eases your workload

More than ever, users want instruments that are easy to use and don't require a high level of expertise to get good results.The Mastersizer 3000 software delivers a modern intuitive interface, streamlined method development and expert advice on your results.





INNOVATIVE AND PRACTICAL DESIGN

The Mastersizer 3000 combines a stylish and compact design with lots of practical features to help you get the most out of your instrument.

Compact footprint

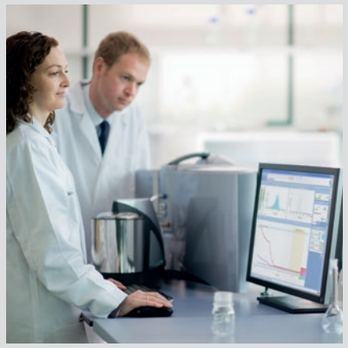
The footprint of the instrument is only 69cm x 30cm, ensuring efficient use and productivity from your valuable bench space. The equally compact wet and dry dispersion accessories use common sample measurement cells for the same type of dispersion, further reducing the footprint required for multi-accessory systems.

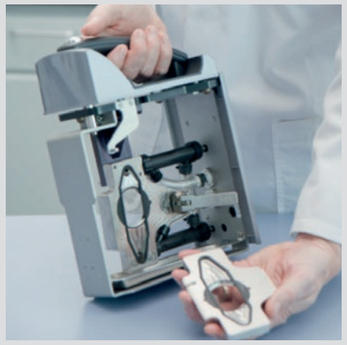
Automatic alignment and cell location

Correct optical alignment is critical to getting accurate and repeatable particle size results. The Mastersizer 3000 ensures this by using an auto-alignment procedure before every measurement. To provide further measurement security, the sample measurement cell has an auto locking mechanism to ensure that the cell is correctly seated every time it is inserted into the instrument.

Easy access for cleaning

The sample measurement cells feature a quick-release window sealing mechanism allowing quick access to the windows without any special tools. This makes cleaning the sample windows extremely easy, improving productivity and ensuring regular maintenance of the instrument for best performance.



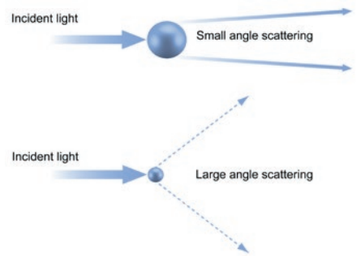


CLASS-LEADING PARTICLE SIZING PERFORMANCE

The Mastersizer 3000 uses the technique of laser diffraction to measure particle size distributions from 10nm up to 3.5mm.

Laser diffraction

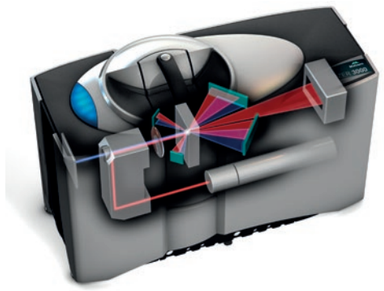
In a laser diffraction measurement a laser beam passes through a dispersed particulate sample and the angular variation in intensity of the scattered light is measured. Large particles scatter light at small angles relative to the laser beam and small particles scatter light at large angles. The angular scattering intensity data is then analyzed to calculate the size of the particles that created the scattering pattern using the Mie theory of light scattering. The particle size is reported as a volume equivalent sphere diameter.



Wide dynamic range

The patented folded optical design in the Mastersizer 3000 provides an impressive particle size range from 10nm up to 3.5mm using a single optical measurement path. The Mastersizer 3000 uses a sequential combination of measurements with red and blue light sources to measure across the entire particle size range.

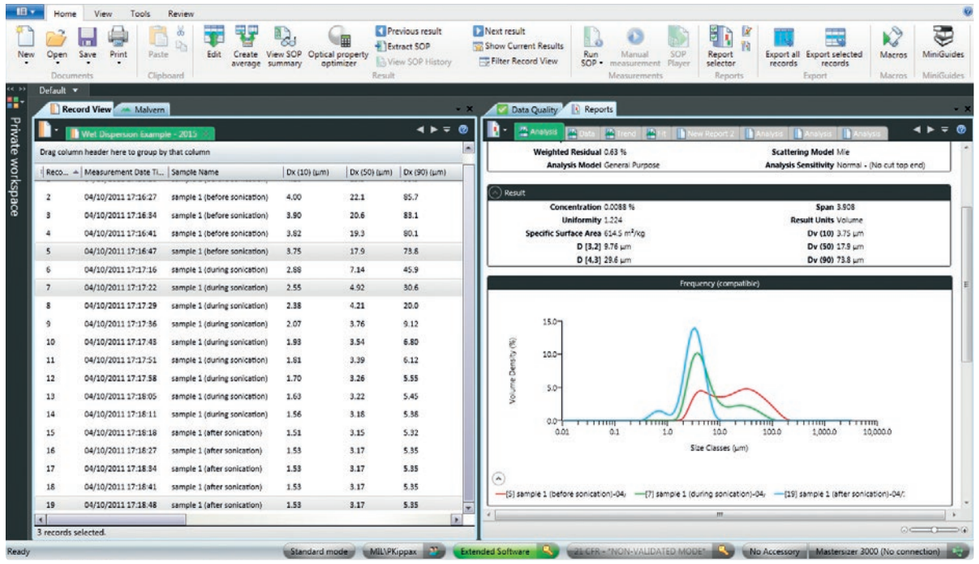
Measurement of large particulates is provided by an advanced focal plane detector design able to resolve very small diffraction angles. Sensitivity to sub 100nm particles, scattering light at wide angles, is achieved using advanced optics and a powerful 10mW solid state blue light source.



SOFTWARE THAT **EASES YOUR WORKLOAD**

With ever more demands placed on both instruments and users, software that is intuitive and easy to use is an essential requirement in the modern busy laboratory environment.

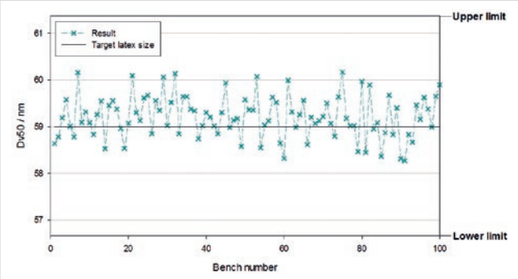
The Mastersizer 3000 software guides users through every stage of a measurement, from method development to result reporting, reducing training requirements and making particle size measurement fast and routine.



Verifiable accuracy and repeatability

Mastersizer particle size analyzers are used on a daily basis in production critical environments around the world. The Mastersizer 3000 delivers verifiable particle sizing performance that you can rely on:

- 0.6% accuracy for polystyrene latex standard measurements
- Repeatability on polystyrene latex standards better than 0.5%
- Reproducibility on polydisperse standards better than 1%, exceeding ISO 13320:2009 and USP <429> recommendations.



Reproducibility of 100 production instruments on 60nm latex

Optical Property Optimizer Interface

Key features that make good quality particle size measurements easier than ever before:

- Intuitive look and feel based upon the latest software tools
- Rapid method development with the measurement manager dash board
- Simple, customizable reporting to present your data the way you want it
- Method development and support tools, including a unique optical property optimizer
- Analysis modes for previous Mastersizer systems are provided, making method and specification transfer easy.

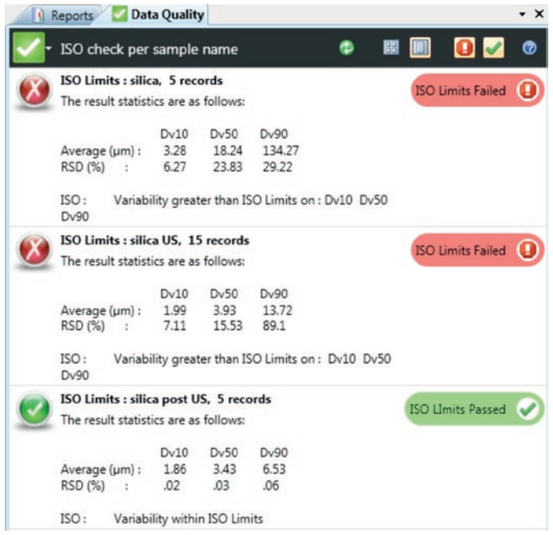
STREAMLINED METHOD DEVELOPMENT

The ability to view how the particle size result changes with dispersion conditions is an essential element to rapid method development within ISO and USP guidelines.

With the measurement manager window, the user can observe, control and optimise measurement conditions in real time, making the method development process as efficient and straightforward as possible.

BUILT-IN EXPERTISE

It is good experimental practice to verify the quality of any measurements made in order to ensure the robustness of your results. Recognizing that not everyone can or wants to be an expert in laser diffraction measurements, we have incorporated a data quality expert within the software that will give you an objective assessment of the measurement quality together with practical advice on how to improve the measurement process. This includes ISO 13320:2009 and UPS <429> measurement stability criteria as well as individual measurement criteria as developed by our highly experienced in-house laser diffraction applications team.



MASTERSIZER **3000E** - ENTRY LEVEL FLEXIBILITY TO SUIT YOUR APPLICATION AND BUDGET

The Mastersizer 3000 is highly regarded as being the premier instrument on the market for design, performance and software user experience. We realise, however, that not every customer needs or can afford all the functionality that the Mastersizer 3000 offers. The Mastersizer 3000E is an entry level addition to the Mastersizer product family based upon the proven design of the Mastersizer 3000 but with more basic performance and software functionality.

The Mastersizer 3000E instrument is available with two different software package levels:

Mastersizer 3000E Basic

- Particle size range from 0.1 – 1000µm
- Manual wet and dry dispersion units only
- Basic software with updates and bug fixes only
- Anytime upgrade option to Mastersizer 3000E Extended.

Mastersizer 3000E Extended

- Particle size range from 0.1 – 1000µm
- Automated wet sample dispersion units supported
- Advanced software functionality with updates, bug fixes and upgrades.

MASTERSIZER **3000** PRODUCT FAMILY COMPARISON

The following quick reference table has been put together to help you choose which instrument in the Mastersizer 3000 product family is most suitable for your application.

Specification comparison	Mastersizer 3000E Basic Software	Mastersizer 3000E Extended Software	Mastersizer 3000
Hardware			
Particle size range	0.1µm to 1000µm	0.1µm to 1000µm	10nm to 3500µm
Manual wet dispersion units (Hydro EV, SM and SV)	✓	✓	✓
Manual dry powder dispersion unit (Aero M)	✓	✓	
Automated wet dispersion units (Hydro MV and LV)		✓	✓
Automated dry powder dispersion unit (Aero S)			✓
Software			
SOP operation	✓	✓	✓
Customisable reporting	✓	✓	✓
Entry level legacy system result compatibility tools	✓	✓	✓
Software bug fixes	✓	✓	✓
Advanced method development and comparison tools		✓	✓
Advanced data quality assessment and reporting tools		✓	✓
Advanced measurement manager functions		✓	✓
Measurement sequencing / SOP player tool		✓	✓
New feature additions and upgrades		✓	✓
Ability to use the software on multiple workstations		✓	✓
User workspace functions		✓	✓
IQ/OQ Validation			✓
21 CFR Part 11 support			✓

MASTERSIZER **3000** MAIN SYSTEM SPECIFICATIONS

Parameters measured	Materials	
Particle size distribution	Suspensions, emulsions, dry powders	
General		
Principle	Laser light scattering	
Analysis	Mie and Fraunhofer scattering	
Data acquisition rate	10kHz	
Typical measurement time	<10 sec	
Optics	**Mastersizer 3000**	**Mastersizer 3000E**
Red light source	Max. 4mW He-Ne, 632.8nm	Max. 4mW He-Ne, 632.8nm
Blue light source	Nominal 10mW LED, 470nm	None
Lens arrangement	Reverse Fourier (convergent beam)	Reverse Fourier (convergent beam)
Effective focal length	300mm	300mm
Detector		
Arrangement	Log-spaced array	Log-spaced array
Angular range	0.015 - 144 degrees	0.032 - 60 degrees
Alignment	Automatic	Automatic
Size		
Size range	10nm - 3.5mm *	0.1 to 1000µm *
Number of size classes	100 (user adjustable)	100 (user adjustable)
Accuracy	0.6% **	0.6% **
Repeatability	Better than 0.5% variation *	Better than 0.5% variation *
Reproducibility	Better than 1% variation *	Better than 1% variation *
Software		
21 CFR Part 11	Enables an operating mode that assists with ER/ES compliance	-
System compliance		
Laser class	Class 1, IEC60825-1:2007 and CRF Chapter I: Sub-chapter J: Part 1040 (CDRH)	
Regulatory	Designed to meet RoHS and WEEE requirements CE / FCC / ICE5-003 / VCCI compliant. Designed to meet C-Tick	
Optics		
Dimensions	690mm x 300mm x 450mm (L x W x H)	
Mass	30kg	
System		
Supply voltage	100/240V, 50/60Hz	
Product storage temperature	-20°C to +50°C (non-condensing)	
Operational temperature range	+5°C to +40°C (non-condensing)	
Computer specification (recommended)	**Software**	
Computer interface	At least 1 high speed USB2 or USB 3 port required	
Operating system	Windows 7 (32 bit and 64 bit), Windows 8, Windows 8.1 and Windows 10	
Hardware specification	Intel Core i7 Processor, 4GB RAM, 250GB HD, CD-ROM or DVD +/-RW drive, Wide screen monitor	

Notes: *Sample and sample preparation dependent. **Accuracy defined for the measurement of monomodal latex standards. This specification accounts for the manufacturer's uncertainty in the latex size. Sample and sample preparation dependant.

MASTERSIZER **3000**
SAMPLE DISPERSION OVERVIEW

Sample dispersion is controlled by a range of wet and dry dispersion units. These ensure the particles are delivered to the measurement area of the optical bench at the correct concentration and in a suitable, stable state of dispersion to make accurate and reliable particle size measurements.

AERO
REDEFINING DRY POWDER DISPERSION

Setting new standards for dry powder dispersion, the Aero has been designed from the ground up based upon fundamental powder dispersion theory. The modular design ensures rapid and reproducible dispersion of cohesive powders for both fragile and more robust materials.

The Aero is available with two performance levels:

Aero M - entry-level, manually-operated dry powder dispersion unit for use with the Mastersizer 3000E

Aero S - fully automated dry powder dispersion unit for the Mastersizer 3000, designed with the flexibility to meet the widest possible range of applications.

Aero M

Aero S

Hydro - Rapid and effective wet dispersion accessories

Hydro LV - A large volume automated dispersion unit suitable for applications where sample availability is not an issue or where larger volumes are required to ensure good sampling.

Hydro MV - A medium volume automated dispersion unit specifically designed for applications where sample is in short supply and/or non-aqueous dispersants are necessary.

Hydro Sight - A lens-less dynamic imaging accessory, supporting method development and troubleshooting by providing real time visualization and assessment of liquid particle dispersions.

Hydro SV - A small volume dispersion unit designed to enable particle size analysis when dispersant use needs to be minimised or the amount of sample available for analysis is limited.

Hydro EV - A unique dip-in, semi-automated wet sample dispersion unit that can be used with 250mL, 600mL and 1000mL standard laboratory beakers.

Hydro SM - Entry level medium volume sample measurements, suitable for applications where samples need to be dispersed in non-aqueous dispersants.

AERO **S**
DRY POWDER DISPERSER

State-of-the art dry powder dispersion

SPECIFICATIONS*

Parameter	Specification
Measurements modes	Automated and manual measurement sequence control
Size range (dry powder mode)	0.1 - 3500µm †
Dispersion pressure range	0 - 4 bar
Pressure setting precision	+/- 0.1 bar
Pressure setting accuracy	+/- 0.03 bar
Feed rate range	0 - 58ms^{-2} (expressed as 0-100%)
Feed rate precision	+/- 2% FS
Materials in contact with sample ††	316 stainless 410 hardened stainless Borosilicate glass EPDM PTFE Polyurethane Carbon filled acetal Aluminium Neoprene
Maximum particle size	3500µm †
Minimum time between measurements	less than 60 sec †
Dimensions	260mm x 180mm x 380mm (L x W x H)
Mass	10.5kg
† Sample dependent †† Ceramic venturi dispersers are available for use with abrasive samples	

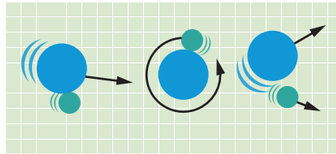
*Not available for Mastersizer 3000E Basic and Extended

The Aero S dry powder disperser has been developed using state-of-the-art powder dispersion understanding. Modular in design, it is easily configured for different applications, delivering efficient sample dispersion for both robust and fragile materials.

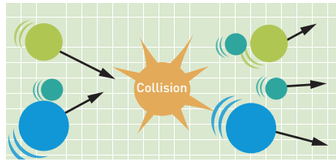
Disperse fragile and cohesive powders with ease

In a dry powder disperser, sample dispersion is achieved by accelerating the dry powder particles through a venturi using compressed air.

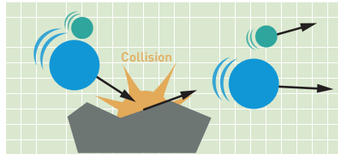
Three different dispersion mechanisms can act upon the sample:



Velocity gradients caused by shear stress



Particle-to-particle collisions



Particle-to-wall collisions

The most dominant dispersion mechanism will depend upon the geometry of the disperser. The Aero S is provided with:

- Standard dispersers for both cohesive and fragile particles
- Impaction-based dispersers for robust, agglomerated materials.

A range of sample trays is available to ensure reproducible delivery of powders to the disperser during measurements.

AERO **M** DRY POWDER DISPERSER

Bulk dry powder dispersion

The Aero M is an entry-level dry powder disperser for the Mastersizer 3000E, enabling particle size distribution measurements to be made for bulk dry powder samples. Its design achieves robust particle size measurements in industrial applications and also ensures it is easy to maintain during routine use.

The use of dry powder dispersion for particle size measurements is advantageous when measuring bulk materials, as a large mass of powder can be measured. This ensures effective sampling is achieved. In addition, dry powder dispersion avoids the need for liquid dispersants, reducing the cost of measurement and increasing sample through-put.

- Measures dry powder particle size distributions over a 0.1-1000mm range
- Manual measurement control, with appropriate user prompts provided to help ensure reproducible measurements are made
- Configurable for different applications through the purchase of additional sample trays and powder hoppers
- Abrasive samples can be measured through the use of ceramic venturi dispersers.

SPECIFICATIONS

Parameter	Specification
Measurement modes	Manual measurement sequence control
Measurement size range	0.1 - 1000µm †
Dispersion pressure range	0 - 4 bar
Pressure setting precision	+/- 0.1 bar
Pressure setting accuracy	+/- 0.03 bar
Feed rate range	0 - 58ms-^{2} (expressed as 0-100%)
Feed rate precision	+/- 2% FS
Materials in contact with sample ††	316 stainless 410 hardened stainless Borosilicate glass EPDM PTFE Polyurethane Carbon filled acetal Aluminium Neoprene
Maximum particle size	1000µm †
Minimum time between measurements	less than 60 sec *
Dimensions	260mm x 180mm x 380mm (L x W x H)
Mass	10.5kg

† Sample dependent. Relates to the use of the unit with the Mastersizer 3000E, which also has an upper size limit of 1000µm
†† Ceramic venturi dispersers are available for use with abrasive samples

HYDRO **LV**

Large volume wet sample dispersion

Intended for applications where sample availability is not an issue, the Hydro LV is ideal for measuring larger particles and broad size distributions, which demand larger sample volumes to ensure representative measurement.

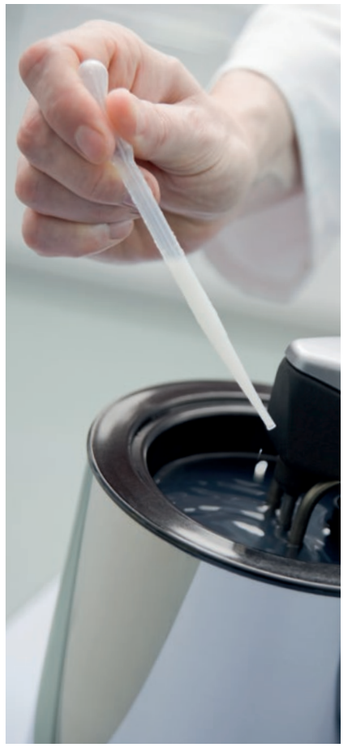
- 600mL dispersant volume
- Patented 40W in-line sonication probe, for rapid agglomerate dispersion
- Powerful centrifugal pump system ensures bias-free sampling
- Automated dispersant supply
- Full software control of all measurement functions, including dispersant supply, sample dispersion and cleaning
- Chemically compatible with a wide choice of organic and inorganic dispersants
- Integral sample tank light.

SPECIFICATIONS*

Parameter	Specification
Pump speed range	0-3500 rpm †
Pump speed resolution	+/- 10 rpm
Pump speed accuracy	+/- 50 rpm
Maximum flow rate	2.0L/min †
Sonication power & frequency	40W max, 40kHz (nominal) †
Maximum volume	600mL
Materials in contact with sample	316 stainless Borosilicate glass Tygon® FKM (cell seal only - FFKM upgrade available) PTFE PEEK FEP Titanium Nitride Aluminium (tubing connectors only) Acrylic (splash guard only)
Maximum particle size	2100µm ††
Minimum time between measurements	less than 60 sec ††
Dimensions	280mm x 180mm x 300mm (L x W x H)
Mass	5kg

† Dispersant dependent †† Sample dependent

* Not available for Mastersizer 3000E Basic



HYDRO **MV**

Medium volume automated dispersion unit

The Hydro MV is medium volume unit for the controlled, automated wet dispersion of samples for particle size analysis. Designed for applications that require smaller sample sizes, the Hydro MV is especially valuable when the supply of test material is limited or when dispersant usage must be minimized.

- 120mL dispersant volume
- Patented 40W in-line sonication probe, for rapid agglomerate dispersion
- Powerful centrifugal pump system ensures bias-free sampling
- Automated dispersant supply
- Chemically compatible with a wide choice of organic and inorganic dispersants
- Full software control of all measurement functions, including dispersant supply, sample dispersion and cleaning
- Integral sample tank light.

SPECIFICATIONS*

Parameter	Specification
Pump speed range	0-3500 rpm †
Pump speed resolution	+/- 10 rpm
Pump speed accuracy	+/- 50 rpm
Maximum flow rate	2.0L/min †
Sonication power & frequency	40W max, 40kHz (nominal) †
Maximum volume	120mL
Materials in contact with sample	316 stainless Borosilicate glass Tygon® FKM (cell seal only - FFKM upgrade available) PTFE PEEK FEP Titanium Nitride Aluminium (tubing connectors only) Acrylic (splash guard only)
Maximum particle size	1500µm † †
Minimum time between measurements	less than 60 sec † †
Dimensions	280mm x 180mm x 300mm (L x W x H)
Mass	5kg
† Dispersant dependent †† Sample dependent	

* Not available for Mastersizer 3000E Basic

HYDRO **SIGHT**

See your dispersion

The Hydro Sight is a revolutionary lens-less imaging accessory for the Mastersizer range of instruments, providing rapid visualization and assessment of your liquid particle dispersions.

Smarter method development

Real-time observation of particles during a laser diffraction measurement enables improved understanding of how stirring, sonication and addition of surfactants and stabilizers affect sample dispersion. One-click capture of images, videos and dispersion metrics provides quick and effective supporting evidence for troubleshooting measurements and achieving method validation in line with ISO and USP requirements.

- Visualize your particles
- Observe dispersion trends
- Automatically detect unusual particles
- Evaluate particle size and shape
- Quickly validate methods.

SPECIFICATIONS

Parameter	Specification
Principle	Lens-less imaging
Analysis	Dynamic image analysis
Illumination	White light LED
Detector type	CMOS Sensor
Data acquisition rate	3.75 fps
Pixel size	1.4µm x 1.4µm
Measurable size range	9-1000µm †
Observable size range	1.4-1400µm † (cell width 1500µm)
Typical measurement time	As per laser diffraction
Materials in contact with sample	316 stainless steel BK7 glass FFKM
Regulatory	Designed to meet RoHS and WEEE requirements. CE / FCC / ICE5-003 / VCCI compliant. Designed to meet C-Tick requirements.
† Sample dependent	

N.B. Full specifications available in separate HYDRO SIGHT brochure.

HYDRO **EV**

Flexible volume wet dispersion

The Hydro EV has a unique dip-in centrifugal pump and stirrer design that achieves full and rapid dispersion in standard laboratory beakers, allowing close matching of the dispersant volume to the application requirements. Following measurement, the dispersion head can be raised out of the beaker, enabling quick cleaning and sample recovery.

- Compatible with 250mL, 600mL and 1000mL laboratory beakers
- Patented 40W in-line sonication probe, for rapid agglomerate dispersion
- Dip-in centrifugal pump and stirrer design
- Sample easily recovered following analysis
- Chemically compatible with a wide choice of organic and inorganic dispersants
- Full software control of pump / stirrer and sonication
- Integral sample tank light.

SPECIFICATIONS

Parameter	Specification
Pump speed range	0-3500 rpm †
Pump speed resolution	+/- 10 rpm
Pump speed accuracy	+/- 50 rpm
Maximum flow rate	1.7L/min †
Sonication power & frequency	40W max, 40kHz (nominal) †
Volume	250mL / 600mL / 1000mL (using lab beaker)
Materials in contact with sample	316 stainless Borosilicate glass Tygon® FKM (cell seal only - FFKM available) PTFE PEEK Titanium Nitride
Maximum particle size	2100µm ††
Minimum time between measurements	less than 60 sec ††
Dimensions	220mm x 150mm x 300mm (L x W x H)
Mass	4kg
† Dispersant dependent †† Sample dependent	

HYDRO **SV**

Small volume wet sample dispersion

The Hydro SV is a simple, cost effective dispersion unit designed to enable particle size analysis using small volumes of sample and dispersant. It is particularly useful where the amount of sample available for analysis is very limited, or where there are significant environmental or health and safety issues associated with the use of the dispersant required to measure the sample.

- 5.6mL - 7mL dispersant volume
- Safe and easy sample introduction
- High chemical compatibility
- Software controlled magnetic stirrer for dispersion control
- Sample and dispersant retained for recovery or disposal
- Wash station provided for quick and easy cleaning.

SPECIFICATIONS

Parameter	Specification
Stirrer speed range	0 rpm and 500 – 1800 rpm †
Stirrer speed resolution	+/- 10 rpm
Stirrer speed accuracy	+/- 50 rpm
Sonication power & frequency	N/A
Minimum volume	5.6mL
Maximum volume	7mL
Materials in contact with sample	316 stainless steel Borosilicate glass PTFE (magnetic stirrer bar only)
Maximum particle size	200µm ††
Minimum time between measurements	less than 60 sec ††
Dimensions	110mm x 280mm x 210mm (L x W x H)
Mass	3.05kg
† Dispersant dependent †† Sample dependent	

HYDRO **SM**

Manual entry level wet dispersion unit

The Hydro SM is a cost effective wet sample dispersion unit designed for measuring samples in non-aqueous dispersants where solvent usage needs to be minimized.

- Sample volume from 50mL -120mL
- Continuously variable single shaft pump and stirrer with digital readout
- Software driven SOPs with appropriate user prompts to assist with adherence to GLP and ensure reproducibility of measurements
- Manual fill, drain and cleaning
- High chemical compatibility.

SPECIFICATIONS

Parameter	Specification
Pump speed range	350-3500 rpm †
Pump speed resolution	+/- 10 rpm
Pump speed accuracy	+/- 20 rpm
Maximum flow rate	2.3L/min †
Sonication power & frequency	N/A
Maximum volume	120mL
Materials in contact with sample	316 stainless steel Borosilicate glass Tygon® FFKM FKM (cell seal only-FFKM upgrade available) Aluminium (cell connectors only)
Maximum particle size	600µm ††
Minimum time between measurements	less than 60 sec ††
Dimensions (dispersion unit)	175mm x 140mm x 390mm (L x W x H)
Dimensions (controller unit)	180mm x 225mm x 80mm (L x W x H)
Mass (dispersion unit)	8.75kg
Mass (controller unit)	1kg
† Dispersant dependent †† Sample dependent	

Malvern Panalytical
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WHY CHOOSE **MALVERN PANALYTICAL**?

We are global leaders in materials characterization, creating superior, customer-focused solutions and services which supply tangible economic impact through chemical, physical and structural analysis.

Our aim is to help you develop better quality products and get them to market faster. Our solutions support excellence in research, and help maximize productivity and process efficiency.

Malvern Panalytical is part of Spectris, the productivity-enhancing instrumentation and controls company.

www.spectris.com

SERVICE & **SUPPORT**

Malvern Panalytical provides the global training, service and support you need to continuously drive your analytical processes at the highest level.

We help you increase the return on your investment with us, and ensure that as your laboratory and analytical needs grow, we are there to support you.

Our worldwide team of specialists adds value to your business processes by ensuring applications expertise, rapid response and maximum instrument uptime.

- Local and remote support
- Full and flexible range of support agreements
- Compliance and validation support
- Onsite or classroom-based training courses
- e-Learning training courses and web seminars
- Sample and application consultancy

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