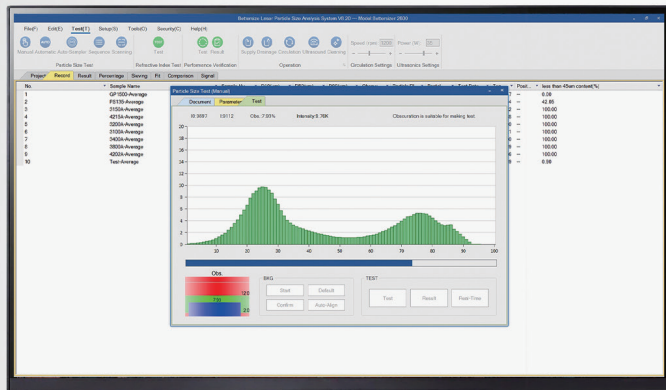# Bettersize

BETTER PARTICLE SIZE SOLUTIONS

Bettersizer 2600

Particle Analysis for Your Every Need

PARTICLE SIZE

PARTICLE SHAPE

Particle Analysis for Your Every Need

BT-804   BT-80N   BT-80N Pro   BT-802   Bettersizer 2600   BT-902   BT-903   PIC-1

The Bettersizer 2600 employs a well-established particle measurement technology—Laser Diffraction Technology, covering a **particle size** range of **0.02 - 2,600 µm**. There are 92 photoelectric detectors to convert light signals from the scattering spectrum to electrical signals, which are transmitted into an intelligent software. By implementing the Mie scattering theory to the data and performing mathematical conversion, the accurate and reliable particle size distribution can be derived.

The modular design of the Bettersizer 2600 endows it with versatile capabilities. The dynamic imaging module enables combined laser and imaging tests, extending the measurement range up to **3,500 µm** and providing both **particle size and shape** analysis. The diverse dispersion system modules support a wide range of testing needs, including both dry and wet dispersion methods to meet various testing requirements.
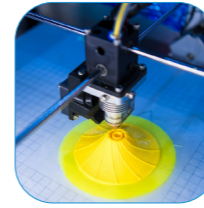
"Ultra-Met has been using the Bettersize Laser Particle Size analyzer for over 1 year. We are able to obtain accurate, repeatable results of our tungsten carbide spray dry powder. This is a crucial tool for our company for development and quality control for our powder metal product. Customer service is always very reliable. I can always rely on having my questions answered same day by a knowledgeable member of their staff. Great company very pleased with their product and customer service overall."

Cara D'Angelo
Metallurgical Engineer
Ultra-Met Carbide Technologies, USA

Applications and Industries

Industries	Samples	Significance
Pharmaceuticals	Lactose, powder inhalers, magnesium stearate, microcrystalline cellulose, etc.	The particle size and size distribution of pharmaceuticals could affect the dissolution, body absorption, efficacy, and safety of drugs. The Bettersizer 2600 is capable of closely monitoring the particle sizes during the processes of pharmaceuticals development.
Abrasives	Silicon carbide, diamond, corundum, garnet, boron nitride, etc.	Optimizing particle size and size distribution in abrasive materials maximize final products' performances while minimizing material waste. Monitoring particle size and identifying agglomerations in raw material could be achieved via the dynamic image analysis technology in Bettersizer 2600.
Batteries	Lithium iron phosphate, lithium cobalt oxide, lithium manganate, modified graphite powder, etc.	The Bettersizer 2600 monitors the particle size distributions of the lithium-ion battery materials, which are critical in affecting the performances of a battery, including energy storage, stability, and safety. It is essential to strictly control the particle size distributions of lithium-ion battery materials.
Building Materials	Cement, rock, clay, sand, wood, gravel, synthetic polymers, etc.	The particle size distribution of cement directly affects the hardening rate, strength, and fluidity of the final set concrete, which is the primary application of cement. Accurate and repeatable measurements of the cement particle size provided by the Bettersizer 2600 reduce costs and provide an optimized distribution in the concrete manufacturing process.
Paints, Inks & Coatings	Titanium dioxide, organic pigments, iron oxides, ceramic inks, etc.	The Bettersizer 2600 characterizes particle size and size distribution of pigment-based inks. It is a crucial process in ensuring the ink remains stable over long periods of storage to prevent aggregation, color inconsistencies, and blockages in the channels or nozzles.

Industries	Samples	Significance
Mining & Minerals	Calcium carbonate, kaolin, talc, quartz powder, graphite, barite, wollastonite, hydromagnesite, diatomite, mica, zirconium silicate, etc.	Minerals are used in many industries, including construction, fracking and abrasives. The performance of these minerals strongly depends on the size and distribution of the particles, which can be accurately measured and characterized by the Bettersizer 2600.
Food & Beverages	Sugar, milk, chocolate, coffee, mayonnaise, flour, etc.	Many important characteristics of food products, such as taste, dissolution, and extraction behavior, are affected by the particle size and shape of particulate ingredients. Equipped with dynamic image analysis technology, the Bettersizer 2600 is an ideal particle analyzer for the food and beverage industry.
3D Printing Materials	Polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), alloys, intermetallic compounds, ceramics, organic materials, etc.	The particle size distribution and particle shape of 3D-printing raw materials determine the degree of surface smoothness of the final printed product. Using the Bettersizer 2600 with the PIC-1, the particle size distribution and particle shape could be optimized, thereby controlling the quality and spreadability of the powders for additive manufacturing.
Ceramics	Aluminum oxide, zirconium oxide, iron oxide, etc.	Particle size analysis by the Bettersizer 2600 can help the manufacturers to determine the optimum time and temperature required for the green body, as a ceramic powder with a proportion of smaller particles reduces the sintering time due to its larger surface area. The dual camera optical system in PIC-1 effectively captures the images of agglomerated oversized particles during the R&D process.
Cosmetics	Lipstick, mascara, eye shadow, moisturizer, skin cream, etc.	For cosmetics, the Bettersizer 2600 aids in monitoring subtle differences in color and shine controlled by differences in the particle size distribution. The smoothness or UV light-blocking properties of creams also vary depending on the particle size distribution.

Why the **Bettersizer 2600**?

The Bettersizer 2600 excels in particle analysis through its dual optical systems: laser diffraction and dynamic imaging. The combination of dual optical systems allows for comprehensive particle characterization, making the Bettersizer 2600 a versatile and indispensable tool for advanced particle analysis.

The laser diffraction system, supported by two robust patents, ensures precise and reliable particle size results in compliance with ISO 13320, enabling a wide range of industries and applications to achieve new levels of performance. Owing to its modular design, the Bettersizer 2600 effortlessly integrates a dynamic imaging system, extending the measurement range and providing individual and quantitative particle shape analysis in real time with ISO 13322-2 compliance.

Laser Diffraction System

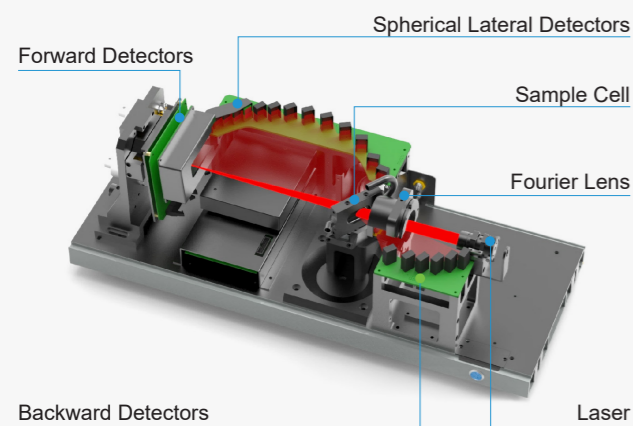### Patented Technologies Driving Instrument Excellence

Ⅰ. Combination of Fourier and Inverse Fourier Design

The Bettersizer 2600 is superior in the combination of Fourier and inverse Fourier design. Its laser system structure features 92 detectors in total, including forward, lateral, and backward detectors.

Equipped with a widely distributed spherical detector array, the Bettersizer 2600 can detect light signals across a broad angular range from 0.016° to 165°, enabling precise measurement of both small and large particles.

Total internal reflection occurs when the light transitions from a denser medium (glass) to a rarer one (air) and the incidence angle exceeds the critical angle, limiting the angles at which light can escape.

The Bettersizer 2600's innovative sample cell, with its tilted design, effectively minimizes total internal reflection. This allows more light signals to reach the detectors, enhancing measurement reliability and ensuring the acquisition of more comprehensive sample information.

Spherical Lateral Detectors
Forward Detectors
Sample Cell
Fourier Lens
Backward Detectors
Laser

Reflected Light
Emerging Light
Laser
Laser
Sample Cell
Tilted Sample Cell

Ⅱ. Refraction Index Measurement
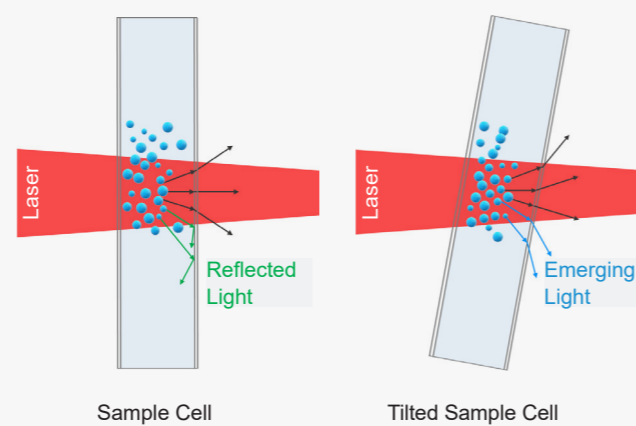
I don't know the refractive index of my sample.

*No problem. With one simple click, Bettersizer 2600 can provide this parameter to you.*

Under Mie theory, measurements by laser diffraction can be particularly challenging for samples due to a variety of factors, including the following:

• Samples with completely unknown complex refractive index;

• Samples with heterogeneous chemical composition;

• Samples with significantly different particulate optical properties compared to the bulk material;

• Samples having a distinctly strong optical dispersion (small Abbe number).

To address these challenges, determining the refractive index is one of the most effective solutions. The Bettersizer 2600 offers the following capabilities:

• Determine refractive index for samples with unknown refractive index;

• Measure samples with unknown properties;

• Verify the known data of a material at a specific light wavelength;

• Provide key parameters to calculate particle size distribution in real-time.

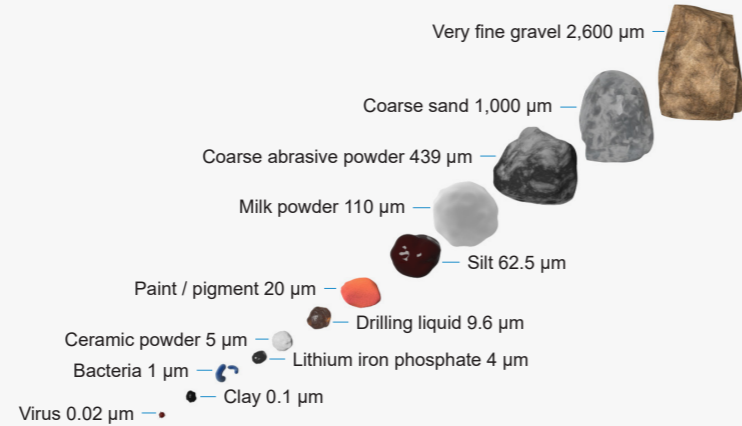| Material	Refractive index (literature)	Refractive index (measured)
$CaCO_3$	(1.53 - 1.65) - 0.1i	1.62 - 0.1i
$BaSO_4$	1.65 - 0.1i	1.68 - 0.1i
ZnO	2.008 - 0.1i	2.02 - 0.1i
Carbon black	1.88 - 0.55i	2.02 - 0.1i
Al Powder	1.4 - 3.9i	1.42 - 3.0i
SiO_2 – Quartz	1.54 - 0.00i	1.54 - 0.01i
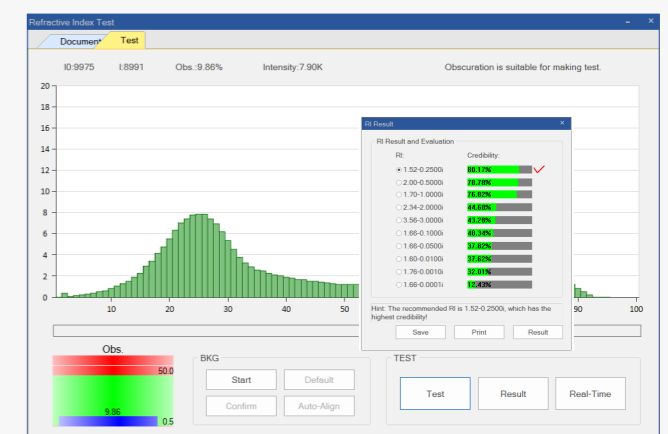
Laser Diffraction System

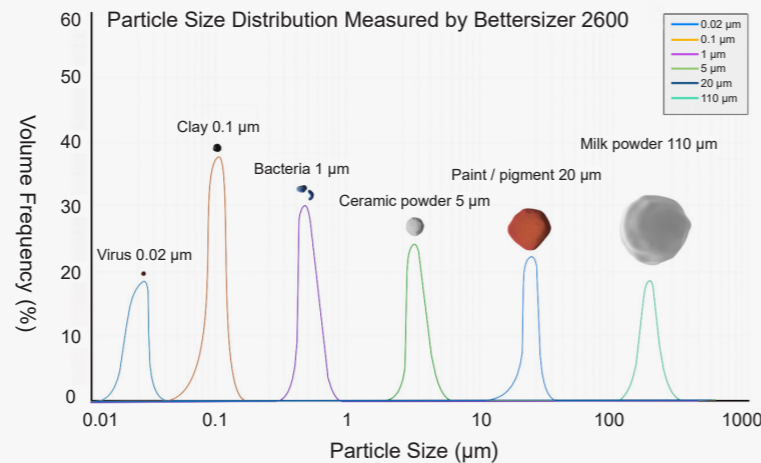## Superior Performance in Particle Size Analysis

I. Wide Measurement Range

Due to the instrument's excellent laser system design with 92 detectors and a very wide angular range from 0.016° to 165°, it achieves a measurement range from 0.02 µm to 2,600 µm, covering both nano and millimeter scales.
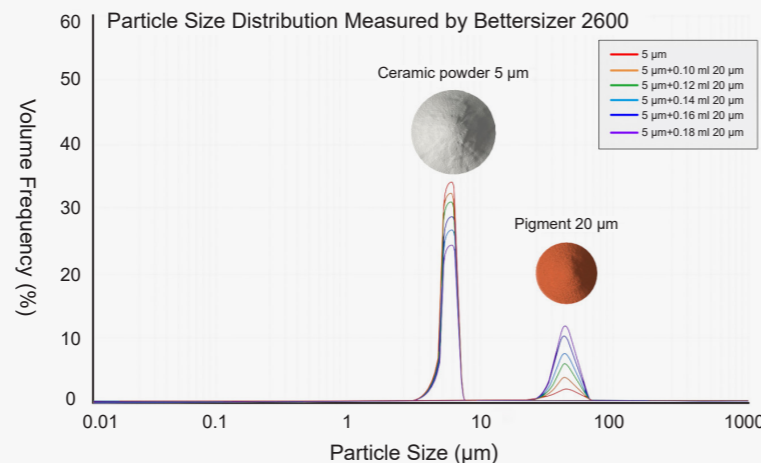
Very fine gravel 2,600 µm
Coarse sand 1,000 µm
Coarse abrasive powder 439 µm
Milk powder 110 µm
Silt 62.5 µm
Paint / pigment 20 µm
Drilling liquid 9.6 µm
Ceramic powder 5 µm
Lithium iron phosphate 4 µm
Bacteria 1 µm
Clay 0.1 µm
Virus 0.02 µm

II. High Resolution

The Bettersizer 2600 is capable of distinguishing different samples with varying particle sizes within a single measurement due to its high-resolution analysis ability.

Particle Size Distribution Measured by Bettersizer 2600

Legend: 0.02 µm, 0.1 µm, 1 µm, 5 µm, 20 µm, 110 µm

Virus 0.02 µm
Clay 0.1 µm
Bacteria 1 µm
Ceramic powder 5 µm
Paint / pigment 20 µm
Milk powder 110 µm

Y-axis: Volume Frequency (%)
X-axis: Particle Size (µm)

III. High Sensitivity

When gradually adding one sample to the other, the Bettersizer 2600 displays the change of particle size distributions in the curve, verifying its excellent sensitivity.

Particle Size Distribution Measured by Bettersizer 2600

Legend: 5 µm, 5 µm+0.10 ml 20 µm, 5 µm+0.12 ml 20 µm, 5 µm+0.14 ml 20 µm, 5 µm+0.16 ml 20 µm, 5 µm+0.18 ml 20 µm

Ceramic powder 5 µm
Pigment 20 µm

Y-axis: Volume Frequency (%)
X-axis: Particle Size (µm)

Dynamic Imaging System

PIC-1: Modular Dual-Camera Imaging System Design

Dual-Camera Imaging System

10x
0.5x
10x Camera
0.5x Camera
Sample Cell
Blue LED
White LED
Samples
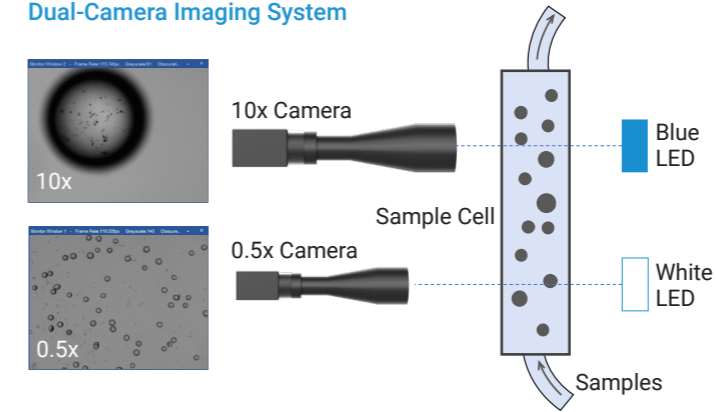
The PIC-1 features a dual-camera dynamic imaging system, making it a leading dynamic imaging module that seamlessly integrates with the Bettersizer 2600. As the dispersion system transports particles through the sample cell, the high-speed cameras capture and convert images to digital format for real-time analysis.

Going beyond mere particle size distribution, this capability allows scientists, researchers, and engineers to utilize particle shape characteristics for a deeper understanding of particles.

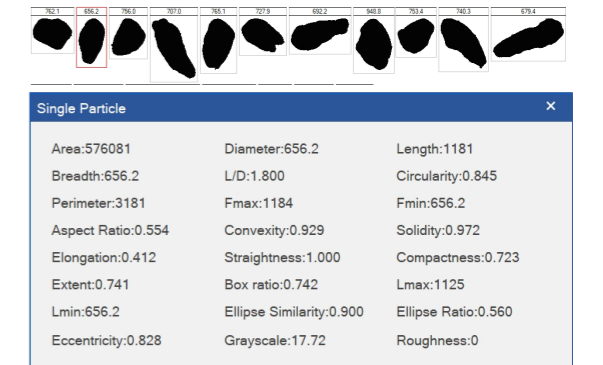## Broadened Insight with Modular Imaging Expertise

Extended Measurement Range

The seamless combination of laser diffraction and image analysis broadens the measurement range of Bettersizer 2600 to an impressive 3,500 µm. Samples with extremely broad distributions are now possible to measure, such as river sediment.

0.01 - 2,600 µm
2 - 3,500 µm

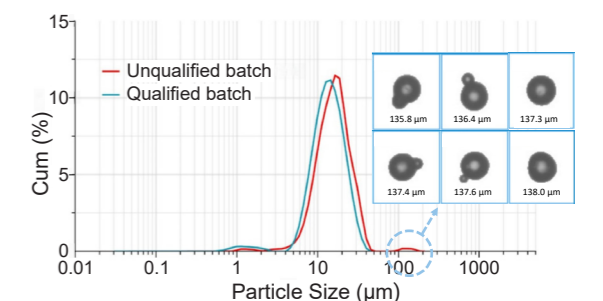X-axis: 0, 500, 1000, 1500, 2000, 2500, 3000, 3500, 4000
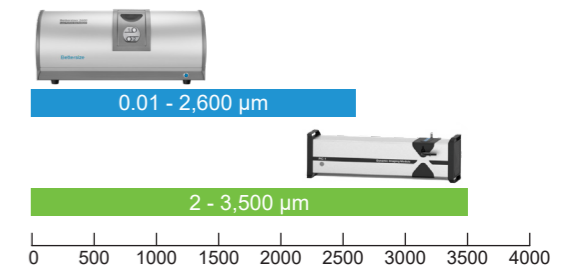
24 Detailed Particle Parameters

The PIC-1 offers comprehensive data by capturing real-time particle images, allowing customers to study individual particles in detail. With the ability to analyze 24 particle size and shape parameters, the PIC-1 provides an in-depth understanding of particle characteristics.

Single Particle

Area:576081	Diameter:656.2	Length:1181
Breadth:656.2	L/D:1.800	Circularity:0.845
Perimeter:3181	Fmax:1184	Fmin:656.2
Aspect Ratio:0.554	Convexity:0.929	Solidity:0.972
Elongation:0.412	Straightness:1.000	Compactness:0.723
Extent:0.741	Box ratio:0.742	Lmax:1125
Lmin:656.2	Ellipse Similarity:0.900	Ellipse Ratio:0.560
Eccentricity:0.828	Grayscale:17.72	Roughness:0

Oversized Particle Detection for Powder Consistency

The combination of laser diffraction and image analysis can sensitively detect oversized particles that are statistically underrepresented within a wide-distributed sample, such as oversized grain, agglomerates, air bubbles, etc.

Legend: Unqualified batch, Qualified batch

135.8 µm, 136.4 µm, 137.3 µm, 137.4 µm, 137.6 µm, 138.0 µm

Y-axis: Cum (%)
X-axis: Particle Size (µm)

Bettersizer 2600 Family

Wet Dispersion Modules

Parameter	BT-804	BT-80N	BT-80N Pro	BT-802
Liquid volume	≤ 8 mL	50 - 80 mL	80 - 200 mL	≤ 600 mL
Automation	Semi-automated	Semi-automated	Fully automated	Fully automated
Anti-corrosive	Yes	Yes	Yes	No

Dry Dispersion Modules

Parameter	BT-902	BT-903
Powder mass	0.2 - 10 g	0.02 - 1 g
Automation	Fully automated	Fully automated

Imaging Module

Parameter	PIC-1
Principle	Dynamic image analysis
Application	Particle shape analysis

Wet Dispersion System

The wet dispersion process begins with adding water or an organic solvent as the dispersing medium. A stirrer prevents settling, and an ultrasonic transducer aids dispersion and removes bubbles. The dispersed particles then flow into the optical systems for measurement and are recirculated to ensure continuous analysis.
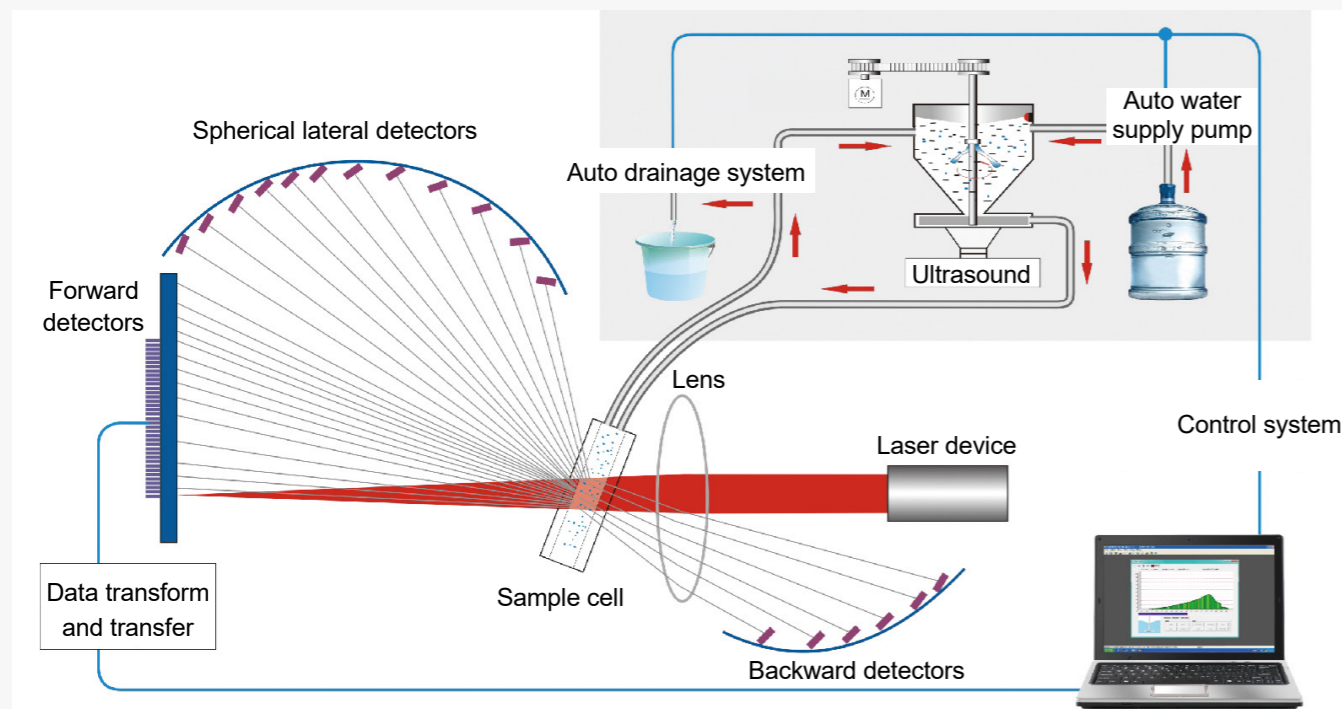
Dry Dispersion System

Dry powder samples are loaded into a sample container, which feeds them into the main disperser through vibration or high-pressure air produced by an air compressor. Inside the disperser, the particles are separated and any clumps are broken up. The dispersed particles then pass through the laser diffraction system for measurement before being collected by a vacuum cleaner.
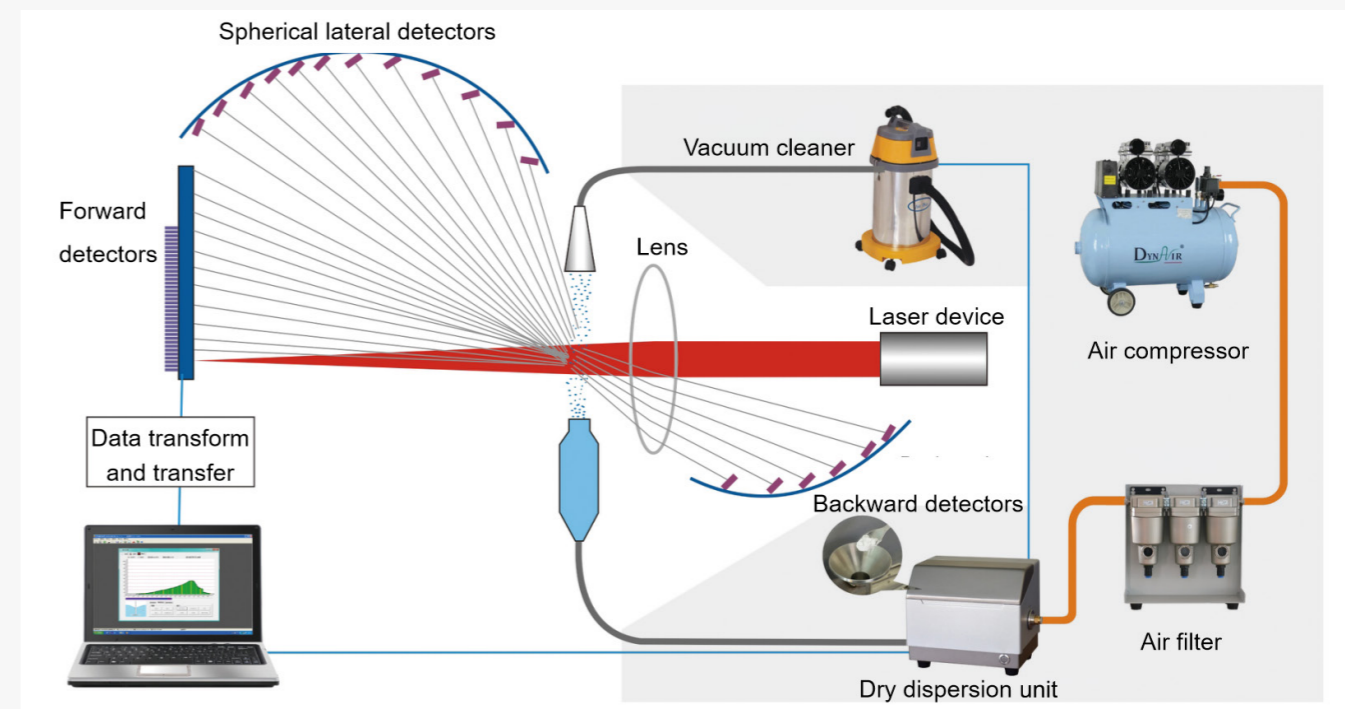
Wet Dispersion Modules

BT-802 - Automatic Wet Dispersion Unit

Parameter	Specification
Measurement range	0.02 - 2,600 µm
Stirring speed	300 - 2,500 rpm
Ultrasonic powder	50 W max
Volume	600 mL max
Medium	Water
SOP	Yes

BT-802 is designed for particle dispersion with water as the medium. It is made up of ABS shells. The components of it include centrifugal pump, peristaltic pump, ultrasonic disperser, pinch valve, control circuit, etc.

BT-80N and BT-80N Pro - Anti-corrosive Wet Dispersion Unit

BT-80N

BT-80N Pro

Parameter	Specification	
	BT-80N	BT-80N Pro
Measurement range	0.02 - 2,600 µm	
Stirring speed	300 - 3,000 rpm	300 - 2,500 rpm
Ultrasonic powder	50 W max	
Volume	50 - 80 mL	80 - 200 mL
Medium	Ethanol, Methanol, Isopropanol, Ether, Toluene, Xylene, Acetone, Octane, NMP solvents, etc.	
SOP	No	Yes
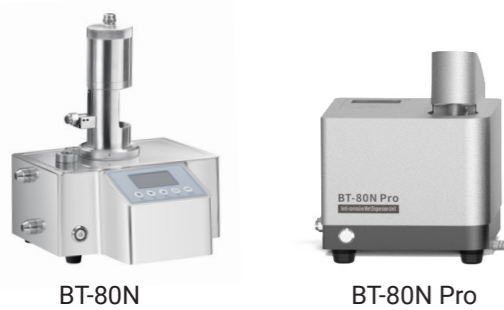
BT-80N Pro is an automatic particle dispersion unit with organic solvents. The manual BT-80N is a basic entry-level model. Both models include stainless steel shells, centrifugal pump, ultrasonic disperser, PTFE pipeline, etc.

BT-804 - Small Volume Wet Dispersion Module

Parameter	Specification
Measurement range	0.02 - 2,600 µm
Stirring	Semi-automated
Volume	8 mL max
Medium	Water or organic solvent
SOP	No

BT-804 is designed for valuable or small-volume sample measurements, where the medium is water or organic solvent.

Dry Dispersion Modules

BT-902 - Automatic Dry Dispersion Unit

Parameter	Specification
Measurement range	0.1 - 2,600 µm
Powder mass	0.2 - 10 g
Air pressure	0.1 - 0.8 MPa
Funnel height	0.7 - 2.9 mm
Medium	Air, nitrogen or noble gases
SOP	Yes

BT-902 is suitable for the dispersion of dry powder particles with compressed gas. BT-902 is made up of electromagnetic vibration feeder, venturi pipe, gas circuit, electric circuit, pressure sensor, etc.

BT-903 - Small Volume Dry Dispersion Unit

Parameter	Specification
Measurement range	0.1 - 2,600 µm
Powder mass	0.02 - 1 g
Volume	5 mL max
Air pressure	0.1 - 0.8 MPa
Medium	Air, nitrogen or noble gases
SOP	Yes

BT-903 is designed for the dispersion of small amount dry powders with a minimum sample volume of 20 mg, using compressed gas. BT-903 is composed of venturi pipe, gas circuit, electric circuit, sample tube, etc.

Effective Particle Dispersion

The Bettersizer 2600's advanced wet and dry dispersion systems are engineered to optimize dispersion energy and ensure effective dispersion without fragmentation.

Wet Dispersion: Precisely controls and monitors ultrasonication and mechanical stirring in liquid media.

Dry Dispersion: Provides exact air pressure for effective dispersion of dry powders.

Large agglomerates → Insufficient energy → Small agglomerates → Effective energy → Well-dispersed particles → Excessive energy → Particle fragments
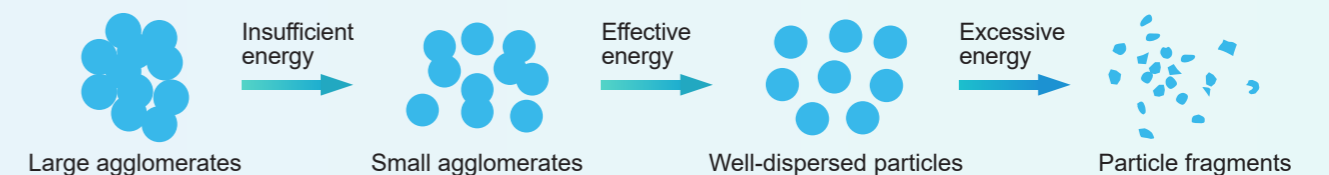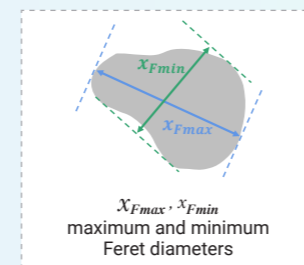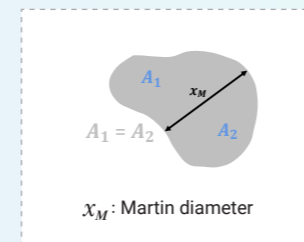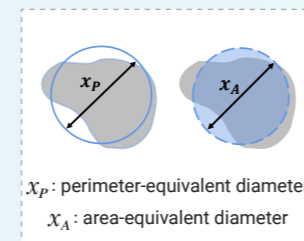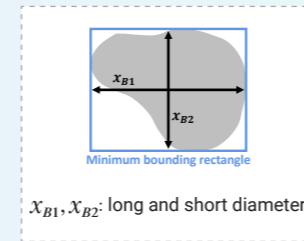
Imaging Module

PIC-1 Dynamic Imaging Module

The PIC-1 dynamic imaging module is a versatile and comprehensive dynamic image analysis instrument, designed for seamless integration with the Bettersizer 2600 laser particle size analyzer and the wet dispersion system. It primarily comprises two high-speed cameras, white and blue LED lights, and a sample cell, among other components. Utilizing dynamic image analysis, the PIC-1 precisely captures high-resolution images of particles in real time as they flow through the sample cell, allowing for detailed analysis of both particle size distribution and shape characteristics.

Parameter	Specification
Particle size range	2 − 3,500 μm*
Size and shape parameters	24
Camera type	CCD sensor, 1.5 Megapixels
Magnification	0.5x and 10x
Imaging rate	120 fps
Illumination	White and blue LED
Image recognition	Up to 10,000 particles per minute
Compliance	ISO 13322-2
Number of size and shape classes	≤100 (adjustable)
Voltage	AC 110 − 240 V, 50/60 Hz
Dimensions (L × W × H)	56 × 137 × 124 mm
Computer configuration	
Processor	Inter Core i3 or a higher
Memory	8 GB or higher
Hard disk space	1 T or higher
Motherboard	with PCI-E X16 interface
Computer system	Windows 7 or higher

*Wet method only

Typical Size Parameters

Minimum bounding rectangle

x_{B1}, x_{B2}: long and short diameter

x_P : perimeter-equivalent diameter
x_A : area-equivalent diameter

$A_1 = A_2$

x_M : Martin diameter

x_{Fmax}, x_{Fmin}
maximum and minimum
Feret diameters

Typical Shape Parameters

$$Aspect\ ratio = \frac{x_{Fmin}}{x_{Fmax}}$$

$$L/D\ ratio = \frac{x_{B1}}{x_{B2}}$$

$$Circularity = \frac{x_A}{x_P}$$

$$Convexity = \frac{P_C}{P}$$
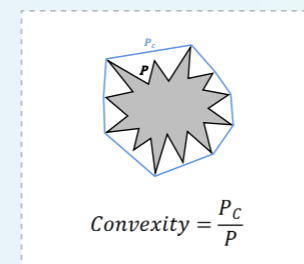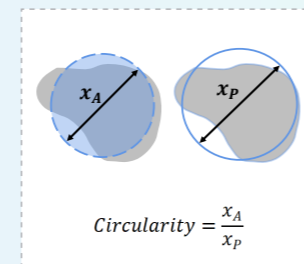
Easy Module Selection for Bettersizer 2600

The Bettersizer 2600 features both wet and dry dispersion modules for effective particle dispersion, along with a dynamic imaging module to expand the measurement range and perform particle shape analysis. Our decision tree* for module selection helps users choose the right dispersion module and determine if the dynamic imaging module is necessary.
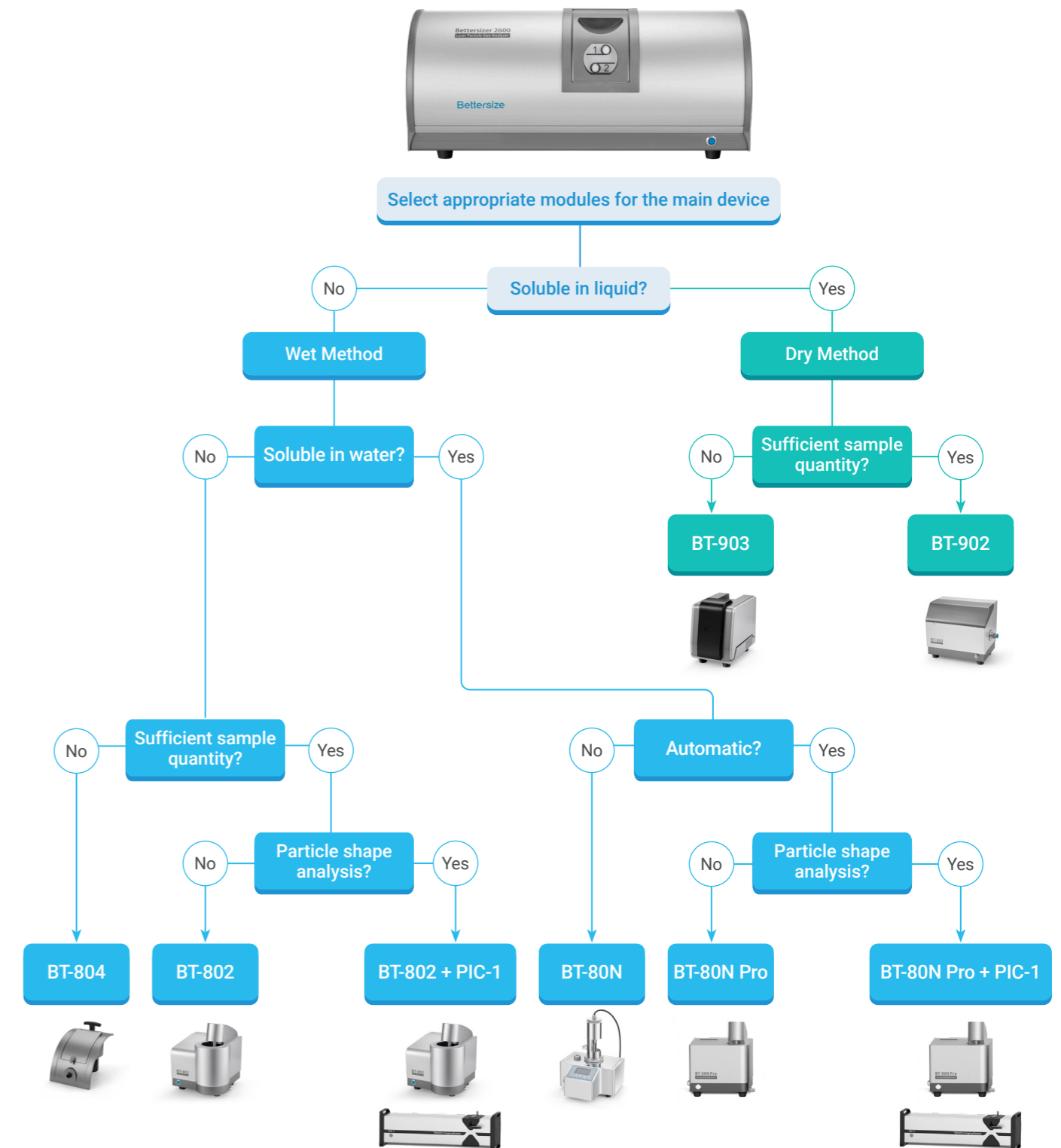
* This decision tree outlines a basic workflow for module selection.
  For more specialized requirements, please contact Bettersize for customized solutions.
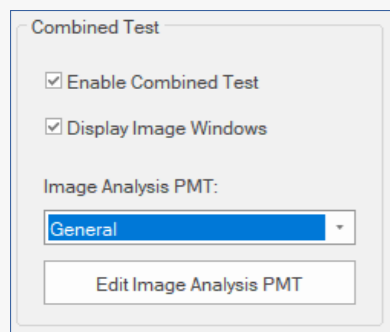
Smart and Powerful Software

Bettersizer software is engineered to enhance your entire measurement process, from pre-processing to final data analysis. By seamlessly automating routine tasks and integrating with the Bettersizer 2600, the software empowers you to focus on scientific intricacies. Experience a streamlined workflow that delivers precise and reliable results with Bettersizer software, accelerating your research, and driving innovation.
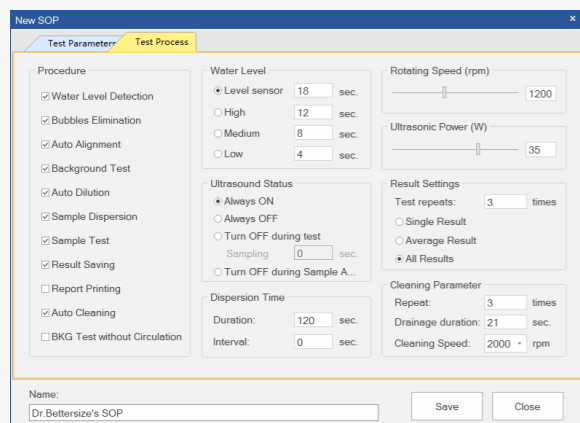
Ⅰ. Versatile Test Setup

Users can easily create new tests based on laser diffraction and dynamic image analysis methods. The software supports both automated and manual operations, providing flexibility for various sample types and testing conditions. The Standard Operating Procedure (SOP) offers a streamlined solution for standardized and automatic testing, ensuring operator-independent results that are objective and reliable.

Combined test
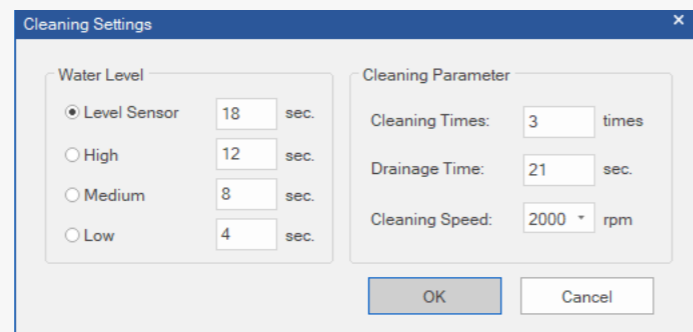
New SOP screen
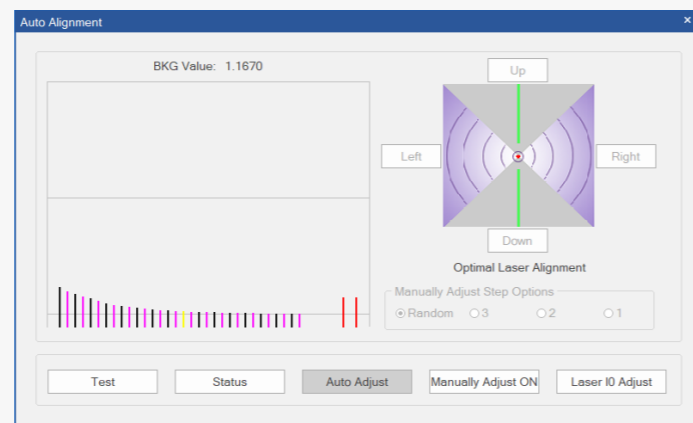
Ⅱ. Automatic Pre-processing

The Bettersizer software significantly enhances data quality by automating critical instrument functions like system cleaning, optical alignment, and sample dispersion. These automated processes ensure optimal instrument performance, leading to increased precision, accuracy, and reproducibility of results.

Cleaning setting

Auto alignment

Ⅲ. Real-time Testing

During the testing process, Bettersizer software delivers real-time insights into particle size distribution and shape. These immediate results provide valuable information on test progress and outcomes, enabling precise adjustments to achieve optimal results.

Imaging windows
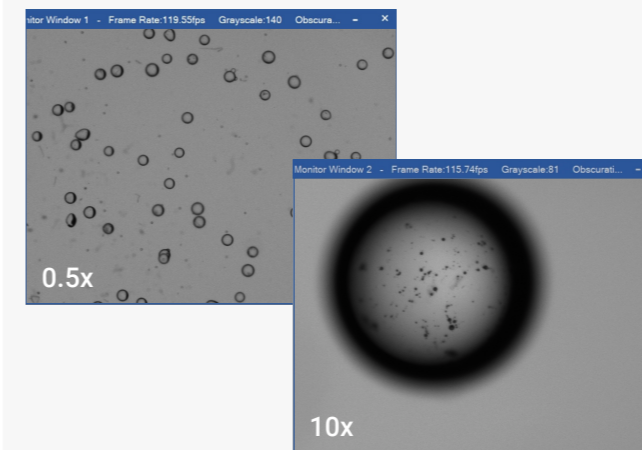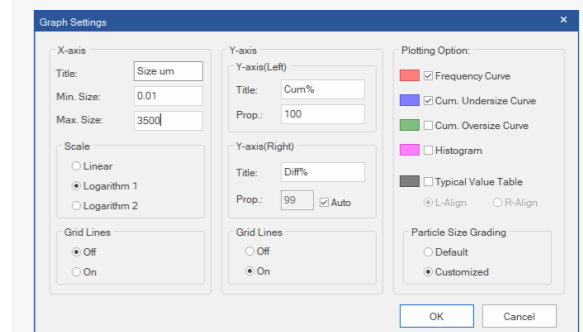
Laser diffraction test
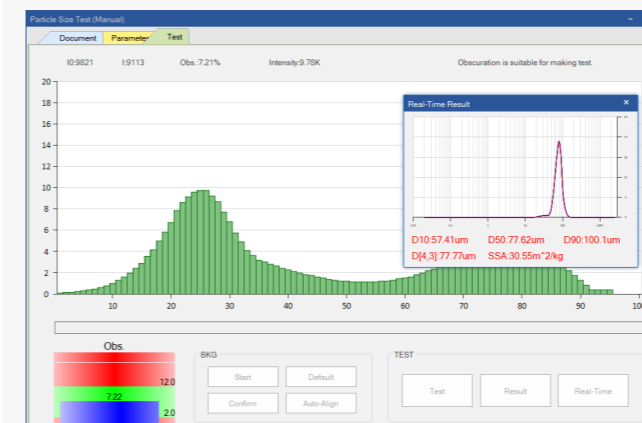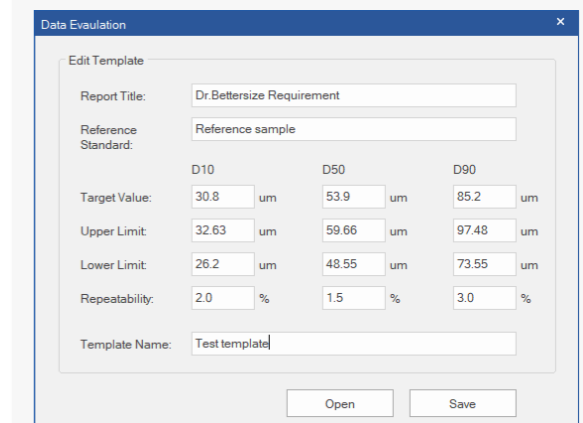
Ⅳ. Comprehensive Data Analysis

The Bettersizer software excels in delivering comprehensive data analysis and report generation capabilities. The software allows users to customize and edit reports to meet specific requirements, including various data points, charts, and graphical representations, to create clear and informative reports. The data evaluation tools can help in assessing the result quality.

Graphical editing

Data evaluation

Highly Customizable Report

- **Complete and detailed data:** Frequency and cumulative distribution curves, simplified and complete distribution table, etc.
- **Editability:** Users can easily edit the reports and change the font, layout, format, etc.
- **Convertibility:** Users can switch the formats of reports freely among PDF, Excel, Text, etc.

"Bettersizer 2600 has a superior performance on drug quality control with its rapid measurement and easy operation."

SINOWAY Pharmaceutical

Specifications

General	
Principle	Laser diffraction technology; Dynamic image analysis
Analysis	Mie scattering theory and Fraunhofer diffraction theory; Image analysis
Typical measurement time	Less than 10 seconds
Measurement performance	
Measuring range	0.02 - 2,600 µm (wet)*; 0.1 - 2,600 µm (dry)*; 2 - 3,500 µm (dynamic image)*
Accuracy	≤ 0.5% *
Repeatability	≤ 0.5% *
Number of size classes	100 (adjustable)
Feeding mode	Automatic circulation or micro cuvette (wet), Gas transportation (dry)
Special functions	SOP settings, refractive index measurement, sample ratio calculation
Main device	
Optical system	Laser diffraction system
Laser	10 mW, 635 nm, Class 1 laser
Detector	92 detectors
Measuring angle	0.016 - 165°
Dynamic imaging module	
Optical system	Dynamic imaging system
CCD camera	0.5x and 10x
Measuring range	2 - 3,500 µm
Frame rate	120 fps
Wet dispersion module	
Dispersion medium	Water or organic solvents
Stirring speed	300 - 2,500 rpm (BT-802, BT-80N Pro); 500 - 3,000 rpm (BT-80N)
Ultrasonication	Dry burning prevention, 50 W
Dry dispersion module	
Dispersion medium	Air / Nitrogen / Noble gas
Air pressure	0.1 - 0.8 MPa
Compliance	
System	RoHS, CE, ISO 13320, USP <429>, ISO 13322-2
Software	21 CFR Part 11
System parameters	
Dimensions (L x W x H)	70.5 x 31.8 x 29.5 cm
Weight	23 kg
Supply voltage	100 / 240 V, 50 / 60 Hz
Computer configuration (recommended)	
Computer interface	At least one high-speed USB 2.0 or USB 3.0 port required
Operating system	Windows 7 or higher
Hardware specification	Intel Core i5 Processor, 4GB RAM, 250GB HD, Widescreen monitor

*Sample and sample preparation dependent

Bettersize
BETTER PARTICLE SIZE SOLUTIONS

www.bettersizeinstruments.com
info@bettersize.com

Bettersize Instruments Ltd.

Address: No. 9, Ganquan Road, Jinquan
Industrial Park, Dandong, Liaoning, China

Postcode: 118009

Tel: +86-755-26926582

Fax: +86-415-6170645

Bettersize Inc.

Address: Suite K-2, 3188 Airway Ave,
Costa Mesa, CA 92626, United States

Tel: +1 833-699-7493 (SIZE)

European Representative:

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www.3P-instruments.com
info@3P-instruments.com

3P Instruments GmbH & Co. KG

Address: Rudolf-Diesel-Str. 12, 85235
Odelzhausen Germany

Tel: +49 8134 9324 0

Fax: +49 8134 9324 25

Visit Our
Bettersizer 2600 Site:

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YouTube Channel:

RIFERIMENTO PER L'ITALIA

Qi technologies

Qi srl
t +39 06 9105461
www.qitech.it | sales@qitech.it