

Bettersizer S3 Plus

Strive For Excellence In All You See

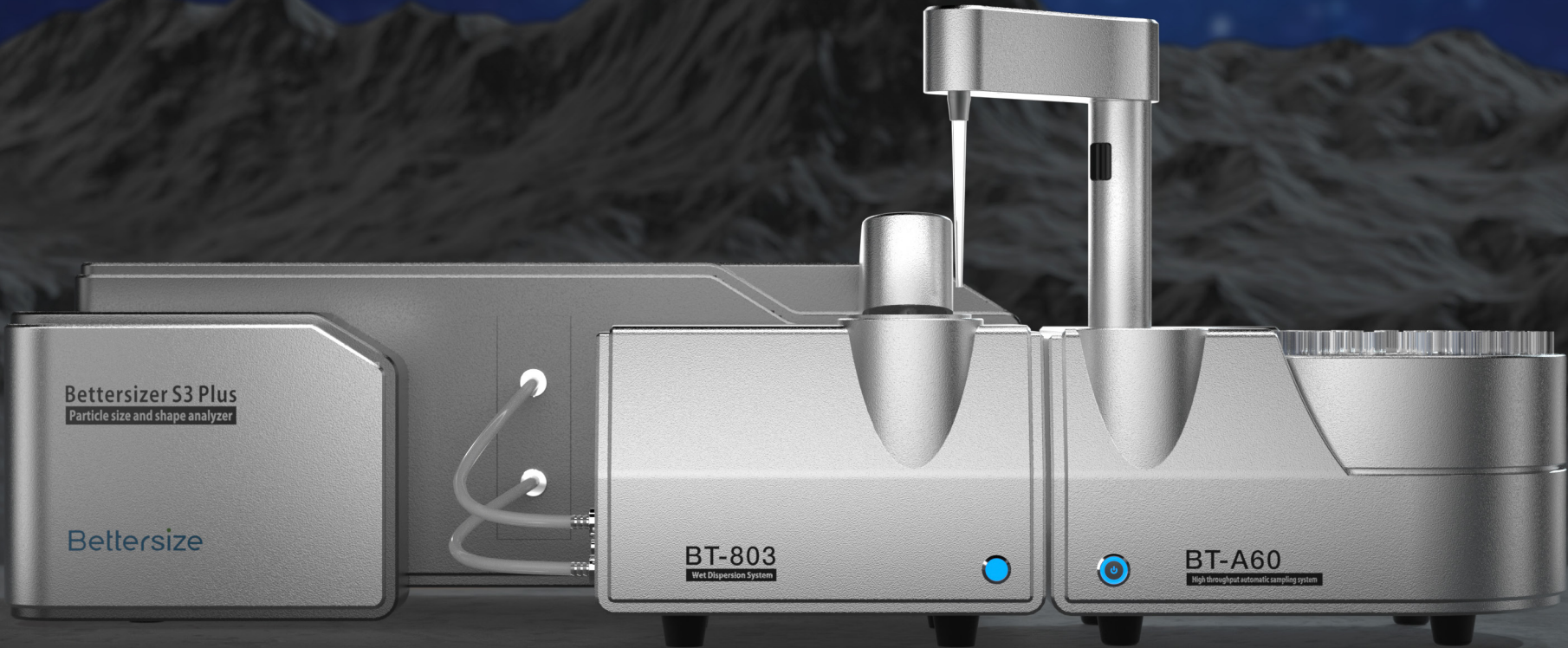


PARTICLE SIZE

PARTICLE SHAPE

Strive for Excellence in All You See

The Bettersizer S3 Plus combines laser diffraction and dynamic image analysis in one instrument. It can measure the size and shape of particles from 0.01 μm to 3500 μm . Its exceptional sensitivity for either ultrafine particles or oversized particles, and unsurpassed resolution, make it the most powerful size and shape analyzer for users across various industries, offering new possibilities for comprehensive particle characterization solutions.




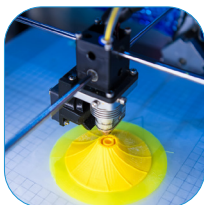




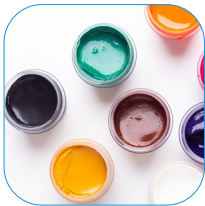



"The combination of laser diffraction and dynamic image analysis perfectly meets the needs of coarse particle measurement in polymer product development and the results obtained are reliable and highly accurate."

XI'AN Thermal Power Research Institute Co., Ltd.

Measured Lunar Soil
See Page 9

Applications and Industries

| Industries | Samples | Significance |
|---|---|--|
| Soils & Sediments  | Stones, clay, gravel, marine sediments, lunar surface, etc. | Particle size and shape are two fundamental properties of any sediment or soil that can provide important clues to its nature and origin. The Bettersizer S3 Plus offers accurate and reliable particle size and shape information in the range 0.01-3500 µm for various sample types including soils, marine sediments and even lunar samples returned from space missions. |
| Ceramics  | Silica, quartz, flint, silicates, alumina, etc. | The particle size distributions of raw ceramic materials significantly impact the final product's surface smoothness, shapes, degree of agglomeration and dimensional stability. The dual camera optical system in Bettersizer S3 Plus effectively captures the images of agglomerated oversized particles during R&D processes. |
| Abrasives  | Calcite, emery, pumice, sandstone, garnet, borazon, 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 S3 Plus. |
| 3D Printing Materials  | Polylactic acid (PLA), Acrylonitrile butadiene styrene (ABS), bronze, nickel, alloy, etc. | The flow property, surface roughness, and quality of 3D printed products greatly depend on its raw material's particle size and size distribution. The Bettersizer S3 Plus helps optimize particle size distribution, thereby controlling the final product's quality. |
| Food & Beverages  | Sugar, chocolate, flour, additives, etc. | Many important characteristics of food products, namely taste, dissolution, and extraction behavior, are affected by particle sizes and shapes of raw materials. Equipped with dynamic image analysis technology, the Bettersizer S3 Plus is an ideal particle analyzer in the food and beverage industry. |

| Industries | Samples | Significance |
|--|--|--|
| Battery & Energy  | Graphite, cobalt, manganese, etc. | It is crucial to utilize the Bettersizer S3 Plus to measure and control the particle sizes and morphological properties of raw materials in the battery industry because they account for central battery performances, including energy storage, stability, and life cycle. |
| Paints, Inks, & Coatings  | Epoxies, polyurethanes, silicon, zinc-rich primers, etc. | Storage time, color consistency, flowability, and stability of pigment-based inks resulted from proper controls in the pigment particle shape, size, and size distribution. The Bettersizer S3 Plus characterizes these pigment properties, maximizing final product performances. |
| Pharmaceuticals  | Cefixime, gliclazide, glimepiride, paclitaxel, etc. | The Bettersizer S3 Plus is extremely helpful in industries where quality control standards are exacting, namely the pharmaceutical industry. The particle size and size distributions of both active and inactive ingredients significantly impact drugs' dissolution, body absorption, efficacy, and safety. |
| Building Materials  | Cement, asphalt, sands, wood, synthetic polymers, etc. | The hardening rate, strength, and fluidity of concrete are greatly affected by the particle size distribution of cement. The Bettersizer S3 Plus provides accurate, repeatable, and reliable measurements of cement size and size distribution, increasing the efficiency in the concrete manufacturing process. |
| Powder Metallurgy  | Steel, tin, nickel, copper, aluminum, etc. | The production rates of final powdered particles at the end of the powder metallurgy process are influenced by grains' size and size distribution. Using the Bettersizer S3 Plus to monitor final products' size greatly improves the production efficiency. |

Evolutionary Technologies

I - Patented DLOI (Dual Lenses & Oblique Incidence)

System: Laser Diffraction

Laser diffraction technology for routine particle size analysis remains the method of choice across various industrial sectors. The Bettersizer S3 Plus applies the patented DLOI system, which is designed based on the Fourier structure to guarantee the accurate measurement of ultrafine particles from 0.01 μm .

Features & Benefits

- Measures **ultrafine particles** accurately with the large angular range (0.02 - 165°) with 96 detectors
- **Robust optical system** with superior resolution using the dual lenses design
- Single short-wave laser system (532 nm) delivers a **continuous scattering spectrum** with a consistent wavelength
- **Zero stabilization and preheating time** needed with solid-state light source

II - Dual-Camera System: Dynamic Image Analysis

Dynamic image analysis can strengthen your understanding of materials with comprehensive shape or morphological information that is independent of laser diffraction. Individual particles with specific geometric properties such as agglomerates, crushed particles, and foreign particles can be effectively tracked through the dual-camera system.

Features & Benefits

- 0.5x and 10x cameras - photograph **extremely wide size range of particles**
- High speed strobe lights - capture up to **10,000 particle images in 60 seconds**, offering authentic **shape results**
- Suitable for **measuring heterogeneous samples** with unknown optical properties

III - Groundbreaking Combination: Laser Diffraction with Dynamic Image Analysis

The Bettersizer S3 Plus integrates laser diffraction and dynamic image analysis into one instrument to simultaneously characterize particle size, size distribution, and particle shape over a wide dynamic range. Working in tandem, users can gain a deeper understanding of material behavior to fasten the troubleshooting process and method development process.

Features & Benefits

- DLOI System - precisely measures **ultrafine particles down to 0.01 μm**
- Dual-camera Imaging System - efficiently detects **oversized particles up to 3,500 μm**
- 2-in-1 System - simultaneously obtains **particle size and shape results**
- Fast time-to-result - rapidly generates results in **10 seconds**

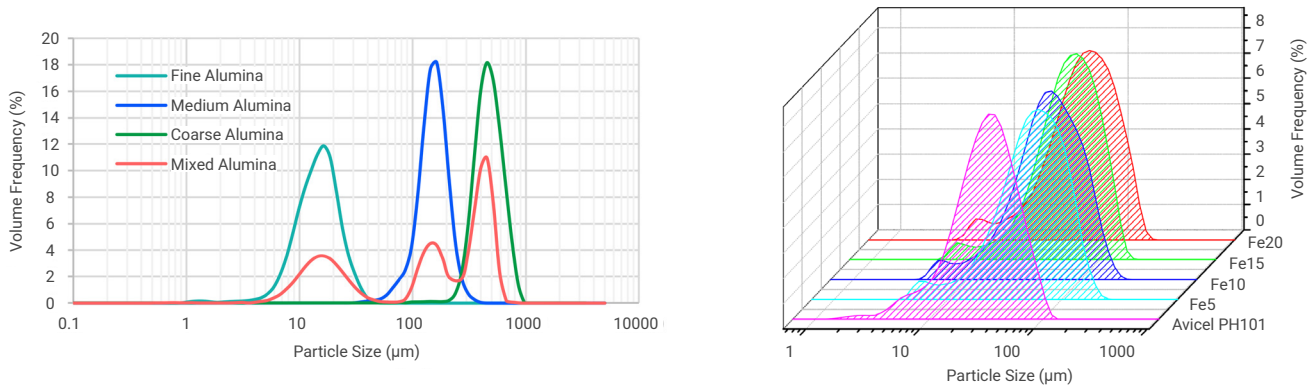
"The Bettersizer S3 Plus is easy to use and has brought excellent repeatability and high productivity to the research of abrasives."

North University of China

Patented DLOI System

Size Measurement

The Bettersizer S3 Plus achieves exceptional resolution and sensitivity for particle size measurements. The DLOI system allows the size distributions of polydisperse samples to be determined precisely, and the size changes of products to be detected sensitively.



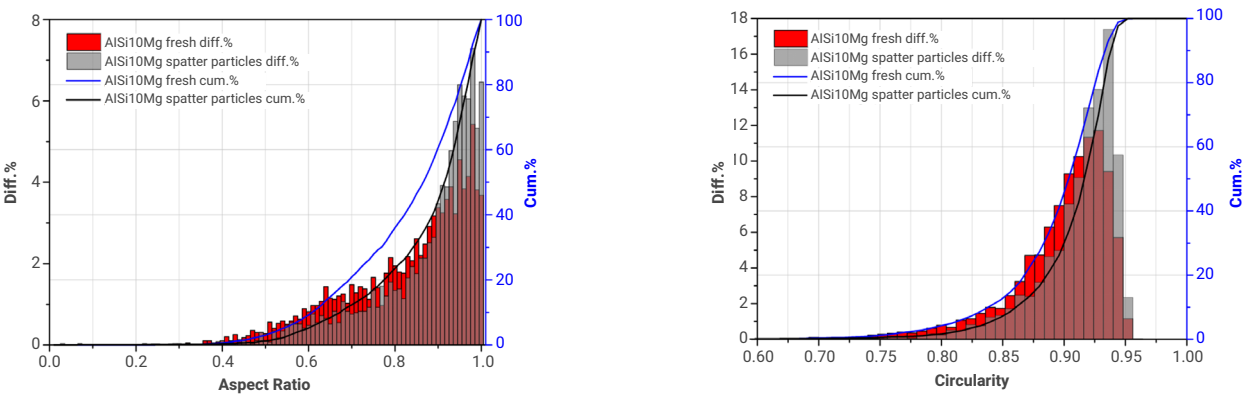
A mixed alumina sample is investigated, and as to be expected, the analysis notes the existence of the three raw samples, suggesting the **high-resolution capability** of the DLOI system.

The sizes of as-prepared MCC (microcrystalline cellulose) exhibit a slightly decreased trend with the increasing Fe³⁺ concentration, suggesting the **high-sensitivity capability** of the DLOI system. (Adapted from Yue, Xiaopeng, et al. *Cellulose* 28.3 (2021): 1405-1419.)

Dual-Camera Imaging System

Shape Measurement

An example of additive manufacturing for shape analysis using the Bettersizer S3 Plus is shown below. A representative number of individual particles are recorded from two AISi10Mg samples, and the number-weighted aspect ratio and circularity are evaluated in compliance with ISO standards. (Adapted from F. Schleife, C. Oetzel. *Chem. Ing. Tech.* 93.8 (2021): 1199–1203.)



Compared to the fresh powders, the spatter particles show a significantly larger aspect ratio and thus a lower average elongation.

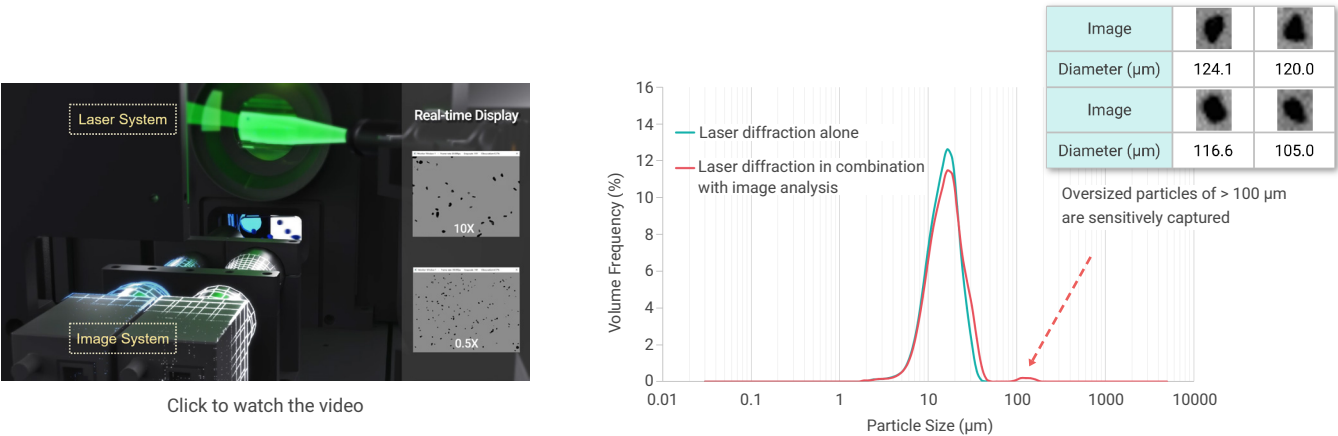
The spatter particles exhibit a higher average circularity and are expected to possess a lower shape anisotropy than the fresh powders.

Combination: Laser Diffraction and Image Analysis

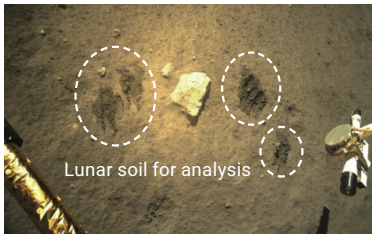
Oversized Particle Detection

Laser diffraction in combination with image analysis can sensitively detect oversized particles that are statistically underrepresented within a wide-distributed sample, such as oversized grains, agglomerates, air bubbles, etc.

An example of an off-specification abrasive is displayed below. The Bettersizer S3 Plus confirms the presence of oversized particles, by showing a size peak at around 120 μm and the images of overly coarse particles.



Analysis of Samples with Extremely Broad Distributions



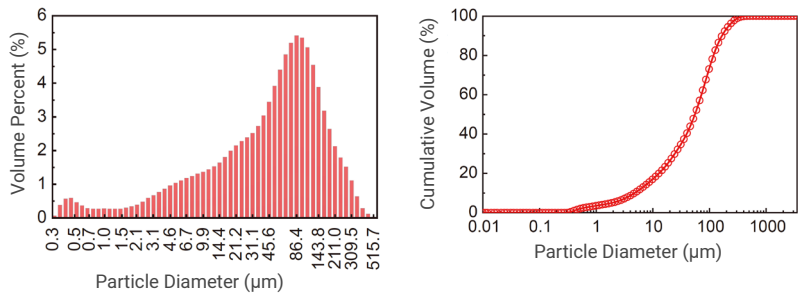
Lunar soil analyzed by the Bettersizer S3 Plus

The combined measurement of the Bettersizer S3 Plus is an ideal solution to acquire accurate quantitative results of samples. Here shows an example to measure the soil sample returned from the Moon.

Based on the comprehensive size and shape results, the lunar sample can be described to be well-graded according to geotechnical criteria. (Adapted from Zhang, Hui, et al. *Science China Physics, Mechanics & Astronomy* 65.2 (2022): 1-8.)

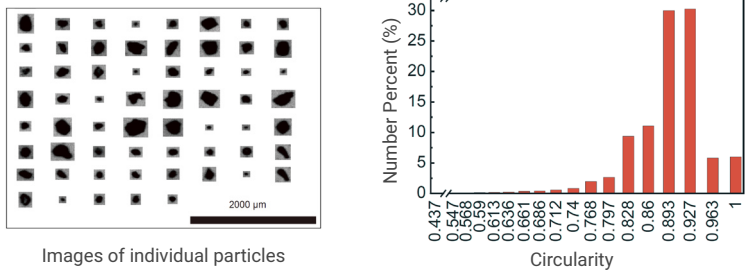
Size Characterization

A very broad distribution of particle size occurs in the range of 0.3 - 516 μm. In the size range of 1 - 10 μm, there is a slow increase, suggesting the presence of a **noticeable amount of fine dust**.

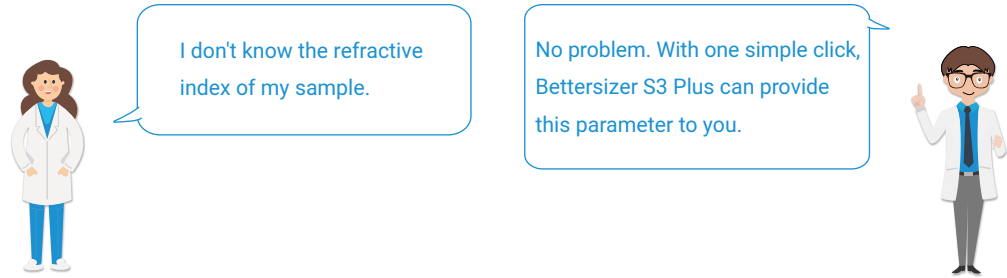


Shape Characterization

The circularity of individual particles of the lunar sample is analyzed based on particle images. Most lunar regolith particles possess high circularity and are thus **relatively regular in shape**.



Refractive Index Measurement



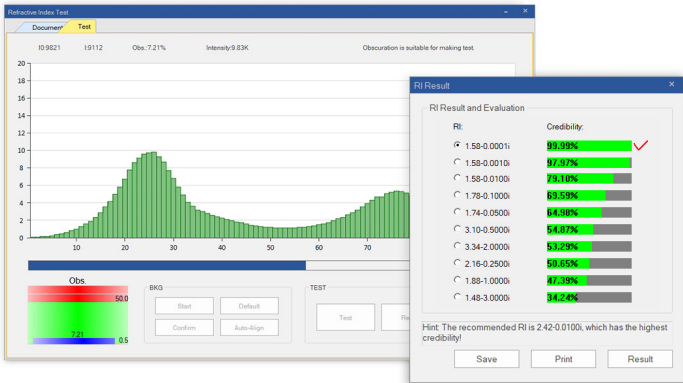
Under the Mie theory, measurements by laser diffraction are challenging for samples including:

- 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).

Refractive index measurement is one of the best solutions. Bettersizer S3 Plus is capable of the following:

- Determine comprehensive refractive index for unknown samples;
- 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) |
|--------------------------------|-------------------------------|-----------------------------|
| Carbon black | 1.88-0.55i | 1.95-0.1i |
| BaSO ₄ | 1.65-0.1i | 1.71-0.1i |
| As ₂ O ₃ | 2.65-0.1i | 2.59-0.1i |
| FeCO ₃ | 1.875-0.1i | 1.83-0.1i |
| CaCO ₃ | (1.53-1.65)-0.1i | 1.59-0.1i |
| SiO ₂ | 1.54-0.00i | 1.57-0.01i |



BT-A60 Autosampler

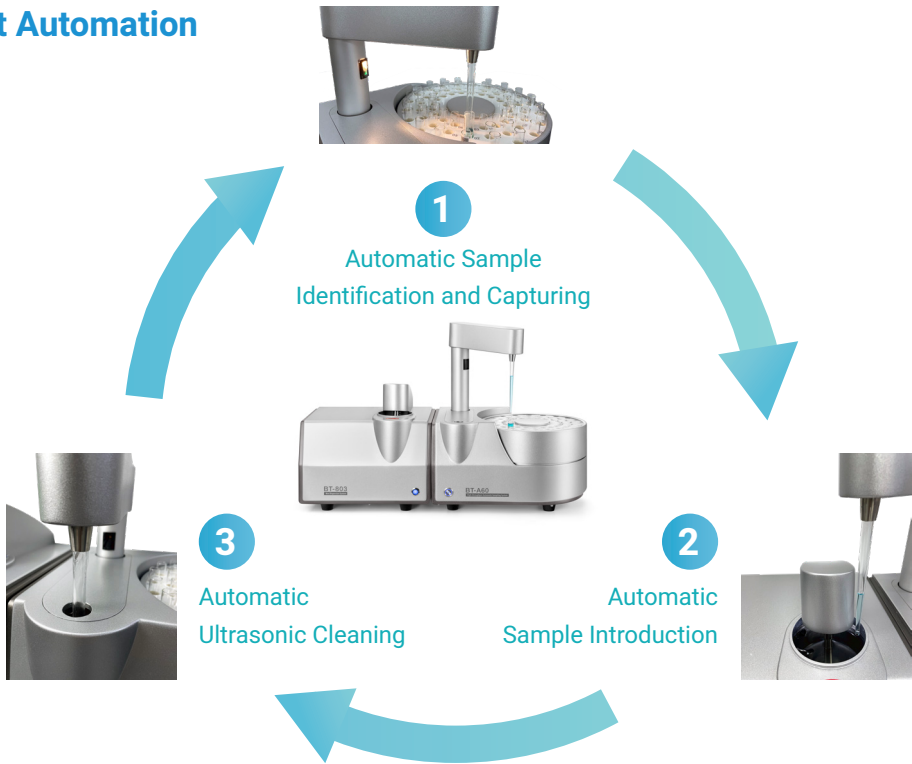
Bring Your Productivity to the Next Level

The BT-A60 is a robust, high-throughput autosampler. It measures up to 60 samples in a single run and reduces labor costs while improving laboratory productivity and efficiency. Compatible with the Bettersizer S3 Plus, the BT-A60 provides 24/7 fully automated sample analysis for a variety of analytical applications.

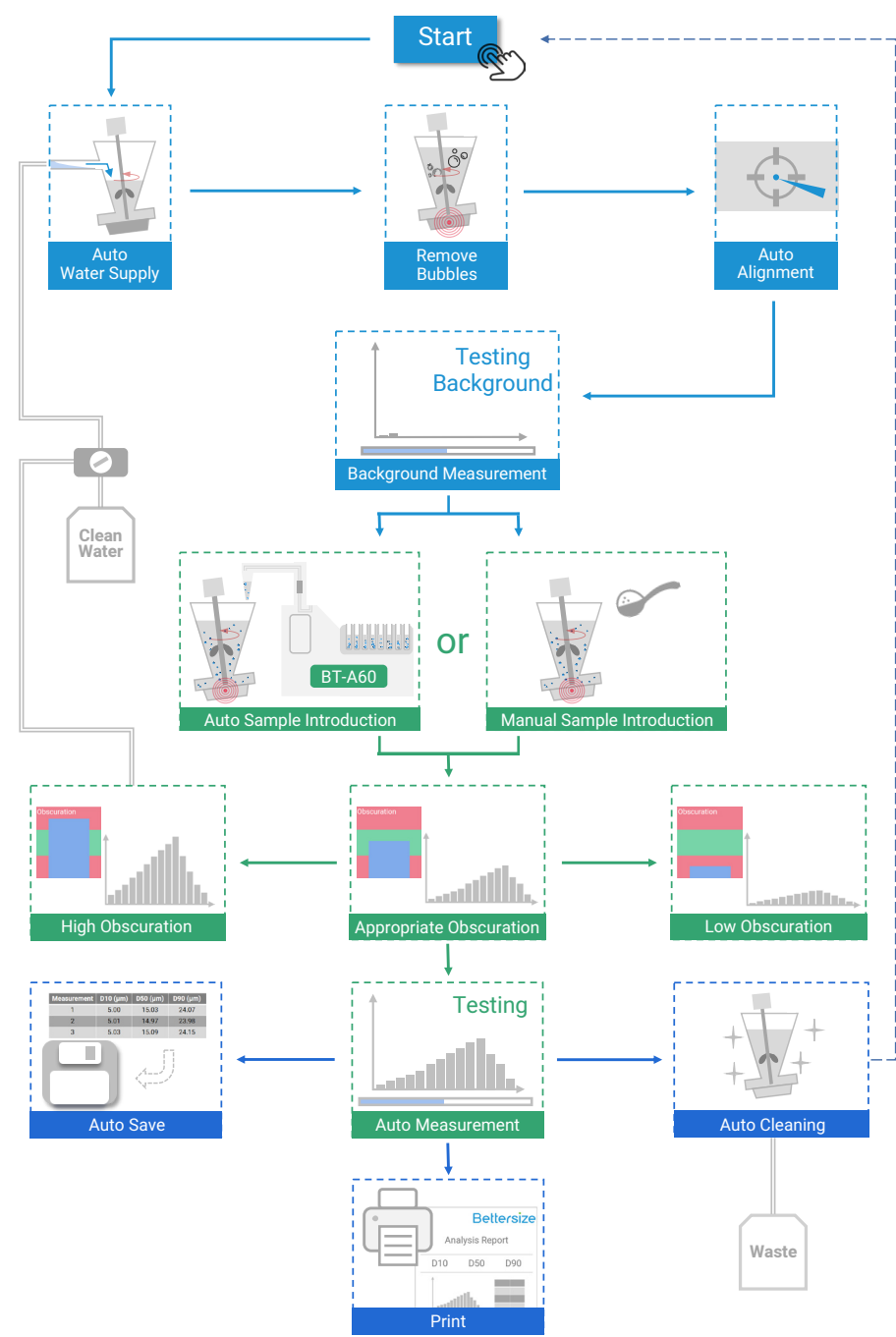


- | | |
|-------------------------------------|--------------------------------------|
| × Skilled operator required | ✓ Save labor costs |
| × Potential risk of human error | ✓ Independent of human error |
| × Risk of cross-contamination | ✓ No risk of cross-contamination |
| × Messy workbench | ✓ Well-organized workbench |
| × Longer sample-to-sample run times | ✓ Shorter sample-to-sample run times |

Measurement Automation

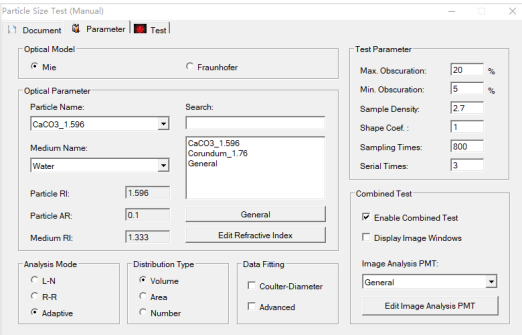


Standard Operating Procedure (SOP)

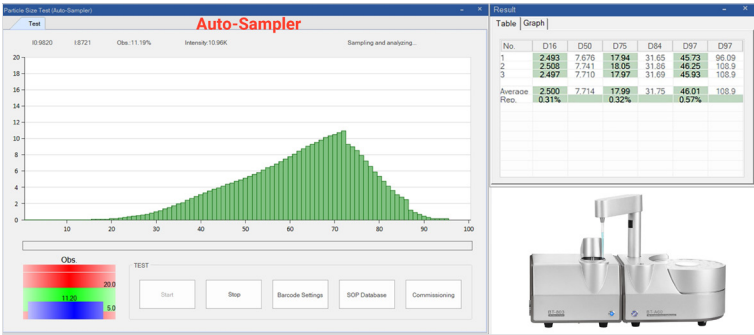


Intuitive and Workflow-oriented Software

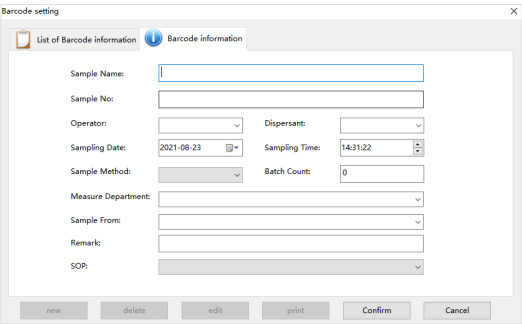
The Bettersizer S3 Plus comes with the workflow-oriented software that includes comprehensive built-in functions such as multilingual operating system, signal extraction, system inspection, SOP, etc. Integrated with these functions, the powerful software guarantees the accuracy and repeatability of results.



Template Settings



Measurement Interface



BT-A60 Barcode Printing

Advantages of the software

- Real-time display for determining the optimal measurement conditions
- Fully automatic measurement and cleaning routine
- Commonly used particles and media refractive indices available
- Fully comply with 21 CFR Part 11



Accessories and Dispersion Modules

BT - A60 High-throughput Autosampler

Durable, automatic, and efficient sampling system designed for full-auto measurement of either dry powders or suspensions.

| | |
|-----------------|-------------------|
| Sample Capacity | 60 samples |
| Sampling Volume | 0.5 - 5 mL |
| Dimensions | 16.1×11.4×19.0 in |



BT-803 Automatic Wet Dispersion Module

Large volume automated dispersion unit suitable for measurements with water-based suspensions.

| | |
|----------------|------------------|
| Maximum Volume | 600 mL |
| Liquid Supply | Automated |
| Dimensions | 13.4×9.4×12.6 in |



BT-80N Anti-corrosive Wet Dispersion Module

Solvent-resistant dispersion unit designed for measurement with corrosive dispersion media or limited sample volume.

| | |
|---------------|------------------|
| Volume | 50 - 80 mL |
| Liquid Supply | Manual |
| Dimensions | 11.4×8.3×14.8 in |



BT-80N Pro Automatic Anti-corrosive Wet Dispersion Module

Automated solvent-resistant dispersion unit designed for measurement with corrosive dispersion media.

| | |
|---------------|-----------------|
| Volume | 80 - 200 mL |
| Liquid Supply | Automatic |
| Dimensions | 9.4×8.7×11.4 in |

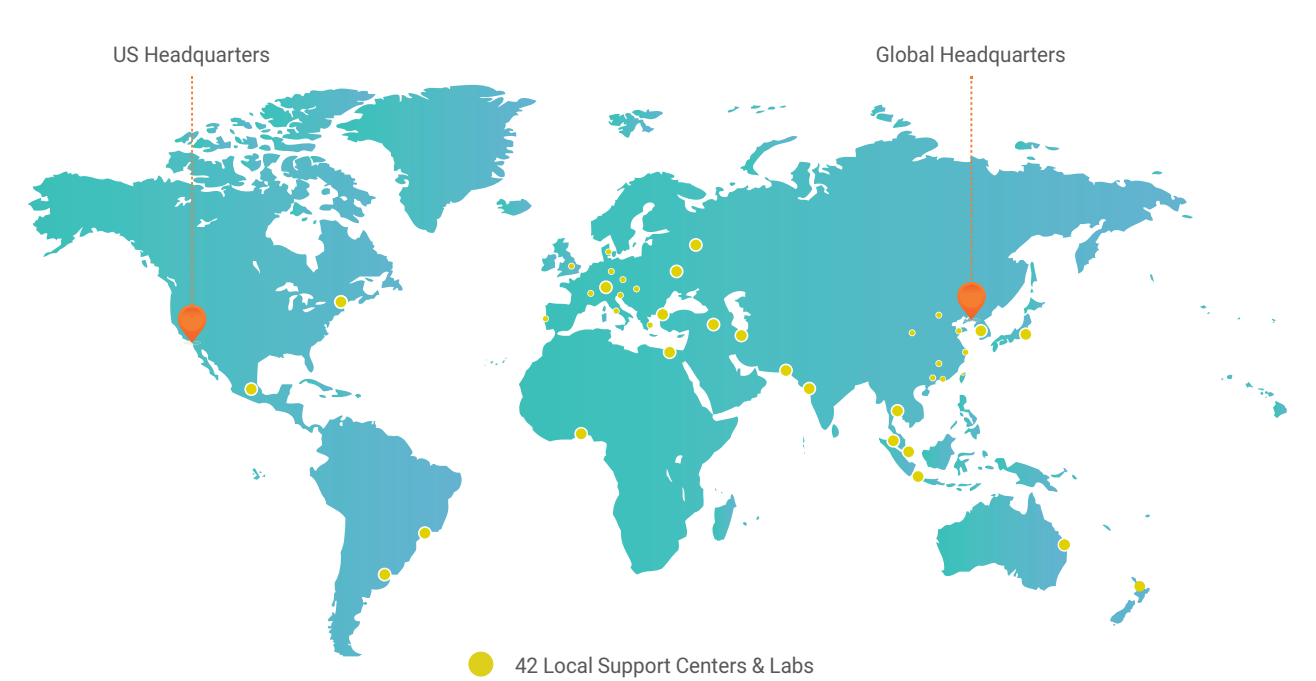


Specification

| Parameter Measured | |
|--------------------------------------|---|
| Particle size distribution | Suspension, emulsion, dry powders |
| Particle shape | |
| General | |
| Principle | Laser diffraction and dynamic image technologies |
| Analysis | Mie scattering theory and Fraunhofer diffraction theory |
| Typical measurement time | Less than 10 seconds |
| Measurement Performance | |
| Measuring range | 0.01 - 3500 μm (Laser System) 2 - 3500 μm (Image System) |
| Accuracy | <0.5% (NIST certified standards) |
| Repeatability | <0.5% (NIST certified standards) |
| Number of size classes | ≤100 (adjustable) |
| Feeding mode | Automatic circulation or semi-automatic circulation |
| Special functions | Refractive index measurement, SOP settings |
| Image recognition | Up to 10,000 particles per minute |
| Main Device | |
| Optical system | Patented DLOI (Dual Lenses & Oblique Incidence) System |
| Laser | Polarized light-pumped solid-state laser (10 mW / 532 nm) |
| Detector | 96 detectors (forward, lateral and backward arrangements) |
| Measuring angle | 0.02 - 165° |
| Camera type | CMOS sensor, 1.5 Megapixels |
| Imaging rate | 120 fps |
| Camera magnification | 0.5x and 10x* |
| Dispersion Module BT-803 | |
| Circulation speed | 300 - 2500 r/min |
| Maximum flow rate | ≥ 3 L/min ** |
| Ultrasonication | Dry run protection, Max 50 W (adjustable) |
| Circulation tank capacity | 600 mL |
| Software | |
| Conformity | 21 CFR Part 11, ISO 13320, ISO 13322, USP <429> |
| Report | Customizable reporting |
| System Parameters | |
| Dimensions (L x W x H) | 820 × 610 × 290 mm |
| Weight | 48 kg |
| Voltage | DC 24 V, 50 / 60 Hz, 20 W |
| Computer Configuration (Recommended) | |
| Computer interface | At least one high-speed USB 2.0 or USB 3.0 port required |
| Operating system | Windows 7 / Windows 10 |
| Hardware specification | Intel Core i7, 8GB RAM, 500GB HD, two PCI-E X16 interfaces |

* The Bettersizer S3 Plus is also available in a single camera (0.5x) model. Contact us for more information.
** Dispersion medium dependent

Global Footprint



Compliance

All series of Bettersize instruments are in compliance with **ISO 9001** and **CE certification**. The software complies with **U.S. FDA 21 CFR Part 11**, ensuring the validity and reliability of measurement results and meeting traceability requirements.



Certified Service and Support

We take great pride in our exceptional customer service, providing excellent application technical support and after-sales service throughout the product life cycle.

From product demonstration and installation, to regular product training and workshops, preventive maintenance programs, software and hardware upgrade, trade-in purchase program, to repair coverage and 24/7 emergency service, our certified service team have you covered.





Bettersize Instruments Ltd.

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

Postcode: 118009

Tel: +86-755-26926582

Bettersize Inc.

3185 Airway Ave, Suite C2, Costa Mesa,
CA 92626, United States

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

info@bettersize.com

www.bettersizeinstruments.com



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