Access to **your** success

SHIMADZU

SALD-7101

Shimadzu
Nano Particle Size Analyzer

SALD

Equipped with
UV Laser

Opening up the World of Particles

Sets a New Standard in
Nano Particle Size
Analyzers

SALD-7101

Features

First in the World to Adopt a 375 nm UV Semiconductor Laser
A great new tool for research and development in nanotechnogy and life sciences

10 nm Lower Limit of Detection

- A previously unreachable 10 nm lower limit of detection is achieved through a combination of a world-first 375 nm-wavelength UV semiconductor laser light source and a light sensor consisting of a high-sensitivity light receptors created by the most up-to-date production processes specifically to handle UV lasers.

- Serial measurements based on the same measurement principle are possible for particle changing across the 10 nm to 300 μm measurement range.
  Accurate particle size distribution measurements are assured across the entire measurement range, as the instrument does not incorporate multiple optical systems that create discontinuities in the data.

Measure Concentrations from Several ppm to 20%

- Compared to other instruments, SALD-7101 permits measurements across an extremely broad range of concentrations from several ppm to 20%.
- The particle size of fine particles, particularly nanoparticles, varies with the concentration. The dispersion and coagulation of nanoparticles can be observed while altering the concentration.

- Accurate analysis of samples in which the particle size distribution changes with dilution is possible, as measurements can be conducted on the undiluted solution or after minimal dilution. For example, commercial hand creams, face creams, and rinses can be measured with hardly any pretreatment.
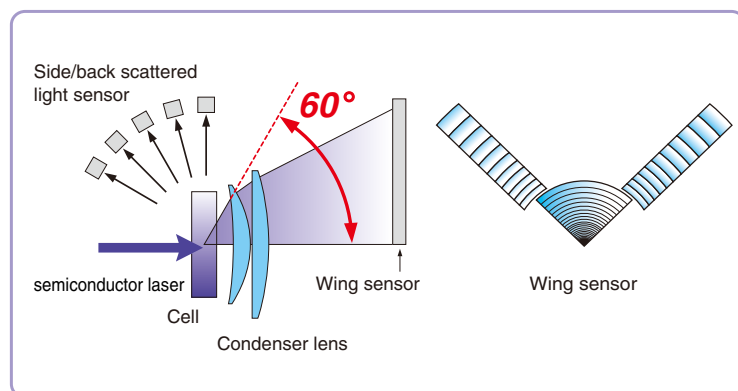
1-second Minimum Measurement Time

- The standard setting for the measurement time is 10 seconds but can be reduced to a minimum of 1 second. The particle size distribution can be displayed in realtime at 1-second intervals.
  This function is permitted by the use of a single light source that requires no switching and the wide-angle detection method.

- Serial observations of the dispersion or dissolution reaction processes are possible at 1-second intervals, and these results can be saved. Functions for statistical processing and 3D display of the particle reaction processes offer multifaceted analyses and evaluations.
  (Using the optional WingSALD-7101CM serial measurement software.)

Small Amount Sample Measurement

- Drainage of a small quantity of a suspension liquid is adequate, as the SALD-BC71 batch cell permits analysis of a volume of just 7 cm^3. Most organic solvents can be used.

- A combination of the SALD-HC71 high-concentration sample measurement system with special glass slides with a shallow indentation permits measurement on just 15 microliters.

Seamless measurement over the entire range using a single measurement principle, single optical system, and single light source The SLIT optical system continuously captures forward-scattered light at up to 60° on a single detection plane

Side/back scattered light sensor

60°

semiconductor laser

Cell

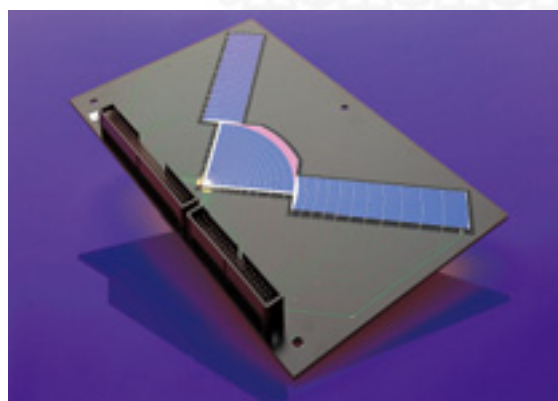Condenser lens

Wing sensor   Wing sensor

SLIT optical system

The target particle size range is covered using a single measurement principle, single optical system, and single light source to achieve a perfectly seamless single wide range. Accurate particle size distribution measurements are possible across the entire measurement range using a single standard, as the instrument does not incorporate multiple optical systems that create discontinuities in the data.

The application of the SLIT optical system, based on sophisticated scattered light intensity tracing technology, smashes conventional wisdom to continuously capture forward-scattered light at up to a wide 60° angle on a single detector face. This achieves high resolution in the fine particle region.

SLIT (Scattered Light Intensity Trace)

High-Resolution/High-Sensitivity Wing Sensor

Forward diffracted/scattered light is detected by a "wing" sensor, a 76-element sensor that was developed using semiconductor manufacturing technology of the highest level. This sensor can detect greatly fluctuating small-angle forward scattering with a high level of resolution and wide-angle scattering of a low optical intensity with a high level of sensitivity. Also, side scattered light is detected by one sensor element and back scattered light is detected by four sensor elements. Accurately capturing light intensity distribution patterns with a total of 81 sensor elements enables the high-resolution, high-precision measurement of particle size distributions over a wide particle diameter range.
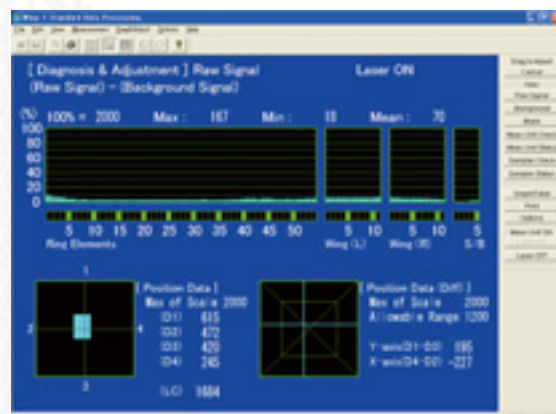
More Stable Optical System

The Omnidirectional Shock Absorption Frame (OSAF) is employed to fully isolate all elements of the optical system from the disturbances of shocks and vibrations. This eliminates concerns about adjusting the optical axis.

Wing sensor

Built-in Self-Diagnostic Functions Ensure Easy Maintenance

These analyzers incorporate powerful self-diagnostic functions. The output signals sent by the sensors and detecting elements and the instrument operating status can be checked, facilitating easier maintenance. Using the Operation Log function, detailed information about, for example, the instrument usage status and contamination of the cells is included with all the measurement data, and so it is possible to investigate the validity of measurement data obtained in the past.

System Configuration

[A Highly-evolved Nano Particle Size Analyzer]

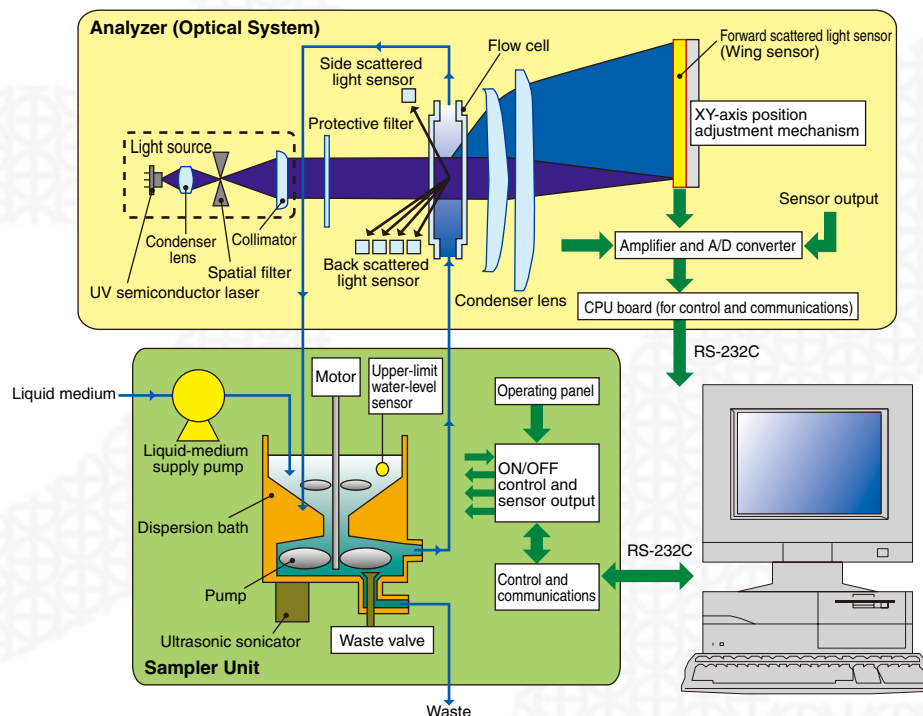### Measurement unit (analyzer)

SALD-7101   **P/N: 347-60710-20**

The SALD-7101 can handle a broad range of measurement objects and purposes. Option units can be selected in accordance with the object and purpose, and used to create a wide variety of system configurations.

Name	Model	P/N
sampler Unit	SALD-MS71	347-60711-20
Batch cell	SALD-BC71	347-60712
High-concentration sample measurement system	SALD-HC71	347-60713-20

* SLIT optical systemThe analyzer unit does not include a cell.
  Select the option appropriate for your purposes.

- UV semiconductor laser (wavelength: 375 nm) is used for the semi-permanent light source. Maintenance, such as gas replacement, is unnecessary.
- The detector incorporates 76 elements at the front, one element at the side, and 4 elements at the back, for a total of 81 elements. Additionally, high-sensitivity light receptors that support UV semiconductor laser wavelength are adopted with all detectors.
- The fixed parts of the cell and cell holder can be pulled out at the front of the unit using a slide mechanism, as shown in the photo on the left. This makes it easy to mount and replace cells, and to perform maintenance.
- WingSALD standard software is supplied as standard. It offers versatile data processing and simple, high-speed operation to suit every purpose and processing requirement.
  (See page 8 for details.)

Configuration diagram for the combination of a SALD-7101 analyzer and SALD-MS71 sampler unit.

[Easy Measurements under PC Control]

Sampler Unit

SALD-MS71   **P/N: 347-60711-20**

- The particles, which are dispersed in a liquid medium, are circulated between the flow cell and the sampler dispersion bath, the flowcell is set in the measurement unit, while measurement is performed.
- The dispersion bath incorporates a stirrer and an ultrasonic sonicator. The dispersed suspension is delivered to the flow cell by a pump.
- The pump is designed specially to ensure that the particles, not just the liquid medium, are circulated.
- It can be controlled from a PC. (Connected to serial port.)
- Almost any organic solvent can be used as the dispersion medium.

Flow cell included

Multifunction Sampler Unit SALD-MS71 Solvent Resistance					
Solvent	Solvent Resistance	Solvent	Solvent Resistance	Solvent	Solvent Resistance
Acetone	Not applicable	Ethyl Alcohol	Applicable	Methyl Alcohol	Applicable
Benzene	Applicable	Ethylene Glycol	Applicable	Propyl Alcohol	Applicable
Cyclohexane	Applicable	Hexane	Applicable	Toluene	Applicable
Dichlorobenzene	Applicable	Isopropyl Alcohol	Applicable	Xylene	Applicable

* Solvent resistance: Solvent resistance toward materials used in the passageways of Sampler Unit SALD-MS71.
  (Solvent resistance values are representative, and are not certified.)
* Do not use flammable organic solvents. They are dangerous. Provide ventilation when using a volatile organic solvent.
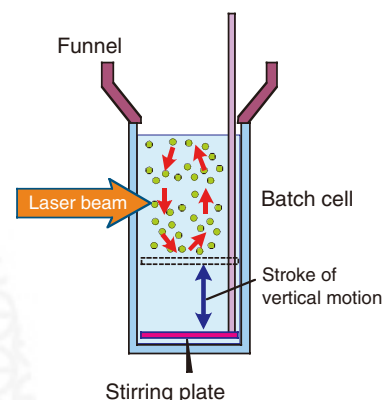
[Ideal for Measurements with Small Amounts of Organic Solvent]

Batch Cell

SALD-BC71   **P/N:347-60712**

- Measurement is possible with small amounts of sample (i.e., measured particles) and liquid medium (i.e., dispersion medium).
- The capacity of the batch cell is only 7 cm^3 and so waste treatment for the suspension can be performed with relatively small amounts.
- The vertical motions of the stirring plate prevent sedimentation of the particles.
- The funnel reduces the possibility of sample spillage.
- A tetrafluoroethylene resin funnel is provided to reduce the possibility of suspension getting on the hands of the user. It also prevents the cell surface from becoming dirty.

Funnel

Laser beam

Batch cell

Stroke of vertical motion

Stirring plate

System Configuration

[Measure Samples without Dilution]

High-Concentration sample Measurement System

SALD-HC71   P/N: 347-60713-20

High-Concentration sample Measurement using the laser diffraction method

- High-concentration samples can be measured using the laser diffraction method.
- Measurement is possible by simply holding the high-concentration sample particles to be measured between two glass slides.
- Samples for which the particle size distribution would be changed by dilution can be measured in their original state, or with the minimum required level of dilution, and true images of the measurement object can be obtained.
- Commercial hand creams, face creams, and rinses can be measured with hardly any pretreatment.

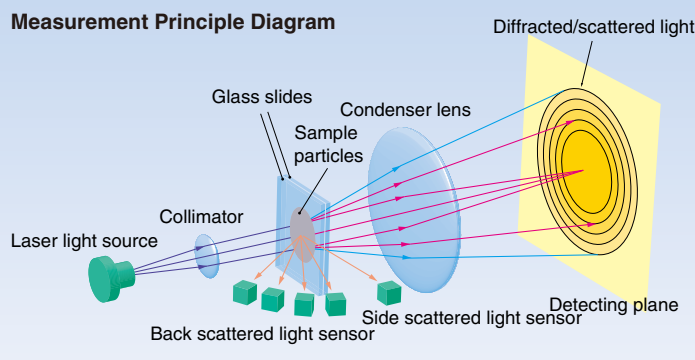**No Complex Parameter Settings Required**

- The refractive index is the only item that requires setting.
- Unlike methods that use ultrasonic waves, this method does not require complex and numerous parameter settings related to the dynamic characteristics of samples and liquid media. Calibration performed with standard particles of the same material as the samples is also unnecessary.

Measurement Possible with Very Small Amounts of Sample

- Sample amounts as small as approximately 0.1 cm^3 can be measured.
- This cell is suitable for the measurement of expensive samples that can only be used in small amounts and samples that can only be extracted in small amounts.
  This is ideal for the fields of life science and nanotechnology.

- Unlike the measurement results obtained with methods based on Brownian motion, the results obtained with this method do not fluctuate greatly with the concentration. They are also unaffected by the commingling of large particles.

Measurement Principle Diagram

Diffracted/scattered light
Glass slides
Condenser lens
Sample particles
Collimator
Laser light source
Side scattered light sensor
Detecting plane
Back scattered light sensor

System Configuration

- Measurement holder for high-concentration samples ·············· 2
- CD-ROM (dedicated software) ·· 1
- Polarizing filter ··· 1
- Glass slides (Qty. 100) ·· 1

* The dedicated software runs under the Windows 2000/XP OS.

notes)
  * There are greater restrictions on the measurement range for the high-concentration sample measurement system than there are for standard wet measurement (when using a flow cell or batch cell). Basically, the range is smaller.
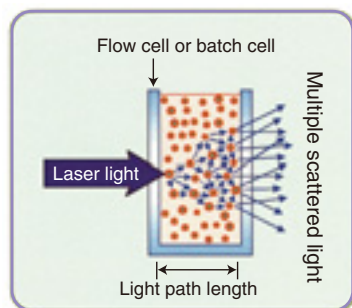 * As a rough guide, measurement is possible for concentrations of up to approx. 20 wt%. Depending on the sample substance, the particle diameter, and the particle size distribution, however, there are cases where measurement is difficult at concentrations of approx. 10 wt%.
  * Samples with wide distributions are more likely to be affected by multiple scattering than samples with narrow distributions, and it may not be possible to obtain accurate measurements in some cases.
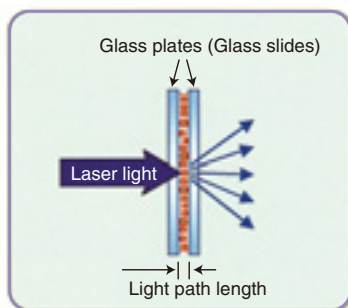
Measurement Principle for High-Concentration Samples

If a standard flow cell or batch cell is used to measure a sample at a high concentration, the long Light path length results in multiple scattering and this makes it impossible to obtain accurate measurements. Measurement is possible by simply holding the high-concentration sample particles to be measured between two glass slides, which shortens the length of the light path, avoids the negative effects of multiple scattering and makes accurate measurement possible.
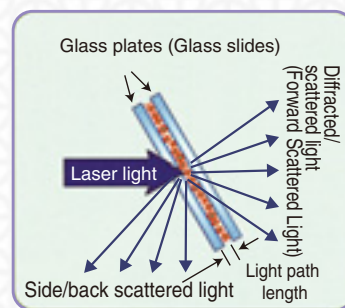
Also, arranging the glass slides so that they are diagonal to the optical axis makes it possible to detect side scattered light. Applying particle size distribution calculations to this and also to forward scattered and back scattered light enables high-concentration sample measurement for fine and ultrafine particles.

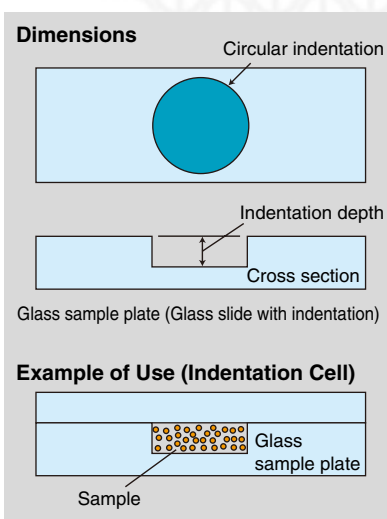Measurement with Standard Flow Cell or Batch Cell   Sample Held between Two Glass Slides

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Options for the High-concentration Sample Measurement System

[Effective for measurement of samples with relatively low concentrations, expensive samples that can only be used in small amounts.]

Glass samples plates created by forming circular indentations in glass slides are available as special accessories (Option). A glass sample plate and a standard glass slide can be combined to form an "indentation cell". This is effective in situations where the concentration is relatively low and enclosing the sample between two standard glass slides would make the optical path length too short, and thereby make it impossible to attain sufficient diffracted/scattered light intensity. With an indentation cell, the Light path length is equal to the depth of the indentation. Also, as shown in the table below, using an indentation cell makes it possible to measure very small amounts of sample. This cell is therefore suitable for the measurement of expensive samples that can only be used in small amounts and samples that can only be extracted in small amounts. The plates are available in six types, with indentation depths varying from 0.05 to 0.5 mm. They come in sets of 10 plates. A set consisting of two of each of the different types (total 12 plates) is also available.

Dimensions

Glass sample plate (Glass slide with indentation)

Example of Use (Indentation Cell)

Optional Cells for SALD-HC71

P/N	Name	Indentation depth	Number	Sample volume	Particle concentration (% by weight)
346-62295-01	Glass sample plate (0.1 mm)	0.1 mm (100 μm)	10	0.03 cm^3	
346-62295-02	Glass sample plate (0.2 mm)	0.2 mm (200 μm)	10	0.06 cm^3	
346-62295-03	Glass sample plate (0.3 mm)	0.3 mm (300 μm)	10	0.09 cm^3	A few
346-62295-04	Glass sample plate (0.4 mm)	0.4 mm (400 μm)	10	0.12 cm^3	hundred ppm
346-62295-05	Glass sample plate (0.5 mm)	0.5 mm (500 μm)	10	0.15 cm^3	to a few percent
346-62295-06	Glass sample plate (0.05mm)	0.05 mm (50 μm)	10	0.015 cm^3	
347-60002	Glass sample plate set	0.05 to 0.5 mm, two each	12 in total		

* The glass sample plates (glass slides with indentation) are optional cells for the SALD-HC71 high-concentration sample measurement system.
A SALD-HC71 high-concentration sample measurement system is required to conduct measurements using the glass sample plates.

Software

[Combining a Variety of Data Processing Functions with Simple, Quick Operability]

Standard Software

| **WingSALD-7101** for windows 2000/XP | **Standard accessory with measurement unit (analyzer)** |

Divided into three "wings" (subprograms) to suit different purposes and processing requirements.
Features a simple menu configuration and high operability.

Wing	Functions	Data processing
Wing 1	Standard Data Processing	Measurement and hardware control
Wing 2	Multiple Data Processing	Batch process and display for up to 12 data items
Wing 3	Extended Data Processing	Statistical processing, time-series processing, and 3D display for up to 200 data items

Incorporates powerful copy functions.

With one touch operation, the format of the transferred data can be selected to suit the type of software copied to and the purpose. For example, numerical da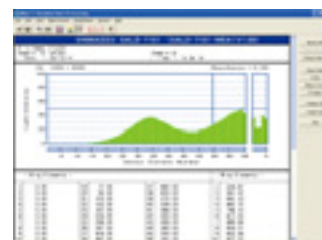ta can be copied to spreadsheet software and image data can be copied to word-processing software. Entire datasheets can be copied and pasted to reports and saved.

Status of sample dispersion can be monitored in real time.   Wing-1

Particle size distribution data and light intensity distribution data can be displayed in real time. This enables the real-time monitoring of changes in the sample and the dispersion state that occur over time. In particular, the real-time display of particle size distribution data is a unique feature of the SALD-7101. Changes from the 100μm level to the 10 nm level and changes from the 10 nm level to the 100μm level can be observed with complete continuity in terms of both time and particle diameter range.
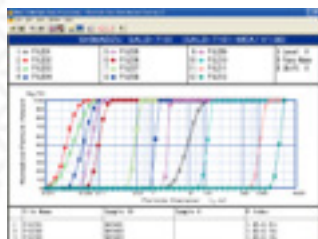

Particle Size Distribution Data

Light Intensity Distribution Data

Overlay Graph possible for up to 12 data items.   Wing-2

Overlay graphs can be displayed for up to 12 data items such as particle size distributions and light intensity distributions. It is also possible to change refractive index parameters and perform the batch recalculation for up to 12 data items.
The particle size distributions displayed for 12 data items are recalculated together and the results are displayed instantaneously. Even if the refractive index at the time of measurement is later found to be inappropriate, measurement does not need to be repeated.

Overlay Graph of Particle Size Distribution Data

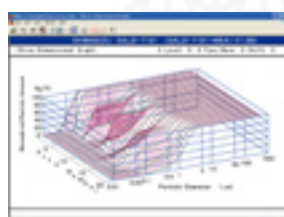Overlay Graph of Light Intensity Distribution Data

Statistical processing, time-series processing, 3D processing, and overlay graph of particle size distribution data is possible for up to 200 data items.   Wing-3
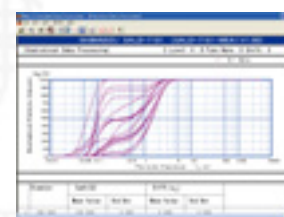

Statistical Processing

Time-Series Processing

3D Graph

Overlay graph of Up To 200 Data Items

[Continuous Measurement System for 1-Second Interval Particle Size Changes]

Cantinuous Measuremert Software

WingSALD-7101 CM for windows 2000/XP   **P/N: 347-64390**

Changes in particle size distributions and particle diameters are measured continuously, at intervals as short as one second and the results are saved. Furthermore, the results can be subjected to multifaceted analysis and evaluation using functions such as 3D graph. For example, the reaction processes that occur when particle groups disperse, aggregate, or dissolve can be monitored.

[Rapid Measurements Simply by Selecting a Condition Table]

Simple Operating Software

WingSALD-7101 EZ for windows 2000/XP   **P/N: 347-64385**

With this software, the portion used by the administrator and the portion used by the operator are clearly distinguished to improve operability and ensure the reliability of measurement data. The administrator can set the numerous measurement conditions that apply to objects as single tables. When the operator selects the table that is appropriate for the object out of multiple tables that have been set previously, all the required settings are made automatically, allowing measurement to be started quickly.
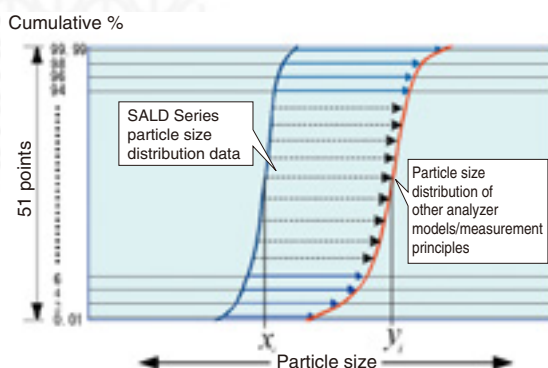
[SALD-7101 Data Emulation for Other Models or Other Measurement Principles]

Data Emulation Software

WingSALD-7101DX for windows 2000/XP   **P/N: 347-64395**

The measured particle size distribution results depend on the measurement principle and the analyzer manufacturer and model. Therefore, the previous standards cannot be used when the analyzer is upgraded. The data emulation software emulate particle size distribution data measured with the SALD-7101 to emulate particle size distribution data measured by other analyzer models or measurement principles.

Cumulative %

51 points

SALD Series particle size distribution data

Particle size distribution of other analyzer models/measurement principles

x y_i

Particle size

99.99% 1st emulation expression: $\log y_1 = (\log x_1) \times a_1 + b_1$
98% 2nd conversion expression: $\log y_2 = (\log x_2) \times a_2 + b_2$
....
....
ith conversion expression: $\log y_i = (\log x_i) \times a_i + b_i$
....
....
2% 50th conversion expression: $\log y_{50} = (\log x_{50}) \times a_{50} + b_{50}$
0.01% 51st conversion expression: $\log y_{51} = (\log x_{51}) \times a_{51} + b_{51}$

The total 102 parameters for the 51 emulation expressions ai (i = 1, 2, ... , 51) and bi (i = 1, 2, ... , 51) are recorded as a single conversion table that is used for data emulation.

[Automatic Sample Concentration Adjustment]

Automatic Dilution Software

WingSALD-7101 AD for windows 2000/XP   **P/N 347-64380**

Using automatic dilution software makes it possible to automate all the procedures, other than sample introduction, required for measurement (e.g., washing, blank measurement, dilution, and measurement) in a standard system consisting of an (measurement unit analyzer) and sampler unit.

Specifications

Shimadzu Nano Particle Size Distribution Analyzer: SALD-7101 (P/N: 347-60710-20)

Hardware	
Measurement principle	Laser Diffraction Method
Measurement range	10 nm (0.01 μm) to 300 μm
Light source	UV semiconductor laser (375 nm wavelength)
Light detector	Detector elements for UV semiconductor laser
	Total 81 elements (76 forward, 1 side, 4 back)
Required power supply	100,115 or 230 VAC as ordered 50 VA
Size	75 cm W x 28 cm D x 45 cm H, 45 kg

* Standard accessories: RS-232C cable (3 m), reference sample

Software		
Wing-1 (Standard data processing)		
Particle size distribution measurement	Individual data	
Particle size distribution re-calculation	Individual data	
Light intensity distribution real-time display	Individual data	
Particle size distribution real-time display	Individual data	
Particle size distribution data display	Individual data	
Light intensity distribution data display:	Individual data	
Diagnosis/adjustment		
Data transfer by clipboard	[Particle size distribution data] individual data	
Multi-windows display	No	[Light intensity distribution data] individual data
Wing-2 (Multiple data processing)		
Particle size distribution re-calculation	Max. 12 data batch calculation or individual data calculation	
Particle size distribution data display	Max. 12 data overlay graph or individual data graph	
Light intensity distribution data display:	Max. 12 data overlay graph or individual data graph	
Data transfer by clipboard	[Particle size distribution data] max. 12 data	
Data sorting	Sort by file name, sample ID, sample#, or refractive index	[Light intensity distribution data] max. 12 data
Multi-windows display	Yes	
Wing-3 (Extended data processing)		
Statistical data processing	Maximum 200 data (Max. 200 data overlay graph)	
Time series analysis	Maximum 200 data	
3-dimensional graph	Maximum 200 data	
Data transfer by clipboard	[Particle size distribution data] max. 200 data	
Data sorting	Sort by file name, sample ID, sample#, or refractive index	
Multi-windows display	Yes	
Output Conditions		
Particle size distribution (μm) number of divisions	Fixed 51/101 divisions,	
Particle mass distribution (%) number of divisions	Fixed 51 divisions	Optional (can be set by user) 51 divisions * 10 tables
Dimension of Partide amount	Qty, length, area, volume	Optical (can be set by user) 51 divisions * 10 tables
Cumulative distribution expression	Undersize, oversize	
Distribution frequency expression	q, $q/\Delta x$, $q/\Delta \log x$	
Smoothing levels	10 levels	
Distribution function fitting	Rosin-Rammler distribution, logarithmic Gaussian distribution	
Data shifting	±10 levels	

Computer Specification Requirements	
OS	Windows 2000/XP
CPU	Must satisfy requirements of operating system.
Memory	Must satisfy requirements of operating system.
Display	Must satisfy requirements of operating system.
Printer	Must be compatible with operating system.
Hard disk drive	Requires at least 30MB available space
CD-ROM drive	Required for software installation
Serial Port	1 port, when the sampler unit is manually controlled 2 port, when the sampler unit is controlled by PC.

* Windows is the registered trademark of Microsoft Corporation in the United States and in other countries.

Optional Units

Sample Unit : SALD-MS71 (P/N: 347-60711-20)	
Dispersing bath	Capacity: 280 cm^3
Stirrer	Blade-type, continuously variable rotation speed
Sonicator	Frequency about 42 kHz, output about 40 W
Liquid Pump	Radial pump, maximum flow rate 1600 cm^3/min
Liquid Pump Material	Tetraflluoroethylene, SUS304, SUS316, perfluoroelastomer, Viton tubing or fluoroelastomer tubing
Liquid Supply Pump	Diaphragm pump, 1000 cm^3/min. max. flowrate
Liquid Supply Pump Material	Polyvinylidene fluoride
Power Requirement	100,115 or 230 VAC as ordered, 300 VA
Dimensions and Weight	W44 cm x D51 cm x H45 cm, 32 kg
Flow Cell	Quartz glass

* RS-232C cable (3 m) supplied as standard

Sampler Unit SALD-MS71 Solvent Resistance					
Solvent	Solvent Resistance	Solvent	Solvent Resistance	Solvent	Solvent Resistance
Acetone	Not applicable	Ethyl Alcohol	Applicable	Methyl Alcohol	Applicable
Benzene	Applicable	Ethylene Glycol	Applicable	Propyl Alcohol	Applicable
Cyclohexane	Applicable	Hexane	Applicable	Toluene	Applicable
Dichlorobenzene	Applicable	Isopropyl Alcohol	Applicable	Xylene	Applicable

* Solvent resistance: Solvent resistance toward materials used in the passageways of Sampler Unit SALD-MS71.
  (Solvent resistance values are representative, and are not certified.)
* Do not use flammable organic solvents. They are dangerous. Provide ventilation when using a volatile organic solvent.

Batch Cell: SALD-BC71 (P/N: 347-60712)	
Cell Material	Quartz glass
Required Liquid Volume	Approx. 7 cm^3
Stirrer Mechanism	Up-and-down movement of blade

High-concentration sample measurement system: SALD-HC71 (P/N: 347-60713-20)	
Measurement Range	Smaller measurement range than wet method (using flow cell or batch cell) *1
Measurable concentrations	Upper limit: approx. 20 wt% *2
Measurement method	High-concentration sample particles held between two glass slides for measurement

* 1 A sample with a wide particle size distribution may not be measurable, as it is more readily affected by multiple scattering than samples with a narrower particle size distribution.
* 2 Measurements may become difficult from concentrations of 10 wt% for some sample materials and particle size distributions.

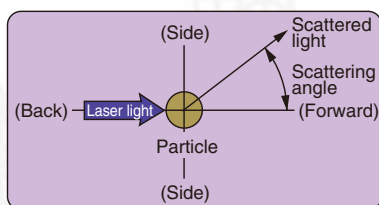## External Dimensions (units: mm)

Measurement with a batch cell and high-concentration sample measurement system

Using the sampler unit SALD-MS71

Principle of the Laser Diffraction

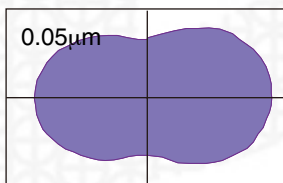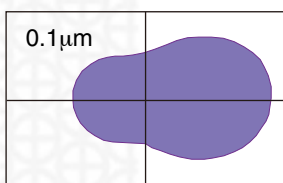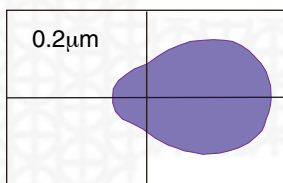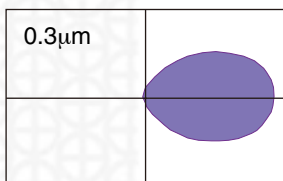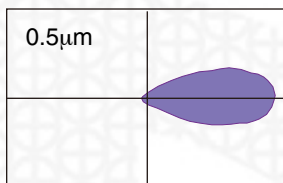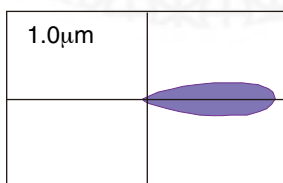## [Laser Diffraction Method (SALD-7101 Measurement Principle)]

Diffraction/Scattering by Particle

There is a one-to-one correspondence between the particle diameter and the light intensity distribution pattern.

When a particle is irradiated with a laser beam, light is emitted from the particle in every direction. This is "scattered light". The intensity of the scattered light varies with the scattering angle and describes a spatial intensity distribution pattern. This is a "light intensity distribution pattern". If the particle diameter is large, the scattered light emitted from the particle is concentrated in the forward direction (i.e., the direction of the laser beam), and fluctuates intensely in an angular range too small to be represented in a diagram. Compared to the light emitted in the forward direction, the intensity of all other light is extremely low.

As the particle diameter becomes smaller, the pattern of the scattered light spreads outwards. As the particle becomes even smaller, the intensity of the light emitted to the side and backwards becomes higher. The light intensity distribution pattern becomes gourd-shaped and spreads out in every direction. In this way, then, there is exists a one-to-one correspondence between the particle diameter and the light intensity distribution pattern. This means that the particle diameter can be ascertained by detecting the light intensity distribution pattern.

UV Laser Allows Accurate Measurements of Ultra-Small Particles.

The light intensity distribution pattern varies little relative to the particle size distribution when the particle size drops to several tens of nanometers. This is the reason for the minimum limit of detection of the laser diffraction method. Using a UV laser creates clearer differences in the light intensity distribution pattern at ultra-small particle sizes than a red laser. Consequently, a UV laser is used to enhance the measurement performance for ultrafine particles of the order of several tens of nanometers.
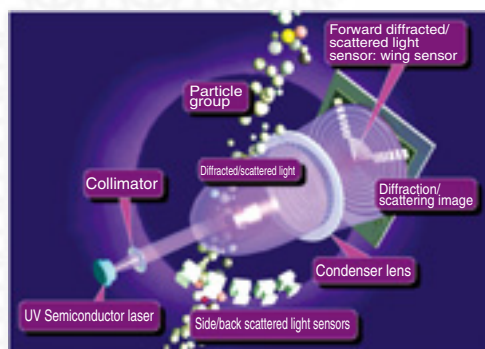
Measurement is performed on particle groups.

Particle size distribution measurement is not performed on individual particles, but rather on particle groups made up of large numbers of particles. Particle groups contain particles of different sizes, and the light intensity distribution pattern emitted by a group is composed of all the scattered light emitted from all the individual particles. The particle size distribution, in other words, what particle sizes are present in what proportions, can be obtained by detecting and analyzing this light intensity distribution pattern. This is the basic principle behind the laser diffraction/ method used in laser diffraction particle size analyzers.

Optical System in SALD-7101

The laser beam emitted from the light source (semiconductor laser) is converted into a thick beam with a collimator and this is directed at the particle group. The scattered light emitted from the group in a forward direction at up to a wide 60∞ angle is concentrated with a lens, and concentric scattering images are formed at a detecting plane positioned at a distance equal to the focal length. This is detected with the wing sensor in which light-receiving elements are arranged concentrically. The scattered light emitted to the side and backwards is detected with side and back scattered light sensors. The ligft intensity distribation data can be obtained by detecting scattered ligft data of all directions.

Optical System in SALD-7101

1.0μm

0.5μm

0.3μm

0.2μm

0.1μm

0.05μm

Relationship between Particle Diameter and Light Intensity Distribution Pattern

Method by UV Laser

Overall Flow of Light Intensity Detection and Data Processing
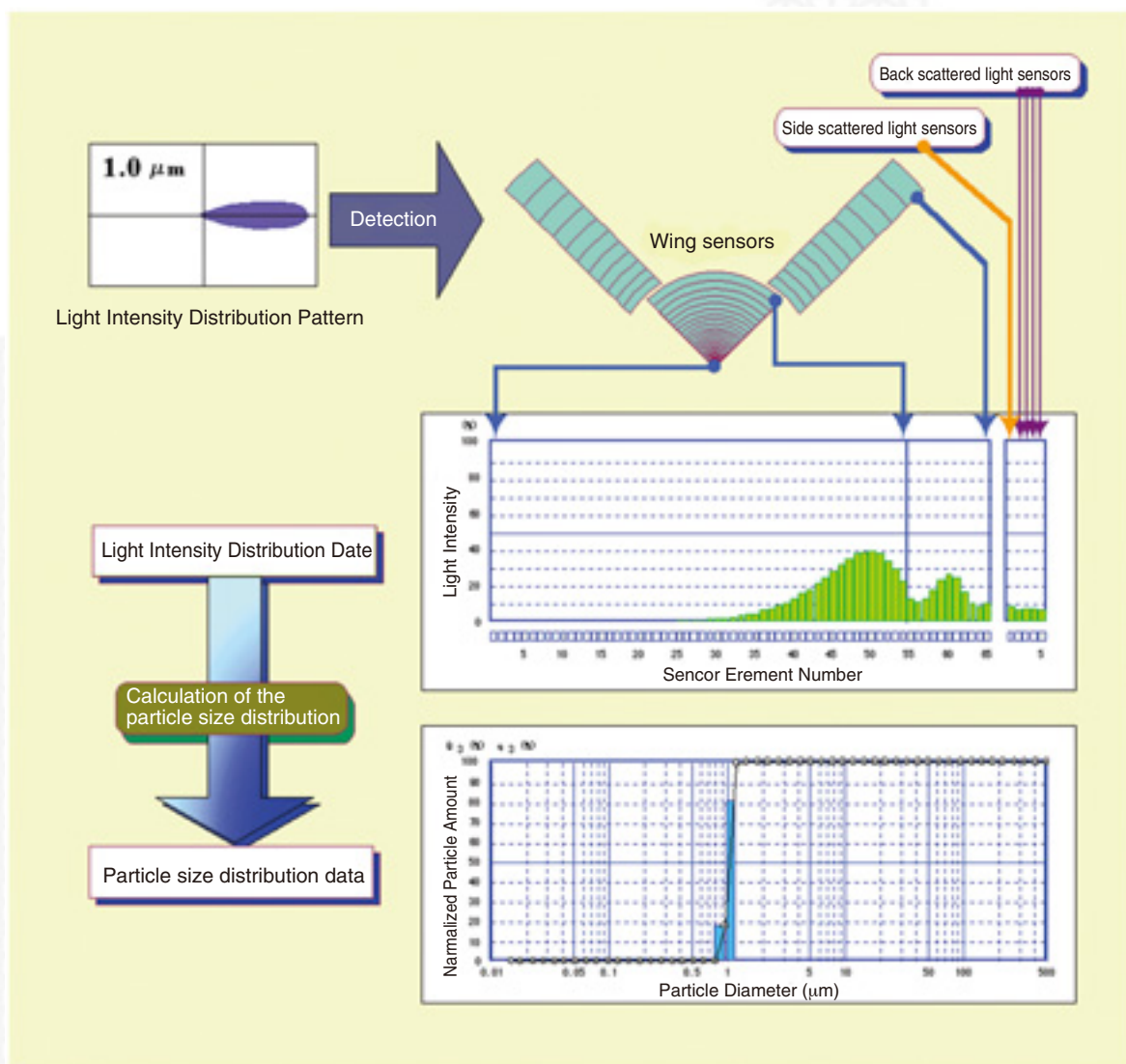
With the SALD-7101 nano particle size analyzer, particle size distributions are calculated using the light intensity distribution data. The overall flow of detection and data processing is shown in the following diagram. In measurement, the whole range of operations from the detection of scattered light intensity distribution patterns to the calculation of the particle size distribution is executed as one process, and the particle size distribution data is output.

Recalculation of particle size distributions

Recalculation of particle size distributions can be performed by using the previously detected and saved light intensity distribution data and selecting a refractive index that is different from the time of measurement.

Overall Flow of Light Intensity Detection and Data Processing in SALD-7101
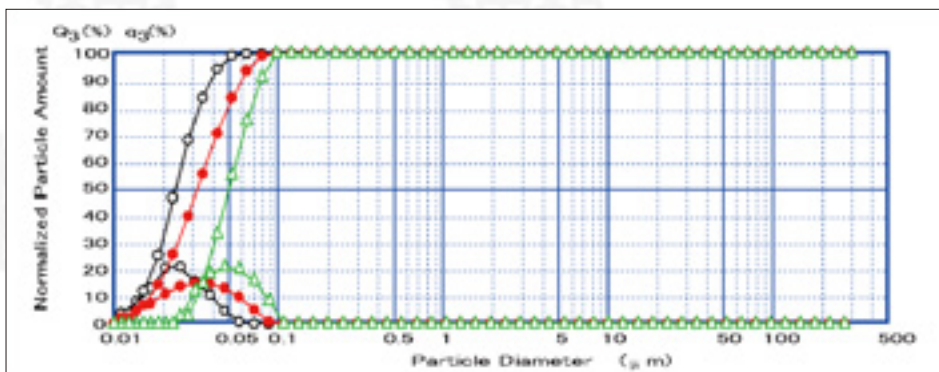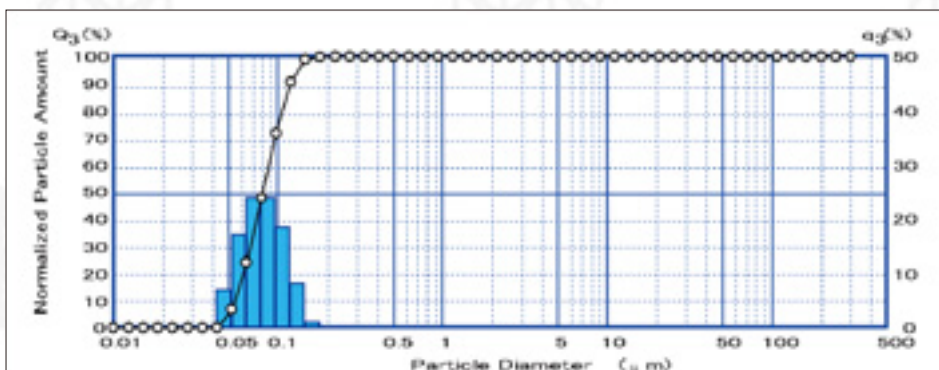
Measured Data

These are measurement results for variety of small and large sample particles using the sampler unit SALD-MS71.

These are measurement results for the dispersion and aggregation of carbon nanotubes using the sampler unit SALD-MS71.

These are measurement results on polystyrene latex (20 nm, 30 nm, 50 nm) using the batch cell SALD-BC71.
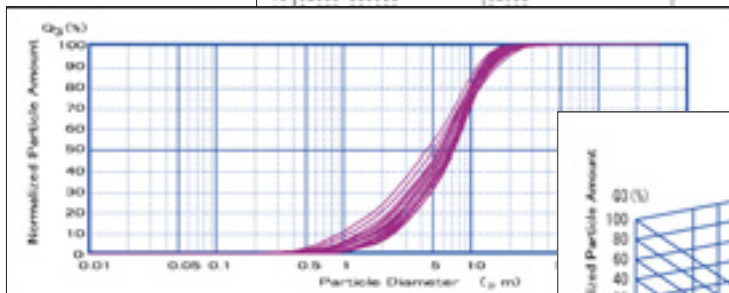

These are measurement results on silica particles using the batch cell SALD-BC71.

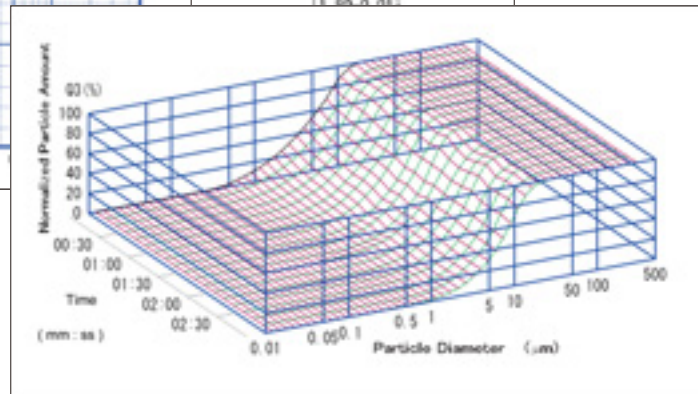## Examples of Constant-interval Serial Measurement Data

[List Data File Titles]

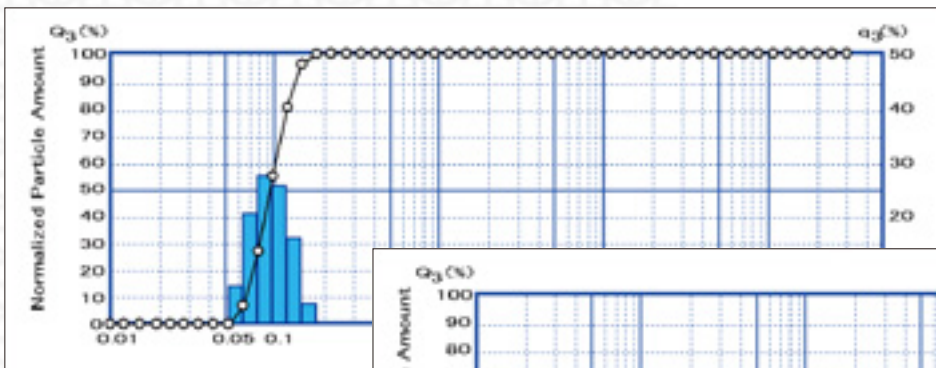|	File Name	Sample ID	Sample #	R. Index
1	CaCO3-0000S	CaCO3		1.80-0.01i
2	CaCO3-0010S	CaCO3		1.80-0.01i
3	CaCO3-0020S	CaCO3		1.80-0.01i
4	CaCO3-0030S	CaCO3		1.80-0.01i
5	CaCO3-0040S	CaCO3		1.80-0.01i
6	CaCO3-0050S	CaCO3		1.80-0.01i
7	CaCO3-0060S	CaCO3		1.80-0.01i
8	CaCO3-0070S	CaCO3		1.80-0.01i
9	CaCO3-0080S	CaCO3		1.80-0.01i
10	CaCO3-0090S	CaCO3		1.80-0.01i

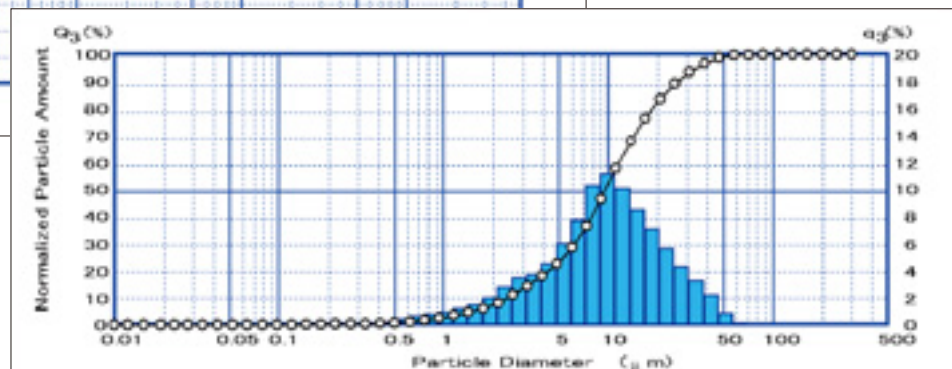Overlay Graph of All data

Sample: calcium carbonate

3D Graph

Examples of High-concentration Sample Measurement Data

0.1 mm polystyrene latex

Wax (creamy)

Shimadzu Laser Diffraction Particle Size Analyzer SALD Series

SALD-3101

For coarse particles and high-density particles

- Measurement range : 0.05 to 3000 μm
- Light source : Red semiconductor laser (690 mm wavelength)
- Sampler incorporates a powerful pomp to ensure circulation of coarse particles and high-density particles.
- Handles particle size distribution measurements of soils and sands. Ideal for environmental research and disaster prevention work.
- Handles injection type and free-fall type dry measurement.

SALD-2201

Standards Models of SALD Series

- Measurement range : 0.03 to 1000 μm
- Light source : Red semiconductor laser (680 nm wavelength)
- The SALD-2001/2101 Series boast the highest distribution of instruments in Japan. The continuity and transferability of data to the later instruments is emphasized.
- Supports spray-type dry analysis.

SALD-301V

Popular model for fine particles

- Light source : Blue-violet semiconductor laser (405 mm wavelength)
- Easily measures sub-micron particles.
- Wet-type analyzer for relatively light samples, such as foods, drinks, pharmaceuticals, cosmetics, emulsions, pigments, and paints.
- Accurately detects blue and black fine particles that are hard to measure with other analyzers.

Model-1 (measurement unit only)
Measurement range : 0.1 to 50 μm
Cell type : batch cell only
Modeo-2 (measurement unit + sampler)
Measurement range : 0.1 to 350 μm
Cell type : batch cell or flow cell

SALD-201V

Popular model

- Light source : Red semiconductor laser (670 mm wavelength)
- High performance, low cost, small footprint
- Dedicated wet measurement analyzer for relatively light samples, such as food, drinks, pharmaceuticals, cosmetics, and emulsions.

Model-1 (measurement unit only)
Measurement range : 0.25 to 50 μm
Cell type : batch cell only
Modeo-2 (measurement unit + sampler)
Measurement range : 0.25 to 350 μm
Cell type : batch cell or flow cell

ISO 9001

JQA-0376

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