FRITSCH

Laser Particle Sizer

IDEAL FOR

- MEASURING THE PARTICLE SIZE DISTRIBUTION OF SOLIDS AND SUSPENSIONS
- MEASURING RANGE 0.01 – 2100 µm
- PRODUCTION AND QUALITY CONTROL
- RESEARCH AND DEVELOPMENT

STATIC LIGHT SCATTERING

QUALITY
MADE IN GERMANY

FRITSCH is more than just a brand: It is backed by a strong, medium-sized, family business in its fourth generation, which has been firmly embedded in the region since 1920 and globally active for decades. All FRITSCH-products are produced according to strict quality criteria, and our entire production is in-house. The innovative ideas of our development department are inspired by the close relationship with our customers and their practical work in the lab. Satisfied customers worldwide count on our quality, our experience and our service. This makes us proud and motivates us.

FRITSCH. ONE STEP AHEAD.

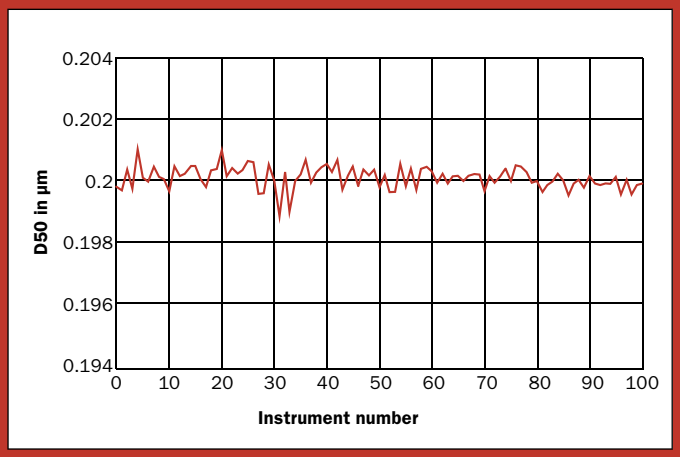
ANALYSETTE 22 NanoTec

Reliable measurement down into the nano range

YOUR ADVANTAGES

- **Measurement even of nano particles in an extremely wide measuring range of 0.01 – 2100 µm**
- **Fast, automatic particle size analysis**
- **Simple measurement with short measuring times**
- **Especially high measurement precision due to the analysis of 110 channels**
- **Consistent reproducibility – reliable comparability**
- **User-friendly operation**
- **Quick change between wet and dry measurement**
- **Fast and simple cleaning**

Due to its especially wide measuring range of 0.01 – 2100 µm, the ANALYSETTE 22 NanoTec is the ideal, universally applicable Laser Particle Sizer for efficient particle size analysis down into the nano range – in production and quality control as well as in research and development. Benefit from its decisive advantages: extremely simple operation, short analysis times and consistently reproducible and reliable results. And a convincing combination of price and performance.



Measurement accuracy: D50 value of certified 200 nm latex standards, measured with 100 FRITSCH Laser Particle Sizers from ongoing production

FRITSCH-Plus
Short measuring time

The ANALYSETTE 22 NanoTec completes most measurements in less than one minute. The instrument is then ready to be used again.

FRITSCH-Plus
Fully automatic analysis

with clearly organised results visible directly on the screen. Of course, you can also print out or save a report customised to your needs.

Practical fast-switch-system

Quickly switch between dry dispersion unit (left) and wet dispersion unit (right) by simply changing the cartridge containing the measuring cell.

FRITSCH-Plus

Intelligent modular design

The ANALYSETTE 22 NanoTec consists of a compact measuring unit that can be quickly and easily combined with different dispersion units for dry or wet measurement. This allows you to buy only what you need for your applications.

Simple. Fast. Reliable.

Laser particle sizing at the push of a button

With the ANALYSETTE 22 NanoTec the precise measurement of particle sizes becomes a simple matter – even for employees with brief instructions and no prior knowledge, e.g., in merchandise receipt or shipping departments: Start the programme, select a SOP and add the sample. The rest takes place completely automatic.

1. START PROGRAMME

To start a measurement with the ANALYSETTE 22 NanoTec, simply select one of the predefined Standard Operating Procedures (SOPs, see page 19).

2. ADD SAMPLE

The programme will prompt you to add the sample material. As soon as the quantity is sufficient, the measurement starts automatically.

3. COMPLETELY AUTOMATIC PROCEDURE

- Automatic dispersion
- Automatic measurement
- Automatic analysis
- Automatic report generation
- Automatic rinsing

DONE!

Reliable measuring results

The ISO 13320 (Particle Size Analysis – Laser Diffraction Methods) defines as a guideline the minimum standards for Laser Particle Sizers regarding repeatability, reproducibility and measurement precision and thus regulates the verification of the measurement precision. The FRITSCH ANALYSETTE 22 NanoTec fulfils the requirements of ISO 13320 and in fact exceeds them significantly. Typically FRITSCH.

Reference material for inspecting the measuring system

Reference materials

Particle size measurement using laser diffraction is based on fundamental physical relationships, meaning that, strictly speaking, calibration of the instruments is not necessary. Nevertheless, the measuring instrument should be inspected regularly to ensure proper function. This is done using reference materials with a spherical shape that permit precise determination of the particle size with the help of laser diffraction.

The reference materials offered by FRITSCH are delivered along with precise dispersion and measurement instructions and are accompanied by a certificate containing the upper and lower limits of the expected particle sizes. These limit values were determined using an internationally recognised process (NIST-traceable).

The ISO 13320 defines:

- The fundamental measuring principle
- The optical arrangement of Laser Diffraction Instruments
- The key instrument parameters for users for a quick comparison of different instruments
- Important details on utilizing the physical theories of light scattering, in particular the Mie or Fraunhofer theory
- Inspection of the minimum requirements for repeatability and accuracy with suitable standard materials

Flexible. Focused. Accurate.

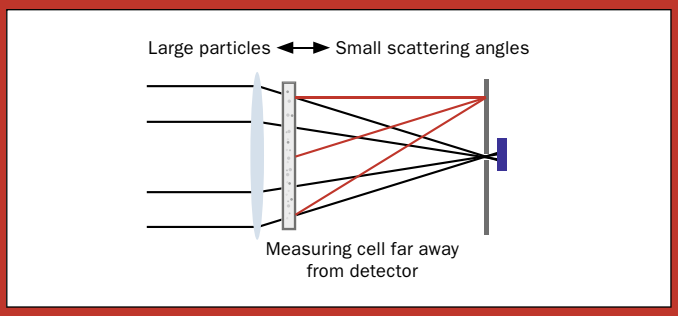
Detecting forward and backward scattering

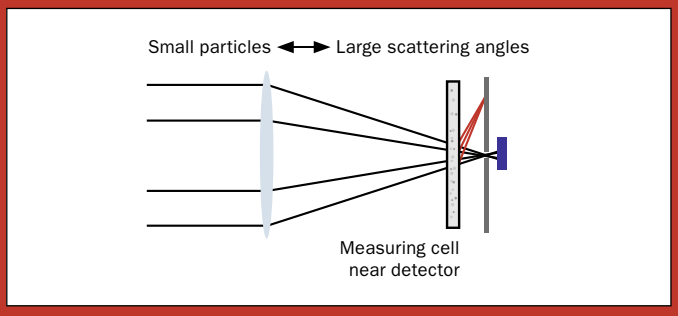
Like every FRITSCH ANALYSETTE 22 Laser Particle Sizer since 1984, the ANALYSETTE 22 NanoTec also employs the FRITSCH-patent of Reverse Fourier design which has been adopted by nearly all manufacturers. It has the advantage that no additional optical elements are required between the measuring cell and detector.

FRITSCH-Plus

Total measuring range without optical conversion

Especially convenient: In the ANALYSETTE 22 NanoTec the total measuring range of 0.01–2100 µm can be detected without converting the optical elements: the distance between the detector and the measuring cell is adjusted automatically. The measuring cell contains the sample particles prepared by the dispersion unit which are irradiated with laser light. By changing the spacing between detector and measuring cell, a different angle range of the scattered light is detected. The particle size distribution is calculated from this data.





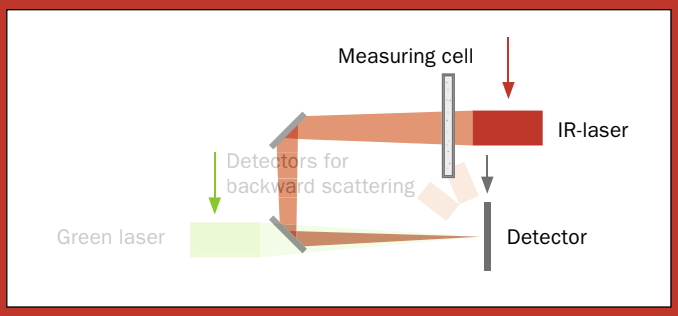
ANALYSETTE 22 NanoTec – practical modular system: measuring unit with separate wet dispersion unit

New optical design

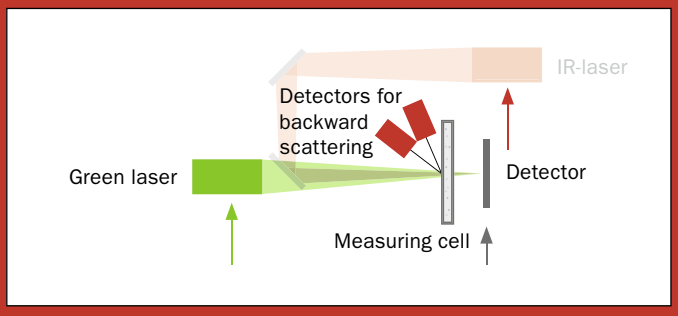
The very large measuring range of the ANALYSETTE 22 NanoTec results from the combination of two lasers with two different measuring cell detector spacings: Large particles are detected using an infrared laser with a large distance to the measuring cell, for small particles a green laser with a small distance to the cell is used, which permits the detection of the forward scattered light up to a scattering angle of 65°. The measurement of smallest particles down into the nano range is performed by the green laser light for backward scattering. Specially arranged detectors ensure this. The result: perfect measurements with outstanding reliability, meaningful comparability and consistent reproducibility.

FRITSCH-Plus
Highest measurement precision with all detectors

The elegant FRITSCH measuring solution: The ANALYSETTE 22 NanoTec always uses all measuring channels, which are detected in 41 microseconds (24 kHz). By combining the various measurement positions, up to 110 effective measuring channels are detected in the measurement. Your advantage: a particularly high resolution and sensitivity.



Measurement design for the upper particle size range



Measurement design for the lower particle size range

Flexible. Efficient. Modular.

Perfect FRITSCH dispersion

Each particle size measurement is only as good as its dispersion. For this reason we place great importance on this aspect and bring all our experience to bear. The result: an especially practical modular system – choose between a wet or dry dispersion unit depending on the measurement task. We are happy to advise you. Thus you can easily modify your ANALYSETTE 22 NanoTec at any time.

FRITSCH-Plus Time-saving fast-switch-system

The measuring cells of the ANALYSETTE 22 dispersion module are located in practical cartridges that can be exchanged with a single motion when switching between wet and dry measurement – without changing any hoses or modifying the instrument! With this system even the cleaning of the measuring cell is like a child's play. Plus, whenever you are not using the cartridge, it is simply stored in the respective dispersion unit.

Always the right dispersion module

All ANALYSETTE 22 dispersion modules can be connected to the measuring unit individually or in combination. Depending on the measurement task, choose between a wet or dry dispersion unit. For wet dispersion of very small quantities, the automatic small volume wet dispersion unit SVA with illuminated dispersion bath and the compact manual small volume wet dispersion unit SVM are available. The practical, fully automatic AutoSampler makes it easy to perform a series of measurements with the wet dispersion unit. For dry measurement of agglomerates or free-flowing materials, choose the falling chute.

Wet dispersion	**Wet dispersion unit**	**Small volume wet dispersion unit SVA**	**Small volume wet dispersion unit SVM**	**AutoSampler for wet dispersion unit**
				
Measuring range	0.01–2100 µm	0.01–600 µm	0.01–600 µm	0.01–2100 µm
Recommended dispersion liquid	Water	Almost all dispersion liquids	Water, organic solvents	Water
Volume	300–500 ml	50 ml	100 ml	Up to 26 containers at 40 ml

The measuring cell is simply switched to change the dispersion

Our tip:

The right dispersion

Wet dispersion is the ideal dispersion method for most samples. For easily soluble samples or samples that swell significantly, dry dispersion or the falling chute is the right solution. Just ask us.

FRITSCH-Plus

Total flexibility and fast work

Standard programmes for simple operation, freely programmable dispersion and measurement process, an especially fast and efficient automatic cleaning and many other advantages simplify your work and ensure high-quality measuring results.

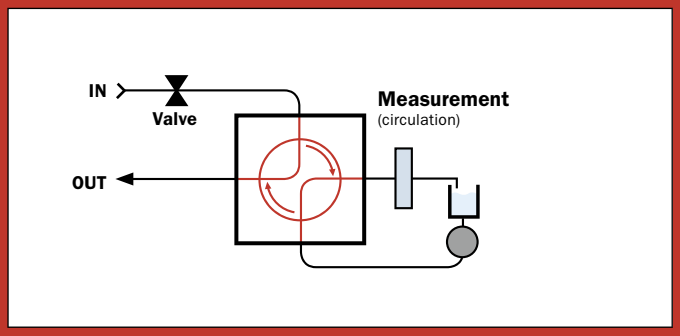
Dry dispersion	**Dry dispersion unit**	**Falling chute**
		
Measuring range	0.1 – 2100 µm	0.1 – 2100 µm
Dispersion	Degradation of agglomerates with compressed air	Without dispersion and compressed air, agglomerates are preserved
Volume	1 – 100 cm^3	1 – 100 cm^3

Wet dispersion unit

YOUR ADVANTAGES

- **Strong ultrasonic power of up to 100 Watt, freely adjustable**
- **Freely programmable**
- **Automatic rinsing cycle**
- **Variable suspension volume between 300 and 500 ml**
- **Extremely quiet dispersion**
- **Fast and consistent cleaning**
- **Benzine, alcohol and many organic solvents can also be used as suspension liquid as a standard feature**
- **No dead space in measuring and rinsing circulation system**

For most samples wet dispersion represents the ideal method for perfect dispersion. Therefore, the sample material is fed into a closed liquid circulation system. An integrated ultrasonic emitter with up to 100 Watt of ultrasonic power and adjustable dispersion conditions ensures fast and extremely efficient degradation of the agglomerates – precisely adapted to each sample. Due to the integrated water connection, the wet dispersion unit can be automatically cleaned and refilled with new liquid after each measurement. And is quickly ready to be used again.



4/2-way valve for measurement and rinsing without dead space

Extremely quiet

With a separate soundproof ultrasonic chamber, we have drastically reduced the unpleasant noise emissions during the dispersion process. Your advantage: the quietest dispersion currently available.

Illuminated dispersion bath

Ergonomically positioned making it incredibly easy to feed the sample and observe the dispersion process.

Powerful pump

A powerful centrifugal pump with individually adjustable speed ensures optimal transport of even heavy, high-density particles and facilitates the fast and uniform distribution of the sample material in the entire circulation system. Your advantage: a stable measurement.

Parameter: Water quality

Generally, normal tap water is perfectly adequate for wet dispersion. In rare cases, it may be necessary to use distilled water. Just ask us – we will be happy to advise you.

SUITABLE FOR MANY SUSPENSION LIQUIDS!

All parts of the sample circulation system, which come into contact with the suspension, are made of high-quality stainless steel 1.4404 (SS316L), PTFE, BK7 glass, Viton® Extreme or silicone.

Transparent hoses made of silicone with especially smooth interior surfaces are barely susceptible to deposits and make soiling or blockages directly visible.

AutoSampler

Ideal for efficient automation of measurement series: The practical FRITSCH AutoSampler provides automatic sample feeding as a simple attachment for the wet dispersion unit of the ANALYSETTE 22.

- Work completely independently right from the start
- 26 positions for 40 ml standard containers
- Reliable complete sample feeding due to tilt function and programmable rinsing function with a strong water jet
- Automatic assignment of the position and measuring result via software
- All function sequences, such as the dispersion and measurement duration, can be specified for each position separately and can be saved as a SOP standard list
- Practical Home button for automatically returning to position 1

FRITSCH-Plus

Only the FRITSCH AutoSampler can simply be placed on top of the wet dispersion unit and is immediately ready for use. And after use, removing it is just as easy – simply lift it off. For fast, smooth work processes.

Small volume wet dispersion unit SVA

YOUR ADVANTAGES

- **Very small sample quantities in below 50 ml of liquid**
- **Almost all dispersion liquids can be used**
- **Resistant to chemicals**
- **Very strong and controllable ultrasonic power of 100 Watt**
- **Practical illuminated dispersion bath**
- **Automatic rinsing for fast cleaning**
- **No dead space in the liquid circulation system**
- **All functions are SOP-controlled**

The small volume wet dispersion unit SVA ensures perfect, fully automatic dispersion of samples which are only available in a minimal quantity. For measurements in organic solvents, the unit needs less than 50 ml liquid. This minimises the disposal costs and decreases environmental pollution.

Fully automatic operation

The entire dispersion and measurement sequence – start, pump speed, valve opening, cleaning and analysis – runs fully automatically, using preset or user-definable SOPs. For easy work processes with best results.

Optimal dispersion

Thanks to ultrasonic power of up to 100 Watt, strongly bound agglomerates are quickly and effectively degraded, with perfect results. The ultrasonic power and the dispersion duration can both be controlled directly by the software. Due to a separate soundproof ultrasonic chamber, the operation of the small volume wet dispersion unit SVA is pleasantly quiet. The illumination of the dispersion bath ensures simple operation – and the integrated water connection ensures automatic cleaning and filling after each measurement.

Resistant against chemicals

All parts of both small volume wet dispersion units SVA and SVM, coming into contact with the dispersion liquid are made of high-quality stainless steel, PTFE, BK7 glass, Viton® Extreme or silicone and suitable for use with benzine, alcohol and many organic solvents as suspension liquids. If you are working with extremely aggressive chemical dispersion liquids, like for example acetone or dimethyl ketone, you can order the SVA dispersion unit with the conversion kit for extreme chemical resistance. The kit consists of seals, O-rings and flow plate made of FFKM Kalrez® – the hoses are made of Santoprene®. Ask us about it! If you already have a unit, you can order the conversion kit separately and your equipment can be retrofitted.
A list providing an overview of chemicals can be downloaded under www.fritsch-sizing.com/chemicals.

Extremely strong:
the illuminated dispersion bath of the automatic small volume wet dispersion unit SVA for powerful dispersion of very small quantities

Manual small volume wet dispersion unit SVM

Compact and economical: The FRITSCH small volume wet dispersion unit SVM, with a total volume of 100 ml, is ideal for mechanical dispersion of very small sample quantities and offers intuitive manual operation. Easy, fast, uncomplicated.

FRITSCH-Plus

The small volume wet dispersion unit SVM is also delivered with a fast-switch measuring cell, which you insert as a practical cartridge into the measuring unit and easily store in its cover stand after use. A clean solution – perfectly conceived!

Your advantages

- Practical transparent glass container for checking the sample
- Thorough rinsing of the measurement circuit, which has no dead space, with a single-lever valve (4/2-way ball valve)
- Manually controlled centrifugal pump for gentle transport of the sample
- Benzine, alcohol and many organic solvents can also be used as suspension liquid

Dry dispersion unit

YOUR ADVANTAGES

- **Fast measurement of powdery samples in an accelerated airflow**
- **For sample volumes from less than 1 cm^3 to approx. 100 cm^3**
- **Efficient degradation of agglomerates with a special annular gap Venturi nozzle**
- **No impact areas – protection against comminution of the particles**
- **Perfect sample feeding with high frequency feeder**
- **Automatic computer-controlled adjustment of the dispersion pressure**
- **Fully automatic, freely programmable measurement processes**
- **Especially fast and easy to clean**

Dry dispersion is especially suited for not too fine, free-flowing materials, which react in water or other liquids. The sample material is transported with a vibratory feeder through the intake funnel into the dry measuring cell, where it falls directly into a Venturi nozzle operating with an adjustable flow of compressed air. Upon passing through the nozzle, agglomerates are broken up and the measurement of the particle size dispersion in the laser beam takes place directly behind it. Generally larger sample quantities are required for dry dispersion; however it is also easier to obtain a representative analysis.

Note: For the operation of the dry dispersion unit, an oil-, water- and particle-free supply of compressed air with a pressure of at least 5 bar and an air volume of at least 125 l/min is required. An external exhaust system is necessary to vacuum the sample material and can be ordered as a FRITSCH accessory together with the instrument.

Multifunctional exhaust system

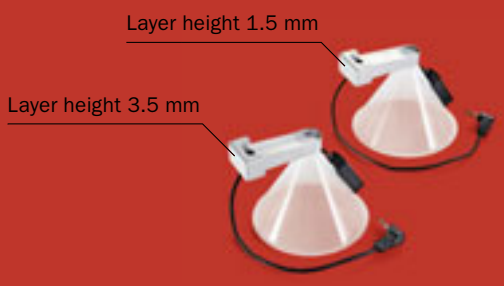
The integrated exhaust system of the dry dispersion unit ensures automatic sample exhaust during the measurement. When the measurement is completed it can also be easily used to manually clean the feeder.

Integrated feeding

An electronically controlled high-frequency feeder ensures automatic continuous feeding of powdery samples without residues when using the dry dispersion unit and the falling chute.

FRITSCH-patent

Easy-to-change channel inserts with funnel, which are pushed onto the feeder for defined layer heights between 1.5 and 4.5 mm. Your advantage: more easily controlled feeding even of critical samples.



FRITSCH-Plus: A vibrating funnel, which is simply pushed onto the feeder, ensures uniform and homogeneous feeding of the sample.

Practical: The dry dispersion unit is simply connected to the measuring unit as a module

Working without compressed air – the falling chute

For the measurement of agglomerates of dry powder or for determining particle size distributions of free-flowing, coarse-grained materials which you would like to measure without dispersion, we have developed the **FRITSCH falling chute**. In this case, the sample is transported with an electronically controlled feeder directly above the intake funnel of the falling chute, from where it falls directly into the measuring cell and is measured by the laser beam without any dispersion at all. Afterwards, the integrated exhaust system ensures automatic sample exhaustion.

Our tip: Depending on the sample material, the falling chute is also an option where a compressed air connection is unavailable.

FRITSCH falling chute for dry measurement without dispersion and compressed air

Perfect evaluation – MaS control

For the control, recording and perfect evaluation of your measuring results your ANALYSETTE 22 NanoTec is delivered with the FRITSCH MaS control software, which guides you through the entire measurement process in an easy-to-learn and largely self-explanatory manner. The MaS control software is based on a relational database, in which all user entries, parameters and results are securely stored and safe from manipulation. And via simple integration into a local computer network, all measuring data can conveniently analysed on other computers.

The facts

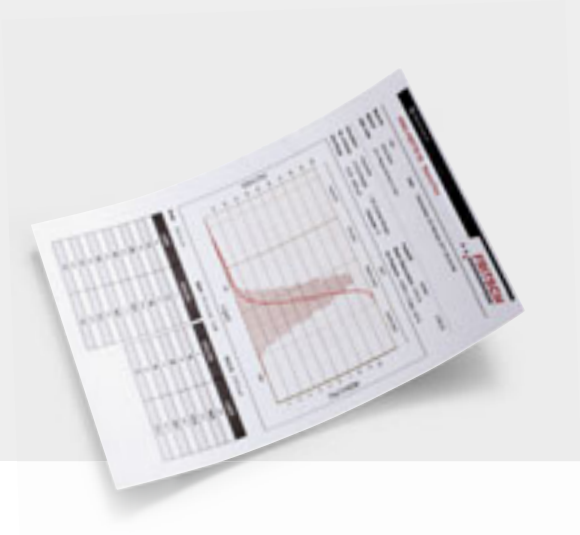
- Simple, clear organisation of the measuring data
- Fast, clear comparison of different measurements
- All relevant information available at a glance
- Analysis according to Fraunhofer or Mie theory
- Control of the measuring process via SOPs
- Individual reports and layouts
- Freely selectable user values issued in table format
- Manual entry of comparison data possible
- Consideration of sieving results
- Data export to Excel™ and in XML format
- SQL database
- CFR 21 part 11 included as a standard feature
- Intuitive operation via central navigation area
- Easy to learn due to use of Microsoft-Office standard
- Multi-lingual user interface

FRITSCH-Plus
Plug and Play due to pre-installed software

We make it very easy for you: each ANALYSETTE 22 NanoTec is delivered with a computer* on which the MaS control software is already fully installed. Plug it in, start it and off you go!

FRITSCH-Plus
Flexible report generator

In addition to integrated standard reports, the freely editable report generator allows you to organise your measurement reports exactly according to your needs. Graphics as well as all measuring parameters, statistical values or selected measured values can be incorporated in a report.



*Except deliveries to CIS countries

Open configuration of the measuring process – SOPs

The ANALYSETTE 22 NanoTec software contains completely predefined Standard Operating Procedures – SOPs for short – for nearly all typical measurement tasks, making operation especially easy. Via a well-arranged input mask, you are completely free and flexible in modifying these SOPs to perfectly suit your measurement requirements.

By selecting a predefined SOP, for example, dispersion process and duration, measuring frequency and time intervals are set automatically. For flexible adjustment you can also freely select these and many other parameters, save them as a separate SOP and retrieve it at any time. Your advantage: a completely new level of freedom in designing and structuring the entire dispersion and measurement process. And simple, consistent reproducibility of the measurement sequence.

FRITSCH-Plus
Individual user rights
Especially safe: the individual assignment of user rights means that access to data or the ability to influence measurement processes can be separately defined for each individual user.

TECHNICAL DATA ANALYSETTE 22 NanoTec

MEASURING UNIT

	ANALYSETTE 22 NanoTec
Measuring range	Wet dispersion: 0.01–2100 µm Dry dispersion: 0.1–2100 µm
Method of analysis	Laser light scattering
Type of analysis	Wet and dry measurement of the particle size of solids and suspensions
Measurement value	Particle size
Theory	Fraunhofer, Mie
Standard	ISO 13320, better than ISO 13320 in accuracy and repeatability
Number of particle size classes	max. 110
Optical design	Reverse Fourier design Moveable measuring cell (FRITSCH-patent)
Laser	1 x green (λ = 532 nm, 7 mW) 1 x IR (λ = 850 nm, 15 mW) Linear polarisation 10000 hours average service life
Laser beam alignment	Automatic
Laser class according to IEC 60825-1:2007 and CRF	Class 1
Fourier lenses	260 mm and 560 mm focal length (green or infrared) 10 mm diameter of the laser beam in the Fourier lens
Cell spacings	20 mm for green, 540 for IR
Angle range	0.014°–165°
Number of main detector channels	51
Number of channels of large angle detectors	6
Number of backward scattering channels	2
Number of laser adjustment channels	19
Time needed for capturing detector channels	41 µs (24 kHz)
Detector	2 segments 1 x for vertical and 1 x for horizontal direction of the laser light polarisation 57 elements
Typical measuring time	5–10 s (measurement value recording of an individual measurement) 2 min (entire measurement cycle)
Evaluation	Particle size distribution as a total curve, bar chart or in table form
Net weight	38.4–43 kg, (depending on configuration)
Dimensions (w x d x h)	53 x 62 x 35–55 cm (depending on configuration)
Computer	Pre-installed MaS control software for controlling, recording and evaluating your measuring results (deliveries to CIS countries without computer)
System requirements (for computers supplied by customer)	Standard Windows PC, at least 500 MB available free hard drive space, 1 GB RAM, Windows XP (current service pack), Windows 7, USB port, at least 19” monitor

DISPERSION UNITS

Wet dispersion unit		Suspension volume 300 – 500 ml Radial pump with adjustable speed, 6.8 l/min Ultrasonic with adjustable output (max. 100 W) Materials used in the sample circuit: high-quality stainless steel 1.4404 (SS316L), PTFE, BK7 glass, Viton® Extreme, silicone hoses Net weight: 30.8 kg Dimensions (w x d x h): 32 x 62 x 44 cm
AutoSampler		Volume per sample container: up to 40 ml Number of samples: up to 26 samples Net weight: 9.4 kg Dimensions (w x d x h): 31 x 58 x 22 cm
Small volume wet dispersion unit SVA		Suspension volume approx. 50 ml Radial pump with adjustable speed Max. particle size approx. 600 µm (depending on the material) Ultrasonic with adjustable output (max. 100 W) Materials used in the sample circuit: high-quality stainless steel 1.4404 (SS316L), PTFE, BK7 glass, Viton® Extreme, silicone hoses Optionally also conversion kit Extended for extreme chemical resistance - FFKM Kalrez® as well as hoses made of Santoprene® Net weight: 35.8 kg Dimensions (w x d x h): 32 x 62 x 44 cm
Small volume wet dispersion unit SVM		Suspension volume approx. 100 ml Radial pump with adjustable speed Max. particle size approx. 600 µm (depending on the material) Materials used in the sample circuit: high-quality stainless steel 1.4404 (SS316L), PTFE, BK7 glass, Viton® Extreme, silicone hoses Net weight: 8 kg Dimensions (Ø x h): 14 x 33 cm
Dry dispersion unit		Sample volume 1–100 cm^3 High-frequency feeder Annular gap Venturi nozzle Required compressed air supply: min. 5 bar, 125 l/min, oil-free, water-free, particle-free External exhaust system required Net weight: 25 kg Dimensions (w x d x h): 36 x 65 x 37 cm
Falling chute		Sample volume 1–100 cm^3 High-frequency feeder External exhaust system required Net weight: 24.6 kg Dimensions (w x d x h): 36 x 65 x 37 cm

ORDERING DATA

Order No.	Article

LASER PARTICLE SIZER

ANALYSETTE 22 NanoTec

MEASURING UNIT
ANALYSETTE 22 NanoTec

22.8000.00 ***Measuring unit***
with USB-interface and computer* with pre-installed software MaS control
for 100–120/200–240 V/1~, 50–60 Hz, 50 Watt

DISPERSION UNITS
ANALYSETTE 22 NanoTec

WET DISPERSION UNITS

22.8500.00 ***Wet dispersion unit***
automatic dispersion unit, volume 300–500 ml,
100 Watt ultrasonic power
for 100–120/200–240 V/1~, 50–60 Hz, 100 Watt

22.8800.00 ***Small volume wet dispersion unit SVA***
automatic dispersion unit, volume 50 ml,
100 Watt ultrasonic power
for 100–120/200–240 V/1~, 50–60 Hz, 100 Watt

22.8855.00 ***Conversion kit Extended for extreme chemical resistance for small volume wet dispersion unit SVA–22.8800.00***
consisting of seals, O-rings, flow plate and hoses

22.8599.00 ***Small volume wet dispersion unit SVM***
manual dispersion unit, volume 100 ml
for 230 V/1~, 50–60 Hz, 35 Watt
(Transformer to adapt line voltage on request!)

DRY DISPERSION UNITS

22.8600.00 ***Dry dispersion unit***
for dispersion in a free jet with pre-dispersion
for 100–120/200–240 V/1~, 50–60 Hz, 50 Watt

22.8900.00 ***Falling chute***
for feeding of free-flowing samples
for 100–120/200–240 V/1~, 50–60 Hz, 50 Watt

22.8670.00 ***Conversion kit to use the dry dispersion unit as a falling chute***
for feeding of free-flowing samples
for 100–120/200–240 V/1~, 50–60 Hz

AutoSampler FOR WET DISPERSION UNIT–22.8500.00
ANALYSETTE 22 NanoTec

22.7020.00 ***AutoSampler***
for the automation of measurement series of up to 26 samples,
incl. 40 ml containers
for 100–120/200–240 V/1~, 50–60 Hz, 30 Watt

83.3115.00 ***Sample containers 40 ml*** with screw lid

Order No.	Article

EXHAUST SYSTEMS FOR MEASUREMENTS WITH THE DRY DISPERSION UNIT AND THE FALLING CHUTE

ANALYSETTE 22 NanoTec

43.9070.00 dust category „M“ according to DIN EN 60335-2-69
for 230 V/1~, 50–60 Hz, 1000 Watt

43.9060.00 with hose and ultra-fine filter dust category „H“
according to DIN EN 60335-2-69
for 230 V/1~, 50–60 Hz

Spare parts for exhaust systems for measurements with the dry dispersion unit and the falling chute

43.9055.00 Fleece filter bag (pack = 5 pieces) for exhaust system 43.9070.00[1)]
43.9052.00 Plastic bag (pack = 5 pieces) for exhaust system 43.9070.00[1)]
43.9051.00 Filter set polyester for exhaust system 43.9070.00[1)]

43.9065.00 Disposal bag (pack = 3 pieces) for exhaust system 43.9060.00[1)]
43.9066.00 Ultra-fine filter for exhaust system 43.9060.00[1)]

[1)] Remark: One pack/one piece is included in the scope of delivery of the exhaust system.

Order No.	Article

REFERENCE MATERIALS AND CERTIFICATES

ANALYSETTE 22 NanoTec

Certified reference materials (NIST-traceable) for performance verification according to ISO 13320

85.2220.00 Test powder for wet dispersion, 10–100 µm
(Box with 10 single-shots 0.5 g)
85.2230.00 Test powder for dry dispersion, 50–350 µm
(Box with 10 single-shots 5 g)
85.2240.00 Test suspension nano (approx. 200 nm) for system check
(Box with 10 single-shots 5 ml)
85.2250.00 Test suspension 1 µm for system check
(Box with 10 single-shots 5 ml)
85.2260.00 Test suspension 10 µm for system check
(Box with 10 single-shots 5 ml)

FRITSCH reference materials according to ISO 13320

85.2100.00 FRITSCH-test powder F-500, 0.5–50 µm for wet and dry dispersion (50 g)
85.2110.00 FRITSCH-test powder F-70, 10–600 µm for dry dispersion (150 g)

Certification

96.1000.00 Set of IQ/OQ blank forms
(questionnaire format - standards and implementation not included)

Certificates for tests according to ISO 13320 on request.

* Except deliveries to CIS countries

Order No.	Article

SPARE PARTS WET DISPERSION UNITS

ANALYSETTE 22 NanoTec

WET DISPERSION UNIT – 22.8500.00

22.8570.04 ***Cartridge***
with cpl. flow measuring cell

SMALL VOLUME WET DISPERSION UNIT
SVA – 22.8800.00 AND SVM – 22.8599.00

22.8590.04 ***Cartridge***
with cpl. flow measuring cell

SPARE PARTS FOR ALL WET DISPERSION UNITS

22.8560.04 ***Flow measuring cell*** *cpl.*
22.8566.26 ***Measuring cell glass***
4 mm for flow measuring cell
22.8561.04 ***Measuring cell glass***
cpl. 12 mm for flow measuring cell
22.8851.15 ***Seal set standard***
for flow measuring cell
22.8856.16 ***Seal set extended for extreme chemical resistance***
for flow measuring cell

SPARE PARTS DRY DISPERSION UNITS

ANALYSETTE 22 NanoTec

DRY DISPERSION UNIT – 22.8600.00

22.8640.00 ***Cartridge***
with cpl. dry measuring cell

FALLING CHUTE – 22.8900.00

22.8670.00 ***Cartridge***
with cpl. dry measuring cell

SPARE PARTS FOR ALL DRY DISPERSION UNITS

22.8650.00 ***Dry measuring cell*** cpl.

22.0430.26 ***Measuring cell glass***
for dry measuring cells

Sample division
For representative sample division, we recommend the Rotary Cone Sample Divider LABORETTE 27 – the foundation for any precise analysis.
More information is available at **www.fritsch.de**.

A computer with already installed software for the control, recording of the data and evaluation is included in the scope of delivery of the FRITSCH Laser Particle Sizer. (Deliveries to CIS countries without computer)

Maintenance and Recalibration of your Particle Sizer on request.

Colour ink jet printer and laser printer on request.

BENEFIT FROM OUR EXPERIENCE!

Choose FRITSCH Particle Sizers to take advantage of the technical superiority resulting from over 30 years of practical experience in the field of high-tech particle technology.

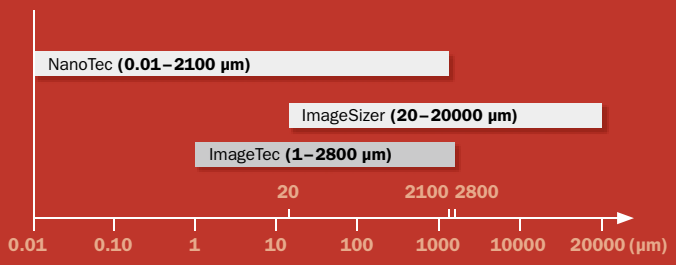
Today, the Static Light Scattering in a convergent laser beam introduced by FRITSCH with the ANALYSETTE 22 is an international standard.

With the ANALYSETTE 28 we set a new standard for particle shape and size analysis with Dynamic Image Analysis for fast and easy quality control in the industrial sector.

+49 67 84 70 138 · crolly@fritsch.de
www.fritsch-sizing.com

ANALYSETTE 22
NanoTec
Static Light Scattering

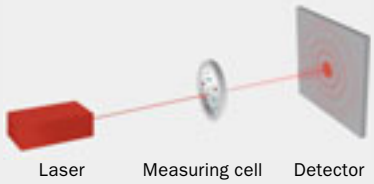
ANALYSETTE 28
ImageSizer and ImageTec
Dynamic Image Analysis



BRIEF INTRODUCTION TO LASER PARTICLE SIZE MEASUREMENT

PRINCIPLE OF LASER DIFFRACTION

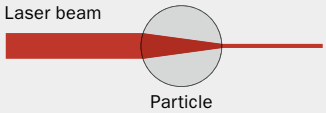
Particle measurement with laser diffraction is actually very simple: to measure the size of a particle, a laser beam is directed at it. The partial deflection of the laser light results in a characteristic, ring-shaped intensity distribution behind the sample which is measured by a specially shaped detector. The particle size is calculated based on the spacing of these rings: large particles produce closely situated rings; small particles produce more widely spaced rings. That is the principle.



BASIC CONCEPTS

The illumination of a particle with light results in various effects that collectively lead to a weakening of the light beam. This extinction is essentially the sum of absorption and deflection of the light from the original direction.

In the absorption, the particle takes up a portion of the electromagnetic energy from the light and converts it primarily into heat. This phenomenon plays a large role in Mie theory.

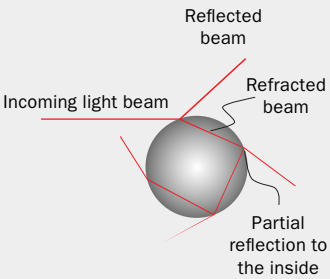


Three different effects fundamentally contribute to the deflection of the incoming light: diffraction, reflection and refraction.

- To understand the **diffraction** it is necessary to imagine the light beam as a broad wave front. When this wave front encounters a particle, new waves are produced at its edges which run in different directions. The overlapping (interference) of the many new waves results in a characteristic diffraction pattern behind the particle which is uniquely determined by the diameter of the particle. Its exact progression is described by Fraunhofer theory.

- The **reflection** occurs mostly on the surface of a particle – according to the law which states: angle of incidence is equal to angle of reflection. This portion of the scattered light cannot be used for particle size determination.

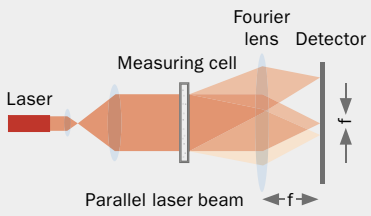
- **Refraction** involves the changing of the light beam direction at a transition between two materials with different indexes of refraction. A light beam that hits a rain drop, for example, is first refracted toward the middle of the drop and then repeatedly reflected into the drop again upon encountering the drop‘s outer edge. A portion of the light also escapes the drop during each reflection.



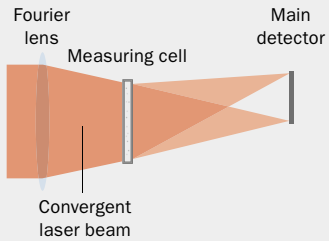
DESIGN OF A LASER PARTICLE SIZER

A significant component of every Laser Particle Sizer is the Fourier lens that focuses the scattered light of the laser within the beam path onto the detector. Its position defines the key difference between a conventional design and the Reverse Fourier design.

- **Conventional Design**
  In the conventional arrangement, the Fourier lens is situated between the detector and the measuring cell, through which a wide, parallel laser beam passes. The disadvantage: only a limited particle size range can be detected, and in order to change the measurement, it is necessary to change the lens and adjust it very precisely. Also, the ability to measure large scattering angles for particularly small particles is severely limited.

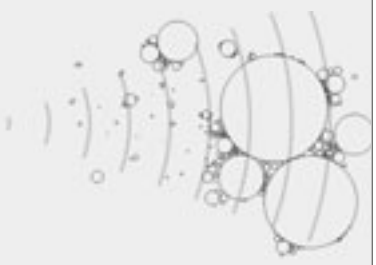


- **FRITSCH technology: Reverse Fourier design**
  30 years ago, FRITSCH was the first company in the industry to bring a revolutionary alternative to the conventional design onto the market in the form of laser diffraction in a convergent laser beam: by positioning the Fourier lens in front of the measuring cell, a convergent laser beam passes through the measuring cell. The scattered light is focused directly on the detector without additional optical elements. This design is now in widespread use and most manufacturers use a main detector to capture the small scattering angles for measuring large particles. For the large scattering angles of small particles, a side detector system must then be integrated, generally consisting of only a few detector elements. FRITSCH has gone one step further.

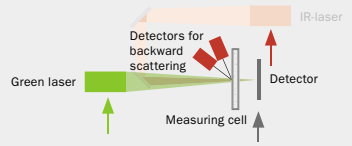


DISPERSION

An optimally dispersed sample is a basic prerequisite for reliable determination of the particle size distribution. In most cases, agglomerates must be broken up and the correct particle concentration of the sample material must be established. In principle, the dispersion process can take place within an air flow (dry dispersion) or in a liquid (wet dispersion). Dry dispersion is especially suited for not too fine, free-flowing materials, which react in water or other liquids. The required sample quantity for dry dispersion is normally significantly larger than for wet dispersion; however, this does make it easy to obtain a representative sample. Wet dispersion must be used for many materials. These include sticky materials such as clay or materials that tend to agglomerate when dry. Even for very fine powders with particles, sizes below about 10 µm, it is often not possible to completely break up the agglomerates using dry dispersion. In this case, wet dispersion also represents the considerably more effective and flexible alternative. Thanks to the modular design of the ANALYSETTE 22 and due to the design of the measuring cell cartridge, it is possible to switch very quickly between wet and dry measurements.



- **FRITSCH technology: simple measurement of backward scattering**
  For detecting particles with a diameter of less than 100 nm, it is necessary to measure the backward scattered light (scattering angle greater than 90°). For this purpose the detectors were positioned close to the measuring cell in the ANALYSETTE 22 NanoTec. A semiconductor laser with green light that is also used for measuring forward scattering is used as a light source. Particular attention was placed in the design of the backward scattering detectors on the suppression of undesirable signal components, caused, for example, by reflexes on the measuring cell glasses.



THEORIES FOR ANALYSIS

The actual result of a particle size measurement is only created through analysis with the supplied FRITSCH software MaS control. Depending on the particle properties and requirements, two common analysis theories are used for this: Fraunhofer theory for larger particles when their exact optical parameters are unknown and Mie theory for the smallest particles with known optical parameters. It is very easy to select both theories in the FRITSCH MaS control software.

The Fraunhofer Theory

Fraunhofer theory describes the portion of light deflection that occurs exclusively as a result of diffraction. If light encounters an obstacle or an opening, this results in diffraction and interference effects. If the incoming light is parallel (even wave fronts), this is referred to as Fraunhofer diffraction. This is always the case if the light source is located at infinity or is "shifted" there by a lens. Since for sufficiently large particles the light deflection is dominated by diffraction, Fraunhofer theory can be used for particle size distribution down to the lower micrometre range. One major advantage of Fraunhofer theory lies in the fact that no knowledge of the optical properties of the examined material is required.

$$I(\theta) = |D(\theta)|^2 = I_0 \left[\frac{2 J_1(kr \sin\theta)}{kr \sin\theta} \right]^2$$

The Mie Theory

For particles with diameters that are not significantly larger than the wavelength of the light used, the Mie theory is applied for the analysis of the measurements. This theory was developed at the start of the 20th century by Gustav Mie and is the complete solution of the Maxwell equations for the scattering of electromagnetic waves by spherical particles. It can be used to analyse the characteristic intensity distributions for even very small particles, which, in contrast to Fraunhofer theory, are not restricted to scattering angles of less than 90° (forward scattering). In fact, scattering angles of greater than 90° also occur (backward scattering). In order to be able to use the intensity distribution for the calculation of the particle size, determined in this manner, the refraction index and absorption index of the sample must be known with the Mie theory in contrast to the Fraunhofer theory. The FRITSCH software MaS control includes a comprehensive database containing the refraction indexes of numerous different materials.

$$\begin{pmatrix} E_{\parallel s} \\ E_{\perp s} \end{pmatrix} = \begin{pmatrix} S_1(\theta) & 0 \\ 0 & S_2(\theta) \end{pmatrix} \frac{e^{i(kr+\omega t)}}{ikr} \begin{pmatrix} E_{\parallel i} \\ E_{\perp i} \end{pmatrix}$$

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in 116 countries

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Wherever you use your FRITSCH instruments: we are nearby. With technical service and direct contact persons for application consultation, who will help you, for example, to determine your SOPs.

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Using the remote maintenance module via Internet, our service technicians will help you through any problem – fast, direct and uncomplicated. We are happy to inform you about our customised maintenance contracts.

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Send us your sample for a free of charge sample analysis. We will then send you a detailed analysis report.

Our expert Dr. Günther Crolly will be happy to assist you in all questions concerning FRITSCH particle sizing.

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