

Laser Particle Sizer



IDEAL FOR

- MEASURING THE PARTICLE SIZE DISTRIBUTION OF SOLIDS AND SUSPENSIONS
- MEASURING RANGE 0.01 – 2000 μm
- PRODUCTION AND QUALITY CONTROL
- RESEARCH AND DEVELOPMENT

STATIC LASER SCATTERING



For over 25 years, FRITSCH has remained one step ahead in the area of particle

sizing. In 1985, we revolutionised measurement precision by introducing the

concept of laser diffraction in a convergent laser beam with the patented FRITSCH

FRITSCH . ONE STEP AHEAD .

measurement process. This process has now become the international standard for

easy, fast and reliable particle size analysis. Benefit from the practical experience

and technical superiority achieved in a quarter-century of work in particle sizing.

ANALYSETTE 22

SIMPLE.

FLEXIBLE.

RELIABLE.

The FRITSCH ANALYSETTE 22 ensures precise determination of particle sizes worldwide – 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 of course getting the best value for your money.

QUALITY AND TECHNOLOGY FROM GERMANY

All key components of all FRITSCH Particle Sizers are manufactured entirely in Germany. The final production takes place exclusively at our own plant at our headquarters in Idar-Oberstein. With strict quality controls and the special attention to detail of a traditional family-owned company. This you can really depend on.

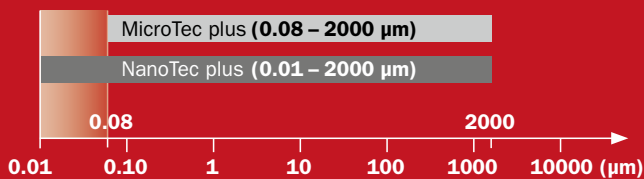
ANALYSETTE 22

COMPACT SIZE – COMPACT PRICE

YOUR ADVANTAGES

- **Measuring range 0.01 – 2000 μm**
- **Short measuring time**
- **High measurement precision**
- **Consistent reproducibility**
- **Reliable comparability**
- **User-friendly operation**

TWO MODELS FOR ALL APPLICATIONS



Choose according to your needs: either the **ANALYSETTE 22 MicroTec plus** – the perfect all-round-laser with a measuring range of 0.08 – 2000 μm for all typical measurement tasks; or the **ANALYSETTE 22 NanoTec plus**, the high-end instrument for measurements down to the nano range – for maximum precision and sensitivity for the smallest particles through the measurement of the backward scattering in a third laser beam.



Dry dispersion unit

Measuring unit

FRITSCH-PLUS

- **Intelligent modular design** Each ANALYSETTE 22 consists of a compact measuring unit that can be quickly and easily combined with various dispersion units for dry respectively wet measurements. This allows you to buy only what you need for your applications.
- **Practical fast-switch-system** Quickly switch between dispersion units by simply changing the cartridge containing the measuring cell.
- **Short measuring time** The ANALYSETTE 22 completes most measurements in less than a minute. The instrument is then immediately ready to be used again.
- **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.



Wet dispersion unit



SIMPLE

Laser particle sizing at the push of a button

With the ANALYSETTE 22, particle measurement becomes a simple matter, for professionals as well as for any employee, with only brief instructions, e.g. in merchandise receipt or shipping departments. No prior knowledge is required. Just start the programme, select a SOP and add the sample – the rest takes place completely automatic. Fast. Reliable. Efficient.



1. START PROGRAMME

To start a measurement with the ANALYSETTE 22, simply select one of the predefined Standard Operating Procedures (SOPs, see pages 7 and 20).

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. THE REST IS AUTOMATIC

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

DONE!

ADAPTABLE

FRITSCH-Plus Open configuration of the measuring processes – SOPs

The software of the ANALYSETTE 22 contains completely predefined Standard Operating Procedures - SOPs for short - for nearly all typical measurement tasks. Via a well-arranged input mask, you are completely free and flexible to modify these SOPs to perfectly suit your measurement requirements: The dispersion process and duration, measuring frequency, time intervals and many other parameters can be easily selected and saved as separate SOPs. Your advantage: a completely new level of freedom in structuring the entire dispersion and measurement process.

Especially safe: You can assign individual usage permissions for each SOP to ensure that no unauthorised changes can be made by the operator while performing the measurement.

WE ASSIST YOU!

Upon installation of your ANALYSETTE 22, we show you how easy it is to create your own SOPs. You can also send us your sample for a free-of-charge sample measurement, and along with the result, receive the parameters for a corresponding SOP. Or simply give us a call – we would be happy to advise you and help you with the determination of the optimal dispersion process for your particular measurement tasks, which you can then save as an SOP.

+49 67 84 70 138





ANALYSETTE 22 MicroTec plus

YOUR ADVANTAGES

- Measuring range 0.08 – 2000 µm
- Especially high measurement precision
- Revolutionary dual-laser technology
- Practical modular system
- Quick change between wet and dry measurement
- Simple cleaning
- Small footprint

FLEXIBLE ALL-ROUNDER FOR ALL TASKS

The ANALYSETTE 22 MicroTec plus is the ideal, compact, all-round Laser Particle Sizer attractively priced for all typical applications. For example for handling your own quality and production control. An interesting alternative even for small and medium-sized companies. And it's worth making a comparison!

FRITSCH-Plus

Immediately ready for use, thanks to notebook with pre-installed software

We make it very easy for you: Each measuring unit of the ANALYSETTE 22 is delivered automatically with a notebook. On the notebook, the MaS control software for controlling, recording and evaluating your measuring results is already fully pre-installed. You only have to plug it in and boot it up – and can then start working immediately. It couldn't be more convenient.*

Variable measuring range

With the ANALYSETTE 22 MicroTec plus, you can easily and fully automatically choose between two individual measuring ranges or combine the two into a third option.

Your advantage: maximum flexibility and a total measuring range of 0.08 – 2000 µm in a single instrument.

Maximum resolution within a compact unit

The ANALYSETTE 22 MicroTec plus measures with two lasers. The detector captures 108 measuring channels. Your advantage: maximum measurement precision and outstanding resolution within a compact unit.

* Except deliveries to CIS countries

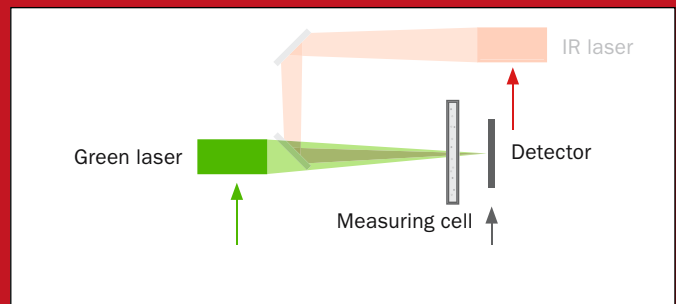


ANALYSETTE 22 MicroTec plus – Practical modular system: measuring unit with separate dry dispersion unit

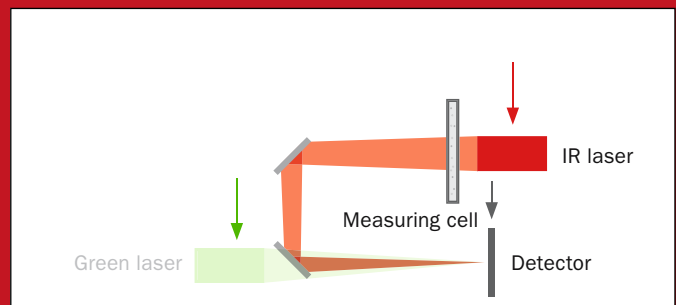
FRITSCH-IDEA: TWO LASERS IN ONE INSTRUMENT

In the FRITSCH ANALYSETTE 22 MicroTec plus, a semiconductor laser with green light carries out the measurement of small particles, while an infrared-semiconductor laser handles large particle size ranges. Both lasers can be optimally aligned extremely quickly, automatically and independently of each other through lateral motion. Your advantage: the ideal wavelength for every particle size and an ideal combination of large measuring range, outstanding resolution and small footprint.

Brilliant FRITSCH-idea: With redirection of the long wavelength red laser beam, the ANALYSETTE 22 MicroTec plus allows for maximum measurement precision even for large particles within a compact unit. To switch to the measurement of small particles in the short wavelength green laser, the detector and the laser source are simply moved as a unit – the measuring cell remains fixed in place.



Measurement design for the lower particle size range



Measurement design for the upper particle size range



ANALYSETTE 22 NanoTec plus

YOUR ADVANTAGES

- Measurement of even nano-particles in an extremely wide measuring range of 0.01 – 2000 µm
- Triple-laser technology for forward and backward scattering
- Especially high measurement precision through the analysis of 165 channels
- Fast, automatic particle size analysis
- Practical modular system
- Quick change between wet and dry measurement
- Fast and simple cleaning

HIGH-END DOWN TO THE NANO RANGE

With a total measuring range of 0.01 – 2000 µm in a single instrument, the ANALYSETTE 22 NanoTec plus is the ideal, universally applicable Laser Particle Sizer for the effective and reliable determination of particle size distributions. Innovative FRITSCH laser technology makes it possible to separately select 5 different measuring ranges. For elegant measurements with maximum flexibility, highest resolution, outstanding sensitivity - and perfect results down to the nano range.

FRITSCH-Plus

Immediately ready for use, thanks to notebook with pre-installed software

We make it very easy for you: Each measuring unit of the ANALYSETTE 22 is delivered automatically with a notebook. On the notebook, the MaS control software for controlling, recording and evaluating your measuring results is already fully pre-installed. You only have to plug it in and boot it up – and can then start working immediately. It couldn't be more convenient.*

5 measuring ranges without optical conversion

With your ANALYSETTE 22 NanoTec plus, you can choose between three measurement positions of the measuring cell, allowing measurements in 5 different measuring ranges without modification. Your advantage: optimal adaptation of the particle size measurement to your sample.

Highest measurement precision with all detectors

The elegant FRITSCH measuring solution: Regardless of the measurement position you select, the ANALYSETTE 22 NanoTec plus always uses all 57 measuring channels of the detector. By combining the various measurement positions, it is possible to perform measurements with up to 165 effective channels. Your advantage: a particularly high resolution and sensitivity.

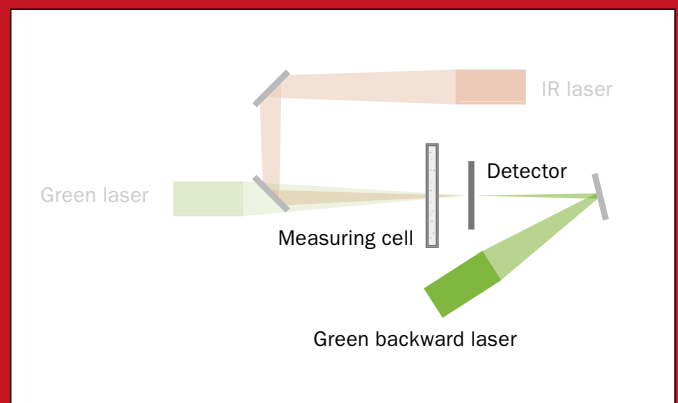
* Except deliveries to CIS countries



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

FRITSCH-IDEA: A THIRD LASER FOR MEASURING THE BACKWARD SCATTERING

To extend the particle size determination down to the nano range, it is necessary to detect the light that scatters backward. And the FRITSCH solution for this is simply brilliant: a third laser beam utilises backward scattering for the measurement. This beam irradiates the sample positioned directly in front of the detector through a micro-hole in the centre of the detector. Your advantage: the uniquely large measuring range of the ANALYSETTE 22 NanoTec plus with a lower measuring limit of approximately $0.01 \mu\text{m}$. And instead of a weak diode a real intensive laser for backward scattering.



Measurement design for the nano particle size range

DISPERSION

Modular design – maximum flexibility

Basically, any 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 for a fast, perfect dry and wet dispersion in both ANALYSETTE 22 models.

THE RIGHT DISPERSION MODULE FOR EVERY TASK

All dispersion modules of the ANALYSETTE 22 can be connected to the measuring unit individually or in combination. Depending on the measurement task, choose between a wet or dry dispersion unit – we are happy to advise you. For wet dispersion of very small quantities, the automatic small volume wet dispersion unit SVA with illuminated ultrasonic 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. You can thus easily and quickly modify both ANALYSETTE 22 models at any time for new measurement tasks.

THE MODULES

**Wet
dispersion
unit**



**Small volume
wet dispersion
unit SVA**



**Small volume
wet dispersion
unit SVM**



**AutoSampler
for wet dispersion
units**





Well-conceived: practical fast-switch-system for changing between the different dispersion units

FRITSCH-Plus

Time-saving fast-switch-system

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

FRITSCH-Plus

Full flexibility and fast work

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

**Dry
dispersion
unit**



**Falling chute
for dry dispersion**



FRITSCH-Tip: The matching dispersion

Wet dispersion is the ideal method for about 80% of all samples. For easily soluble samples or samples that swell significantly, dry dispersion or the FRITSCH falling chute is the right solution. Just ask us – we are happy to advise you!



WET DISPERSION UNIT

YOUR ADVANTAGES

- **Freely adjustable ultrasonic-intensity for optimal dispersion**
- **Automatic rinsing cycle adaptable to each sample material**
- **Free programmability for maximum flexibility**
- **Variable suspension volume with a total volume between 300 and 500 ml**
- **Benzene, alcohol and many organic solvents can also be used as suspension liquids as a standard feature**
- **Simple and fast cleaning of the measuring cell**

WET DISPERSION: THE IDEAL STANDARD SOLUTION

For about 80% of all samples, wet dispersion represents the ideal method for perfect dispersion. Therefore the samples are feed into a closed liquid circulation system. An integrated and freely programmable ultrasonic emitter ensures fast and extremely efficient degradation of the agglomerates – precisely adapted to each sample. Due to the integrated water connection, the unit can be automatically cleaned and refilled with new, clean liquid after each measurement. And is quickly ready again for the next measurement.

Powerful pump

A powerful centrifugal pump with individually variable speed ensures optimal transport of even dense, heavy particles within the wet dispersion unit of the ANALYSETTE 22.

Illuminated ultrasonic bath

Due to illumination of the ergonomically positioned and easily accessible ultrasonic bath offers an outstanding observance of the dispersion process. This makes it incredibly easy to feed the sample into the measurement circuit.

Parameter: Water quality

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





AutoSampler

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

FRITSCH-Plus

Only the FRITSCH AutoSampler can simply be placed on top of the wet dispersion unit and is immediately ready for use, without requiring any manual connections or annoying cables. And after use, removing it is just as easy – simply lift it off. For fast, smooth work processes.



Your advantages

- 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 spray jet
- Automatic assignment of the position and measuring result by means of the 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



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**
- **Strong, controllable ultrasonic power of 100 Watt**
- **Practical, illuminated ultrasonic bath**
- **Automatic rinsing for fast cleaning**
- **No dead space in the liquid circulation system**
- **All functions are SOP-controlled**

AUTOMATIC DISPERSION WITH LITTLE LIQUID

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

Fully automatic control

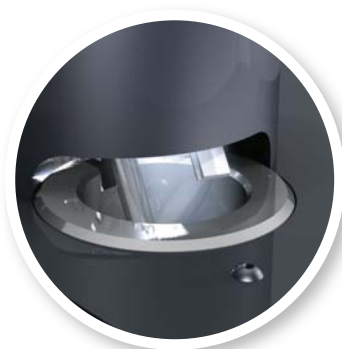
The entire dispersion and measurement sequence – start, pump speed, valve opening, cleaning and analysis – runs fully automatically, using preset or user-definable SOPs. For easy work processes with best results.

Extra-strong ultrasonic bath

Thanks to ultrasonic power of up to 100 Watt, even strongly bound agglomerates are degraded quickly and effectively, with perfect results. The ultrasonic power and the dispersion duration can both be controlled directly by means of the software. And the illumination of the ultrasonic bath makes the work easy.

Resistant against chemicals

All parts of both FRITSCH small volume wet dispersion units SVA and SVM, coming into contact with the dispersion liquid are made of stainless steel, PTFE, BK7 glass, Viton® Extreme, Viton® or Chem-Durance® Bio and are basically resistant against chemicals. If you are working with extremely aggressive chemical dispersion liquids, like for example acetone or dimethyl ketone, we can of course also equip 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® – different hoses are available depending on the utilized dispersion liquid. Ask us about it! If you already have a unit, you can order the conversion kit separately at any time and easily retrofit your equipment. A list providing an overview of chemicals can be downloaded under www.fritsch-sizing.com/chemicals.



Extremely strong:
the illuminated ultrasonic 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 simply insert as 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
- Easy 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
- Resistant to chemicals



DRY DISPERSION UNIT

YOUR ADVANTAGES

- **Fast measurement of powdery samples in an accelerated air flow**
- **For sample volumes from less than 1 cm³ to approx. 100 cm³**
- **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 measurement processes freely programmable**
- **Especially fast and easy to clean**

DRY DISPERSION: FAST AND EASY

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 distribution in the laser beam takes place directly behind it. Generally, larger sample volumes 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 a flow rate of at least 125 l/min is required. An external exhaust system is necessary to vacuum the sample material, which 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. After completion of the measurement, it can also be easily used for manual cleaning of 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 or the FRITSCH falling chute.



High-frequency feeder for automatic sample feeding for the dry dispersion unit and falling chute

Accurate: Digital display for precise adjustment of the spacing between funnel and feeder



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

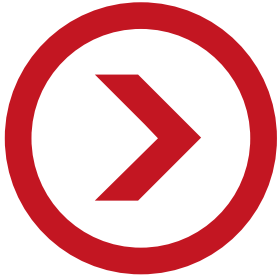
WORKING WITHOUT COMPRESSED AIR – THE FRITSCH FALLING CHUTE

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. Afterward, the integrated exhaust system ensures automatic exhausting of the sample.

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



FRITSCH falling chute for dry measurement without dispersion and compressed air



Software

For the control, recording and evaluation of your measuring results, each ANALYSETTE 22 is delivered automatically with the matching software already fully pre-installed on the notebook, which is delivered free-of-charge*. The software guides you through the entire measurement process in an easy-to-learn and largely self-explanatory manner. Simple, flexible, reliable.

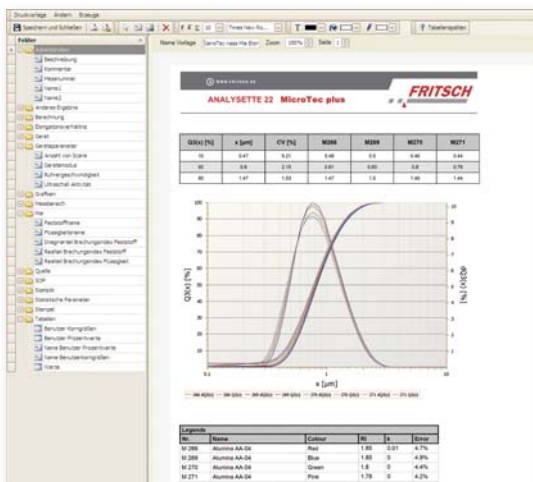
PERFECT ANALYSIS

The special FRITSCH MaS control software is based on a relational database in which all user entries, parameters and results are securely stored and safe from manipulation. Predefined Standard Operating Procedures (SOPs) regulate many typical measurement processes. Own SOPs can be completely freely defined. The report generator allows your measurement reports to be organised exactly according to your needs. The integration into a local computer network is also a simple matter. Your advantage: all measuring data can be conveniently analysed on different 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 measurement process via SOPs
- Individual reports and layouts
- Freely selectable user values issued in a table format
- Manual entry of comparison data is 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 thanks to use of the Microsoft Office standard
- User interface multi-lingual

* Except deliveries to CIS countries



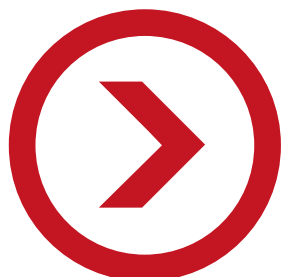
DATA MANAGEMENT AND USER RIGHTS

All results and templates are stored in a SQL database that is tamper-proof. By individually assigning user permissions, you can separately define access to data or the ability to alter measurement processes for each individual user. If the computer connected to the ANALYSETTE 22 has network access, the measuring results can also be viewed at any time from other network computers. Simple, secure, reliable.

FLEXIBLE REPORT GENERATOR

In addition to integrated standard reports, the freely editable report generator offers flexible options for displaying the measuring results according to your individual needs. The reports can integrate graphs as well as all measurement parameters, statistical values or selected measured values.





ISO 13320

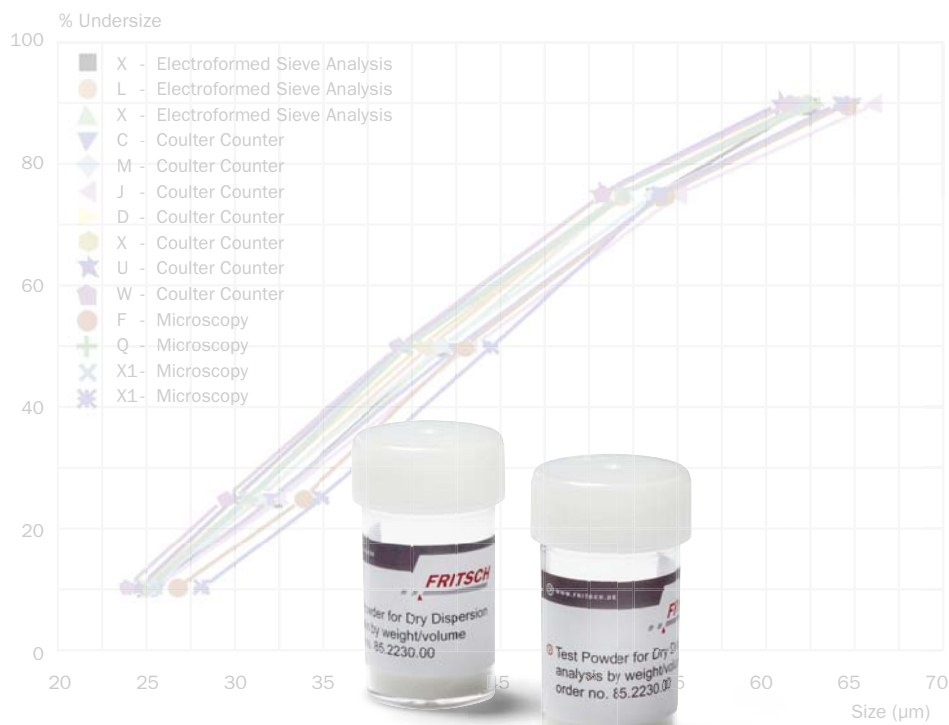
All FRITSCH Laser Particle Sizers meet the strict requirements of ISO 13320 in regard to repeatability, reproducibility and measurement precision. And in fact, they exceed these requirements. Typically FRITSCH.

SURPASSING THE STANDARD

Repeatability, reproducibility and accuracy of measuring results are of central importance in practical applications. In this regard, you can rely on the inspection of all FRITSCH Laser Particle Sizers according to ISO 13320 Particle Size Analysis – Laser Diffraction Methods. As a guideline for the measurement of particle size distribution with Laser Particle Sizers, this norm specifies the minimum standards, which are significantly exceeded by all FRITSCH instruments, and regulates their easy verification.

THE ISO 13320 DEFINES

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

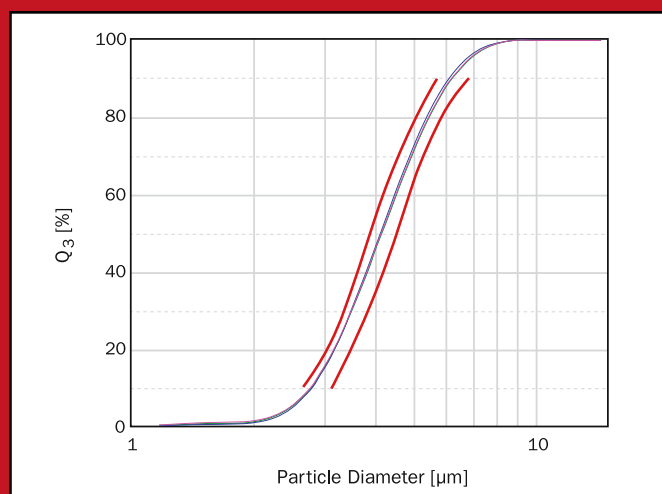


REFERENCE MATERIALS

The particle size measurement using laser diffraction is based on fundamental physical relationships, meaning that calibration of the instrument is not necessary, strictly speaking. Nevertheless, the measuring instrument should be inspected regularly to ensure proper function. This is done with 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 that states the upper and lower limits of the expected particle sizes. These limit values were determined using an internationally recognised process (NIST-traceable).

Reference materials for inspecting the measuring system



Measured cumulative distribution curve for a certified reference material


TECHNICAL DATA

ANALYSETTE 22 MicroTec plus / ANALYSETTE 22 NanoTec plus

MEASURING UNITS

	ANALYSETTE 22 MicroTec plus	ANALYSETTE 22 NanoTec plus
Measuring range	Wet dispersion: 0.08–2000 µm Dry dispersion: 0.1–2000 µm Selectable measuring ranges: 0.08–45 µm / 15–2000 µm / 0.08–2000 µm	Wet dispersion: 0.01–2000 µm Dry dispersion: 0.1–2000 µm Selectable measuring ranges: 0.01–45 µm / 0.08–45 µm / 15–2000 µm / 0.01–2000 µm / 0.08–2000 µm
Laser	Two semiconductor lasers Green (λ = 532 nm, 7 mW), IR (λ = 850 nm, 9 mW) Linear polarisation 10000 hours average lifetime	Three semiconductor lasers 2 x green (λ = 532 nm, 7 mW), 1 x IR (λ = 850 nm, 9 mW) Linear polarisation 10000 hours average lifetime
Number of particle size classes	Max. 108	Max. 165
Optical arrangement	Inverse Fourier design Movable measuring cell (FRITSCH patent)	
Fourier lenses	260 mm and 560 mm focal length (green or infrared) 10 mm diameter of the laser beam in the Fourier lens	
Laser beam alignment	Automatic	
Laser protection class	1 (according to EN 60825)	
Sensor	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 a single measurement) 2 min (entire measuring cycle)	
Net weight	38.4–43 kg (depending on configuration)	48–52.6 kg (depending on configuration)
Dimensions (w x d x h)	53 x 62 x 35–55 cm (depending on configuration)	68 x 62 x 35–55 cm (depending on configuration)
Notebook	Pre-installed MaS control software for controlling, recording and evaluating your measuring results (exception: deliveries to CIS countries)	
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

<p>Wet dispersion unit</p> 	<p>Suspension volume 300–500 cm³ Radial pump with adjustable speed Ultrasonic with adjustable output (max. 60 Watt) Materials used in the sample circuit: stainless steel, PTFE, BK7 glass, Viton® Extreme, Norprene®-hoses</p> <p>Net weight: 30.8 kg Dimensions (w x d x h): 32 x 62 x 44 cm</p>
<p>AutoSampler</p> 	<p>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</p>
<p>Small volume wet dispersion unit SVA</p> 	<p>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 Watt) Materials used in the sample circuit: stainless steel, PTFE, BK7 glass, Viton® Extreme, Chem-Durance® Bio-hoses</p> <p>Optionally also conversion kit Extended for extreme chemical resistance - FFKM Kalrez® as well as hoses according to customer specification</p> <p>Net weight: 35.8 kg Dimensions (w x d x h): 32 x 62 x 44 cm</p>
<p>Small volume wet dispersion unit SVM</p> 	<p>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: stainless steel, PTFE, BK7 glass, FFKM Kalrez®, Viton® Extreme, Viton®-hoses</p> <p>Net weight: 8 kg Dimensions (Ø x h): 14 x 33 cm</p>
<p>Dry dispersion unit</p> 	<p>Sample volume < 1–100 cm³ 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</p>
<p>Falling chute</p> 	<p>Sample volume 1–100 cm³ High-frequency feeder External exhaust system required Net weight: 24.6 kg Dimensions (w x d x h): 36 x 65 x 37 cm</p>

ORDERING DATA

Order No. Article

LASER PARTICLE SIZERS

ANALYSETTE 22 MicroTec plus / ANALYSETTE 22 NanoTec plus



MEASURING UNITS

ANALYSETTE 22 MicroTec plus / ANALYSETTE 22 NanoTec plus

- 22.8400.00 **Measuring unit ANALYSETTE 22 MicroTec plus**
with USB-interface and Notebook with pre-installed software
for 100-120/200-240 V/1~, 50-60 Hz, 50 Watt
- 22.2400.00 **Measuring unit ANALYSETTE 22 NanoTec plus**
with USB-interface and Notebook with pre-installed software
for 100-120/200-240 V/1~, 50-60 Hz, 50 Watt

DISPERSION UNITS

ANALYSETTE 22 MicroTec plus / ANALYSETTE 22 NanoTec plus

WET DISPERSION UNITS

- 22.8500.00 **Wet dispersion unit**
automatic dispersion unit, volume 300-500 ml,
60 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 MicroTec plus / ANALYSETTE 22 NanoTec plus

- 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 MicroTec plus / ANALYSETTE 22 NanoTec plus



- 43.9050.00 dust category "M" according to DIN EN 60335-2-69
for 230 V/1~, 50-60 Hz, 1000 Watt
- 43.9010.00 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 paper filter bag (pack = 5 pieces) for exhaust system 43.9050.00¹⁾
- 43.9052.00 plastic bag (pack = 5 pieces) for exhaust system 43.9050.00¹⁾
- 43.9051.00 filter set polyester for exhaust system 43.9050.00¹⁾
- 43.9011.00 disposal bag (pack = 10 pieces) for exhaust system 43.9010.00¹⁾
- 43.9012.00 safety bag (pack = 5 pieces) for exhaust system 43.9010.00¹⁾
- 43.9013.00 ultra-fine filter for exhaust system 43.9010.00¹⁾

¹⁾ Remark: One pack/one piece is included in the order of the exhaust system.

* Except deliveries to CIS countries

Order No. Article

CERTIFIED REFERENCE MATERIALS AND CERTIFICATES

ANALYSETTE 22 MicroTec plus / ANALYSETTE 22 NanoTec plus



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

85.2220.00	test powder for wet dispersion (Box with 10 single-shots 0.5 g)
85.2230.00	test powder for dry dispersion (Box with 10 single-shots 5 g)
85.2240.00	test suspension nano 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)

Certificates for tests according to ISO 13320

96.0080.00	performance verification for wet dispersion
96.0081.00	performance verification for dry dispersion
96.1000.00	set of IQ/OQ blank forms (standards not included)

Order No. Article

SPARE PARTS WET AND DRY DISPERSION UNITS

ANALYSETTE 22 MicroTec plus / ANALYSETTE 22 NanoTec plus

	WET DISPERSION UNIT – 22.8500.00
22.8570.04	Cartridge with cpl. flow measuring cell
22.8560.04	Flow measuring cell cpl.
	SMALL VOLUME WET DISPERSION UNIT SVA – 22.8800.00
22.8840.04	Cartridge with flow measuring cell (Please note: seal set Standard or Extended is additionally necessary!)
22.8842.04	Flow measuring cell (Please note: seal set Standard or Extended is additionally necessary!)

	SMALL VOLUME WET DISPERSION UNIT SVM – 22.8599.00
22.8590.04	Cartridge with cpl. flow measuring cell

22.8560.34	Flow measuring cell cpl.
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SPARE PARTS FOR ALL WET DISPERSION UNITS

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

	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 cell

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.

The FRITSCH Particle Sizers include the software for the control, recording of the data and evaluation.

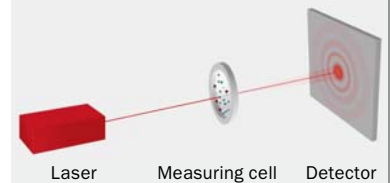
Each measuring unit of the Laser Particle Sizers ANALYSETTE 22 is supplied as standard with a notebook and the software MaS control – already installed, so no additional software installation is necessary. (Except deliveries to CIS countries)

Maintenance and Recalibration of your Particle Sizers on request.

Computer, colour ink jet printer and laser printer on request.

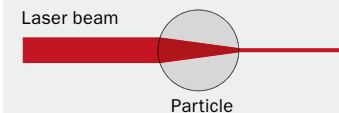
BRIEF INTRODUCTION TO LASER PARTICLE SIZE MEASUREMENT**PRINCIPLE OF LASER DIFFRACTION**

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**

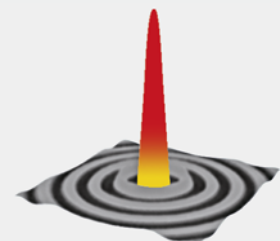
The illumination of a particle with light results in various effects that collectively lead to a weakening of the light beam. This extinction is essentially the sum of absorption and deflection of the light from the original direction.

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.



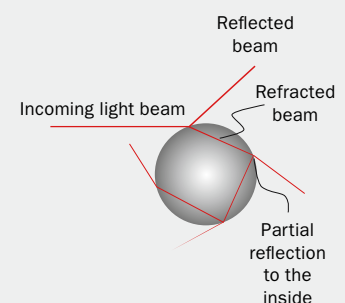
Three different effects fundamentally contribute to the deflection of the incoming light: diffraction, reflection and refraction.

- 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.

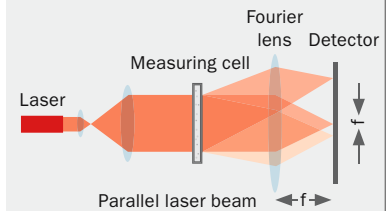


DESIGN OF A LASER PARTICLE SIZER

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 Inverse Fourier design.

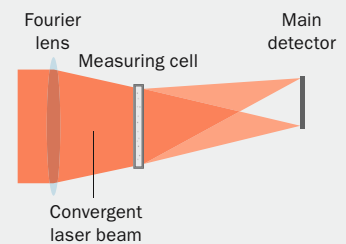
• Conventional Design

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.



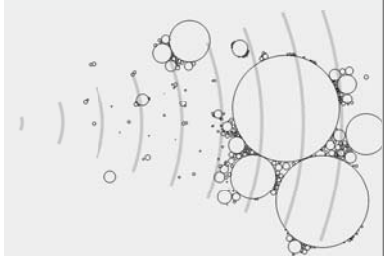
• FRITSCH Technology: Inverse Fourier Design

25 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 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 onto the detector without additional optical elements. This design is now in widespread use, and most manufacturers use a main detector for capturing the small scattering angles for measuring of 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 progressed another step further.



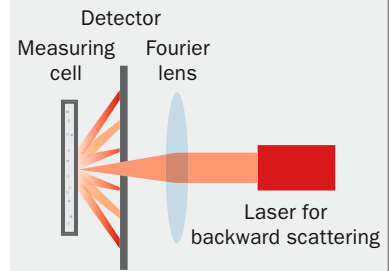
DISPERSION

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 particle sizes below about $10\ \mu\text{m}$, 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 the Backward Scattering**

Another advantage of the FRITSCH patent: the measuring cell can be positioned directly in front of the detector to measure the very small particles below 100 nanometres (nm) of particle diameter. Through a small opening at the centre of the detector, the sample is irradiated by a second laser beam from behind and the backward scattered light can be captured with the full resolution of the detector under very favourable geometric conditions. The result: a very efficient and precise measurement of the backward scattering without complicated coordination of various detector systems.



THEORIES FOR ANALYSIS

The actual result of a particle size measurement is only created through analysis with the supplied FRITSCH software. 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.

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

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 includes a comprehensive database containing the refraction indexes of numerous different materials.

$$\begin{pmatrix} E_{Us} \\ E_{Ls} \end{pmatrix} = \begin{pmatrix} S_1(\theta) & 0 \\ 0 & S_2(\theta) \end{pmatrix} \frac{e^{i(kr_1 - kt_2)}}{ikr} \begin{pmatrix} E_{Uj} \\ E_{Lj} \end{pmatrix}$$



BENEFIT FROM OUR EXPERIENCE!

Choose **FRITSCH Laser Particle Sizers** to take advantage of the technical superiority resulting from over **25 years of practical experience in determining particle size distribution.**

Today, the Static Light Scattering in a convergent laser beam introduced by FRITSCH with the ANALYSETTE 22 is an international standard. The ANALYSETTE 12 DynaSizer offers Dynamic Light Scattering for measurements in the lower nanometer range. And 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.

ANALYSETTE 12

DynaSizer

➤ Dynamic Light Scattering



ANALYSETTE 22

MicroTec plus and NanoTec plus

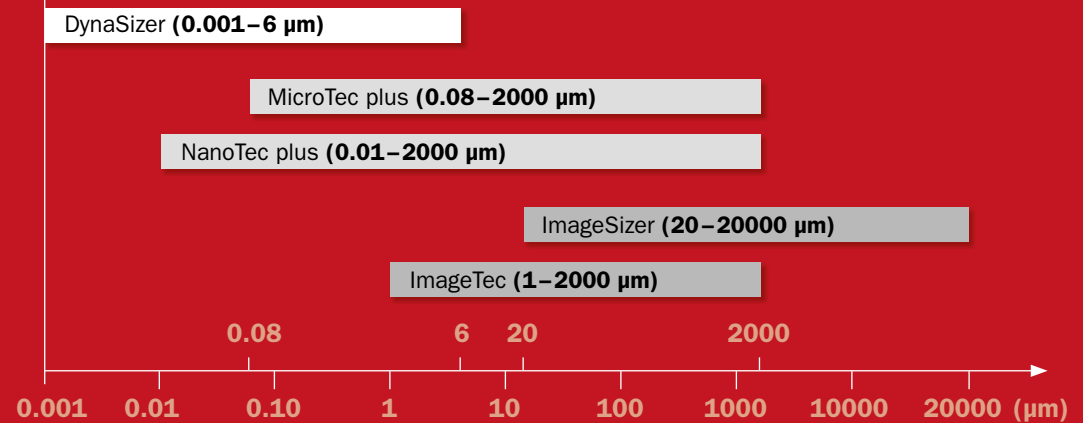
➤ Static Light Scattering



ANALYSETTE 28

ImageSizer and ImageTec

➤ Dynamic Image Analysis



Just give us a call!

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

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