FRITSCH

FRITSCH · 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

F R I T S C H . O N E S T E P A H E A D .

For over 25 years, FRITSCH has remained one step ahead in the area of laser particle sizing. In 1985, we revolutionised measurement precision by introducing the concept of laser diffraction in a convergent laser beam with the patented FRITSCH 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 laser 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

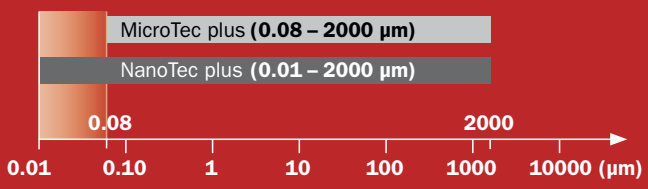
All key components of all FRITSCH Laser Particle Sizers are manufactured entirely in Germany. The final production takes place exclusively at our own plant at our headquarters in Idar-Oberstein. With strict quality controls and the special attention to detail of a traditional family-owned company. This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

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 18).

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!

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.

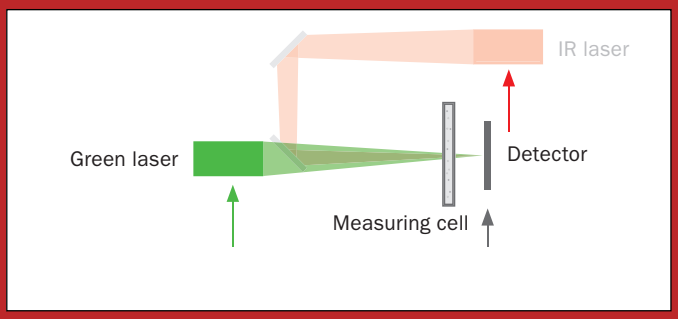
0.08 – 2000 µm

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

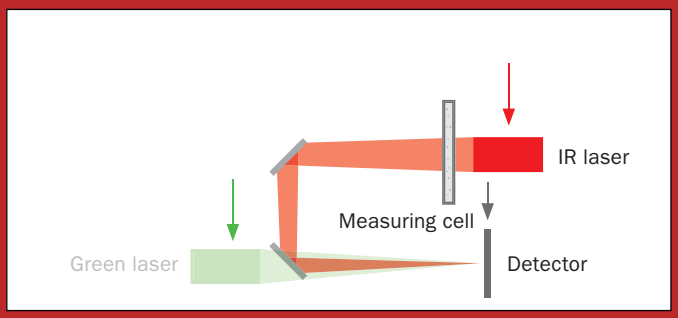
FRITSCH-IDEA: TWO LASERS IN ONE INSTRUMENT

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.

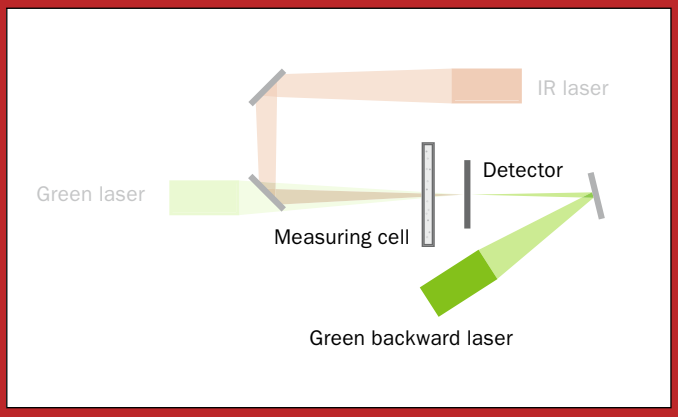
5 measuring ranges without optical conversion
With your ANALYSETTE 22 NanoTec plus, you can choose between three measurement positions of the measuring cell, allowing measurements in 5 different measuring ranges without modification. Your advantage: optimal adaptation of the particle size measurement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

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 µm. 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.

FRITSCH-Plus
Modular concept
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. The small volume wet dispersion unit is available for the wet dispersion of very small quantities, and the falling chute can be used for dry measurements of agglomerates or free-flowing materials. It is therefore easy to quickly modify your ANALYSETTE 22 at any time for new measurement tasks.

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.

THE MODULES

Wet dispersion unit	Small volume wet dispersion unit	Dry dispersion unit	Falling chute
			

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

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.

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!

Practical cartridges with measuring cells for switching between the individual dispersion units.

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!

Small volume wet dispersion unit
and wet dispersion unit in the front

SMALL VOLUME WET DISPERSION UNIT

YOUR ADVANTAGES

- Especially practical transparent glass container for checking the sample
- Manually controlled centrifugal pump for gentle transport of the sample
- The measurement circuit is without dead space and can be easily rinsed with a single-lever valve (4/2-way ball valve)
- All parts coming into contact with the liquid are made of steel, PTFE, glass, FFPM (Kalrez®) or Norprene®

If an organic solvent must be used for a specific sample material or if only minimal sample quantities are available, the use of a solvent-compatible dispersion unit with low volume can be advantageous. For this purpose, FRITSCH offers the small volume wet dispersion unit with roughly 100 ml total volume as the ideal supplement for measurements in solvents up to a particle size of about 600 µm. With intuitive manual operation guided by the software of the ANALYSETTE 22 – for fast, easy operation.

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

Digital display for precise adjustment of the spacing

ANALYSETTE 22 MicroTec plus measuring unit with **dry dispersion unit**

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 or compressed air

Software

For the control, recording and evaluating of your measuring results, each ANALYSETTE 22 is delivered automatically with the matching software, which 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

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

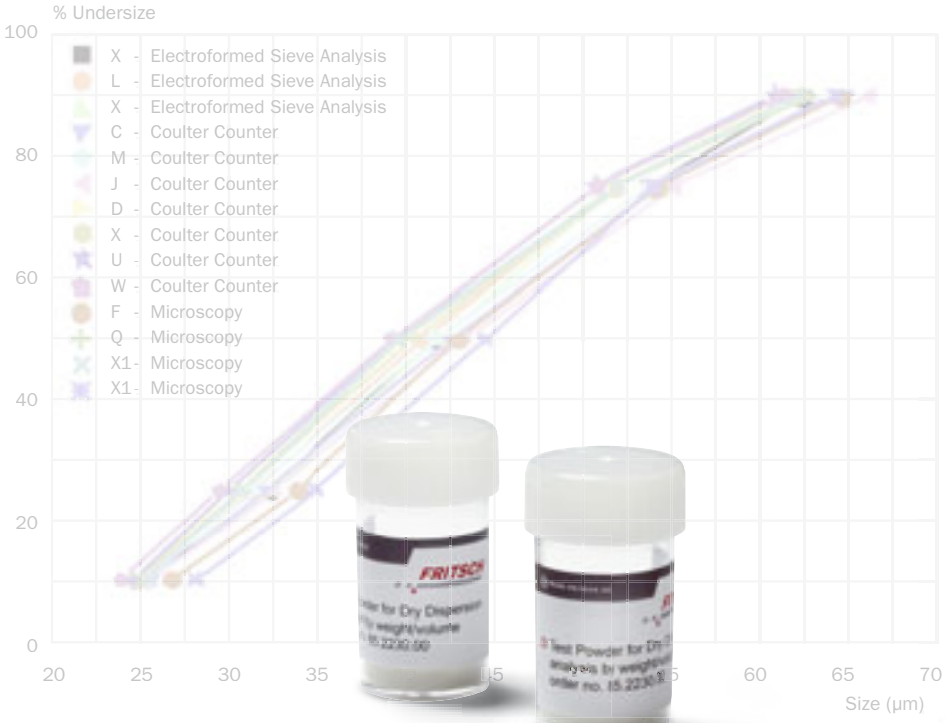
All FRITSCH Laser Particle Sizers meet the strict requirements of ISO 13320 in regard to repeatability, reproducibility and measurement precision. And in fact, they exceed these requirements. Typically FRITSCH.

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

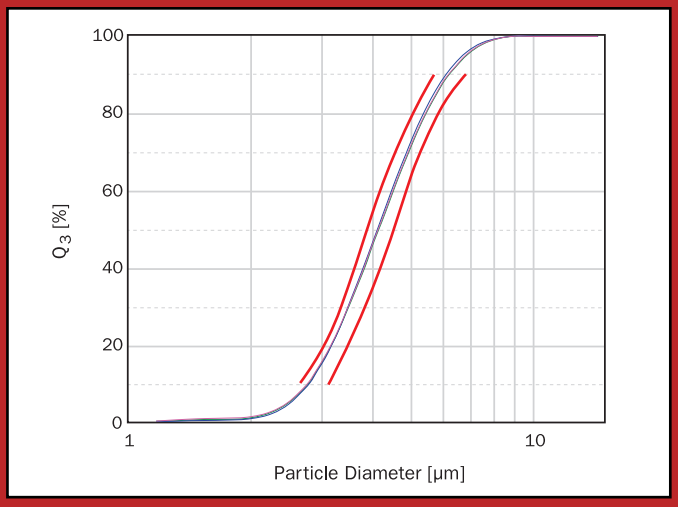


Reference materials for inspecting the measuring system

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).



Measured cumulative distribution curve for a certified reference material

TECHNICAL DATA

ANALYSETTE 22 MicroTec plus/ANALYSETTE 22 NanoTec plus

	ANALYSETTE 22 MicroTec plus	ANALYSETTE 22 NanoTec plus
Measuring range	0.08 – 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 = 940 nm, 9 mW) Linear polarisation 10000 hours average lifetime	Three semiconductor lasers 2 x green (λ = 532 nm, 7 mW), 1 x IR (λ = 940 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)	
Wet dispersion unit	Suspension volume 300 – 500 cm^3 Radial pump with adjustable speed Ultrasonic with adjustable output (max. 60 W) Materials used in the sample circuit: stainless steel, PTFE, BK7 glass, Norprene®-hoses	
Small volume wet dispersion unit	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: steel, PTFE, glass, FFPM (Kalrez®), Norprene®	
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	
Falling chute	Sample volume 1 – 100 cm^3 High-frequency feeder External exhaust system required	
Required computer	Standard Windows-PC, at least 500 MB free hard drive space, 1 GB RAM, Windows XP (current service pack), Windows 7, USB-interface, at least 19“ monitor	
Dimensions (w x d x h)	53 x 62 x 35 – 55 cm (MicroTec plus measuring unit, depending on configuration) 68 x 62 x 35 – 55 cm (NanoTec plus measuring unit, depending on configuration) 32 x 62 x 44 cm (wet dispersion unit) Ø 14 x 33 cm (small volume wet dispersion unit) 36 x 65 x 37 cm (dry dispersion unit) 36 x 65 x 37 cm (falling chute)	
Weight	38.4 – 43 kg (MicroTec plus measuring unit, depending on configuration) 48 – 52.6 kg (NanoTec plus measuring unit, depending on configuration) 30.8 kg (wet dispersion unit) 8 kg (small volume wet dispersion unit) 25 kg (dry dispersion unit) 24.6 kg (falling chute)	

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
For 100-120/200-240 V/1~, 50-60 Hz, 50 Watt

22.2400.00 ***Measuring unit ANALYSETTE 22 NanoTec plus***
With USB-interface
For 100-120/200-240 V/1~, 50-60 Hz, 50 Watt

DISPERSION UNITS
ANALYSETTE 22 MicroTec plus / ANALYSETTE 22 NanoTec plus

22.8500.00 ***Wet dispersion unit***
300-500 ml ultrasonic bath, feed pump and flow measuring cell
For 100-120/200-240 V/1~, 50-60 Hz, 100 Watt

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

22.8599.00 ***Small volume wet dispersion unit***
Incl. cartridge with cpl. flow measuring cell
For 230 V/1~, 50-60 Hz, 35 Watt
(Transformer to adapt line voltage on request!)

SPARE PARTS
ANALYSETTE 22 MicroTec plus / ANALYSETTE 22 NanoTec plus

22.8570.00 ***Cartridge***
With cpl. flow measuring cell for wet dispersion unit

22.8590.00 ***Cartridge***
With cpl. flow measuring cell for small volume wet dispersion unit

22.8560.00 ***Flow measuring cell***
Cpl. for wet dispersion units

22.8566.26 ***Measuring cell glass***
4 mm for 22.8560.00

22.8561.00 ***Measuring cell glass***
Cpl. 12 mm for 22.8560.00

84.0095.15 ***O-ring***
64 mm x 1.5 mm for flow measuring cell

84.0315.15 ***O-ring***
25 mm x 2.5 mm for flow measuring cell

22.8640.00 ***Cartridge***
With cpl. dry measuring cell for dry dispersion unit

22.8670.00 ***Cartridge***
With cpl. dry measuring cell for falling chute

22.8650.00 ***Dry measuring cell***
Cpl. for dry dispersion unit and falling chute

22.0430.26 ***Measuring cell glass***
For 22.8650.00

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 43.9050.00
43.9052.00 Plastic bag (pack = 5 pieces) for exhaust system 43.9050.00
43.9051.00 Filter set polyester for exhaust system 43.9050.00

43.9011.00 Disposal bag (pack = 10 pieces) for exhaust system 43.9010.00
43.9012.00 Safety bag (pack = 5 pieces) for exhaust system 43.9010.00
43.9013.00 Ultra-fine filter for exhaust system 43.9010.00

Order No. **Article**

CERTIFIED REFERENCE MATERIALS AND CERTIFICATES

ANALYSETTE 22 MicroTec plus / ANALYSETTE 22 NanoTec plus

Certified reference materials 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)

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)

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

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

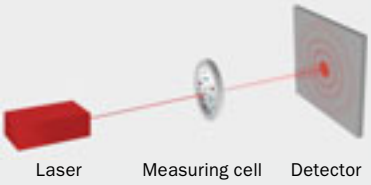
Maintenance and recalibration of your Laser Particle Sizers on request.

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

BRIEF INTRODUCTION TO LASER PARTICLE SIZE MEASUREMENT

PRINCIPLE OF LASER DIFFRACTION

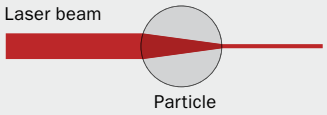
Particle measurement with laser diffraction is actually very simple: to measure the size of a particle, a laser beam is directed at it. The partial deflection of the laser light results in a characteristic, ring-shaped intensity distribution behind the sample which is measured by a specially shaped detector. 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.

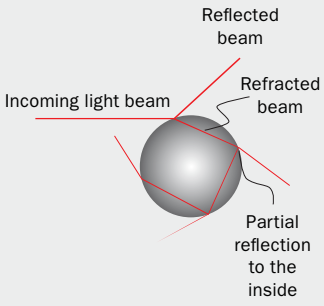


Three different effects fundamentally contribute to the deflection of the incoming light: diffraction, reflection and refraction.

- 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.

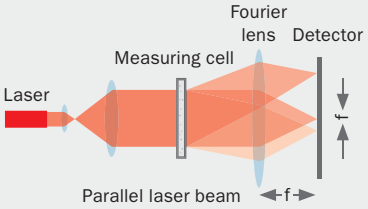
- **Refraction** involves the changing of the light beam direction at a transition between two materials with different indexes of refraction. A light beam that hits a rain drop, for example, is first refracted toward the middle of the drop and then repeatedly reflected into the drop again upon encountering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



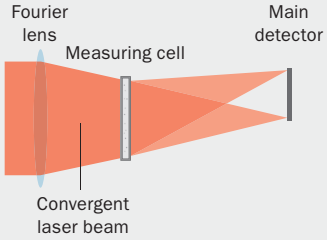
DESIGN OF A LASER PARTICLE SIZER

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.

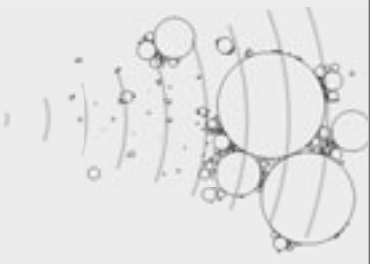


- **FRITSCH Technology: Inverse Fourier Design**
  25 years ago, FRITSCH was the first company in the industry to bring a revolutionary alternative to the conventional design onto the market in the form of a convergent laser beam: by positioning the Fourier lens in front of the measuring cell, a convergent 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.

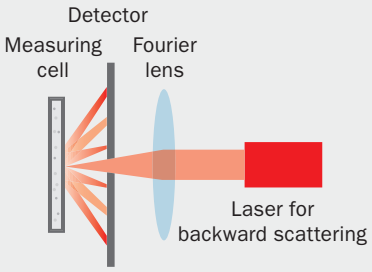


DISPERSION

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 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 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.

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

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.

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

Benefit from our experience

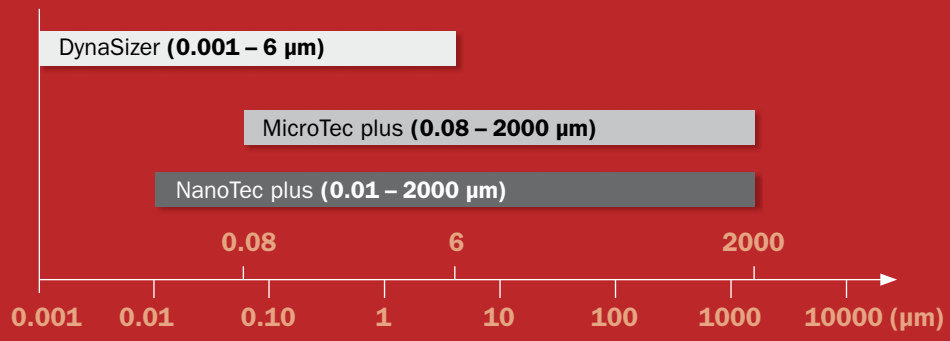
Choose FRITSCH Laser Particle Sizers to take advantage of the technical superiority of over 25 years of practical experience in determining particle size distributions.

Today, the laser diffraction technology in a convergent laser beam introduced by FRITSCH is an international standard, and the models of the ANALYSETTE 22 series are used as perfect assistants worldwide in research and development as well as in production and quality control.

With the ANALYSETTE 12, FRITSCH also offers dynamic light scattering for use in the lower nanometre range. Easy to operate, fast and reliable. Request the separate leaflet for the Nano Particle Sizer ANALYSETTE 12 with dynamic light scattering.

ANALYSETTE 12
DynaSizer
Dynamic light scattering

ANALYSETTE 22
MicroTec plus and NanoTec plus
Static light scattering



We are happy to advise you

For all questions regarding FRITSCH laser particle sizing and its possible application, please feel free to contact our expert Dr. Günther Crolly.
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