analysette 22

ZOOM SIZER

Laser Particle Sizer

- For rapid, automatic particle size analysis
- Measuring range 0.01 – 2000 µm
- Size distribution and shape analysis in a single measurement

particle size analysis

laser diffraction

for lab & production

FRITSCH

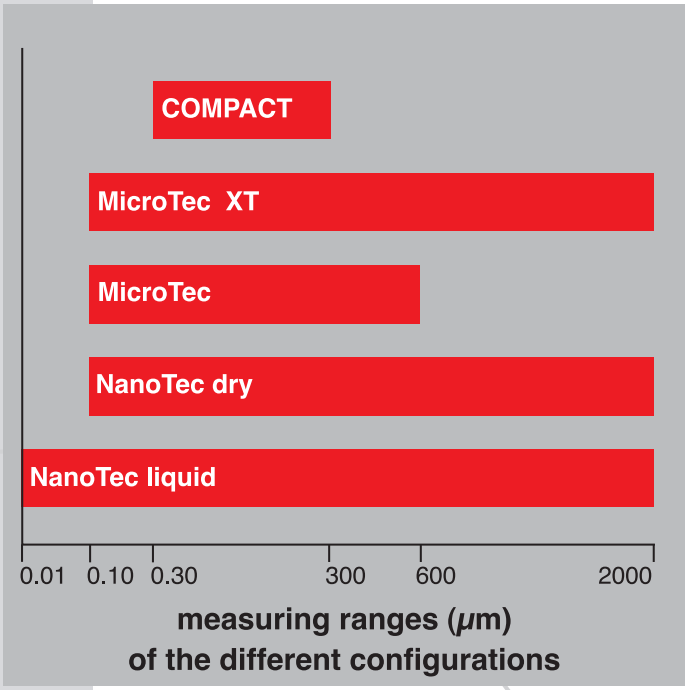
Application and measuring range

Field of Application

The Laser Particle Sizer analysette 22 can determine the particle size distribution of suspensions, emulsions and aerosols. The top of the range models NanoTec and MicroTec also include software for particle shape analysis.

Compared with the “classical” measurement processes such as sieving, sedimentation or image analysis, laser diffraction offers valuable advantages such as, short analysis times, good reproducibility and precision, simple calibration, a large measuring range and high flexibility.

As a result laser diffraction technique is accepted throughout the world and supersedes traditional methods. By assembling the appropriate components, a measurement system can be configured which is specifically customised to your needs, with reliability and efficiency guaranteed by FRITSCH as a recognised authority in particle measurement technology.



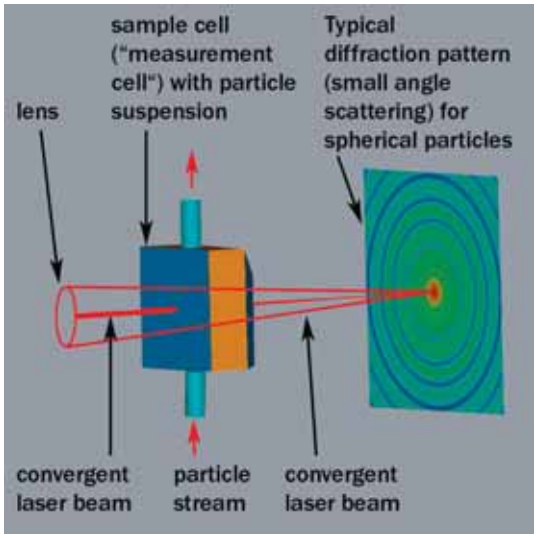
Measuring Range

The measuring range of the analysette 22 extends from 0.01 to 2000 µm. Samples with a still broader distribution, for example up to two millimetres, can be easily sieved and the sieving result integrated into the laser diffraction analysis.

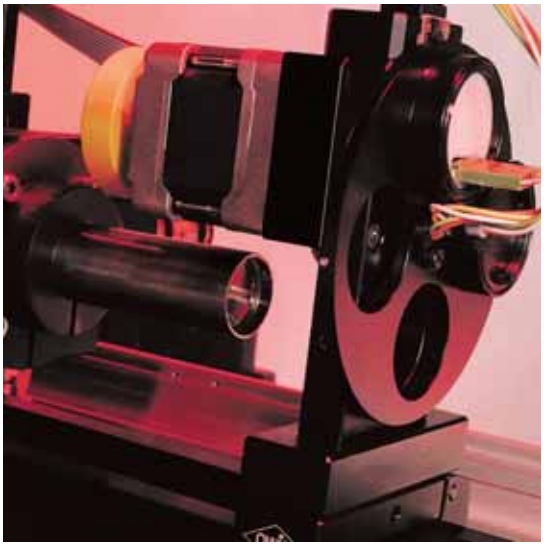
quality control

particle sizing

Laser Particle Sizer



FRITSCH measuring principle



Method of Operation

General

Analytical instruments based on laser diffraction for determination of particle size distribution use the physical principle of the scattering of electromagnetic waves. The design consists of a laser beam directed through a measuring cell to a detector. A dispersion module transports the particles to the measuring cell and through the laser beam. The light scattered proportionally to the particle size is projected by a lens onto a detector. The particle size distribution can be calculated from the distribution of scattered light with the help of complex mathematics. As a result, a volume distribution based on the equivalent diameter of the laser diffraction is obtained.

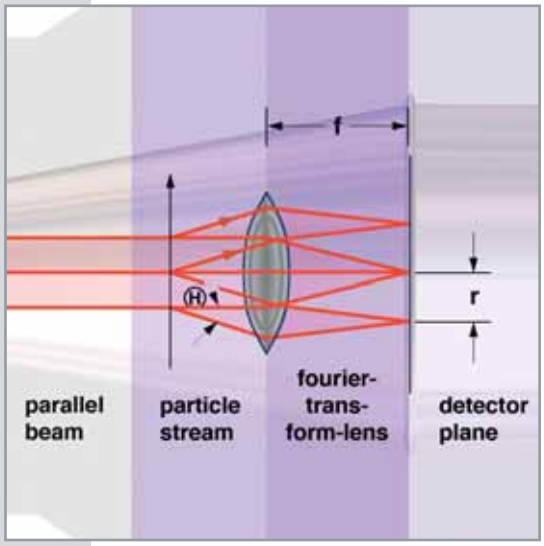
Measuring principle

Measuring Principle

The Conventional Optic

With conventional optics, the measurement takes place within a **parallel** laser beam, the scattered light is projected onto the detector by a lens. Because each lens can only cover a relatively small measuring range, it is necessary to change the lens to examine other measuring ranges.

Similar to a camera that requires a wide-angle lens for near objects and a telephoto lens for distant objects, it is necessary to adapt instruments using the conventional method to the sample that should be measured by altering their configuration.

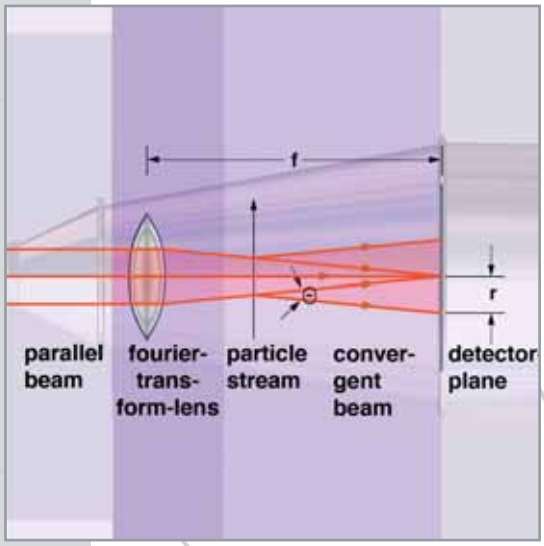


conventional optic

The „Inverse Fourier Optic"

The principle included in the laser diffraction standard ISO 13320-1 under the name of "Inverse Fourier Optics" has long been known, but was first recognised and utilised by FRITSCH.

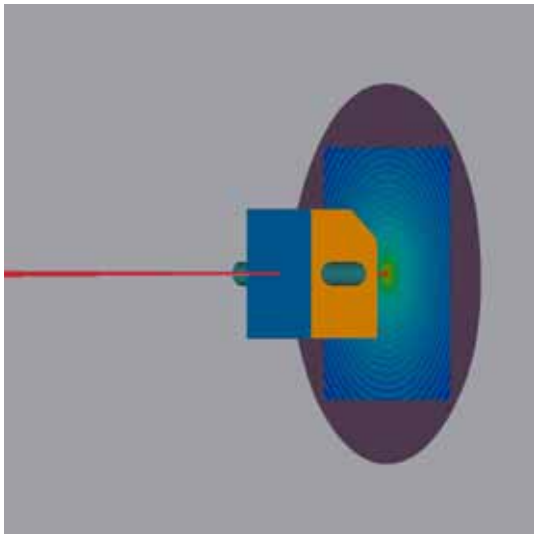
In this process, the sample is measured in a **convergent** laser beam; the scattered light is projected directly onto the detector. Instead of the focal distance of the lens, the measuring range is now determined by the distance between the measuring cell - detector. Positioning the measuring cell at a correspondingly greater distance away allows the measurement of a larger measuring range.



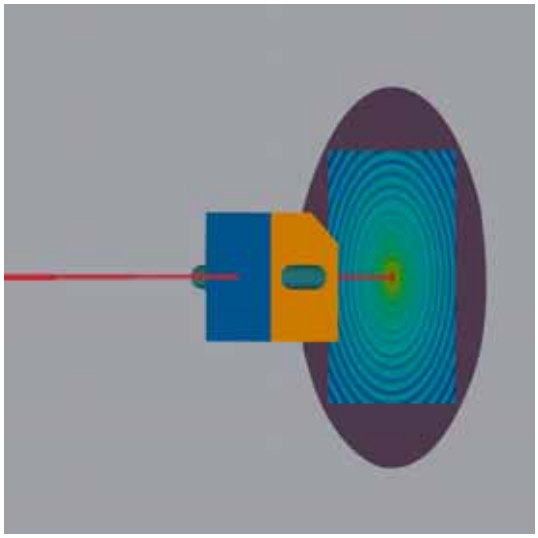
"Inverse Fourier Optic"

ISO 13320-1 convergent laser beam

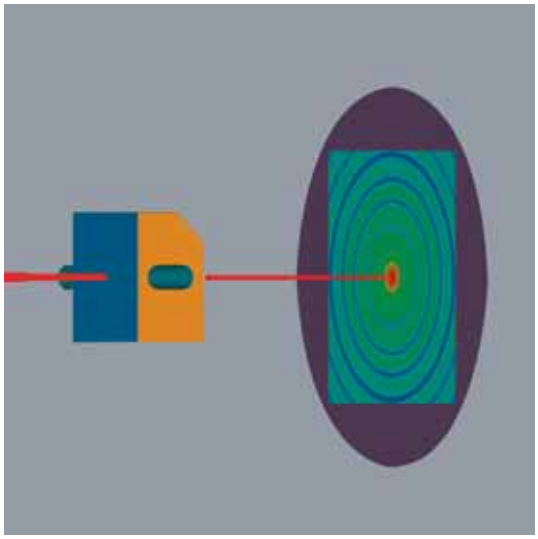
Laser Particle Sizer



small measuring cell – detector distance



medium measuring cell – detector distance



large measuring cell – detector distance

Das FRITSCH Patent:

simple zooming into the sample

Through the unique movement of the measuring cell within the convergent laser beam, the measuring range of the analysette 22 can be adapted to your sample as in a zoom lens (FRITSCH patent).

- small measuring cell – detector distance (wide angle) -> measurement of small particles down to the sub-micron range
- large measuring cell – detector distance (telephoto) -> measurement of coarse particles

A sample with a particle size distribution of 80 – 120 µm, for example, can be measured with the analysette 22 in a selected measuring range from 1.3 to 180 µm with 59 channels. In instruments without a zoom-function, the entire measuring range is always detected, meaning that only a portion of the measurement channels are available for the sample. This results in a lower resolution of the particle size distribution.

...multiple zooming into the sample

The resolution of a particle size analysis (number of measurement channels) with the analysette 22 can be further increased by repeating a measurement with various measuring cell to detector distances. This identifies details of the particle size distribution that are not possible with other measurement instruments of this type.

With the models NanoTec and MicroTec, fully automatic, computer-controlled movement of the measuring cell (measuring cell to detector distance) allows the creation of a super matrix with up to 520 measurement channels.

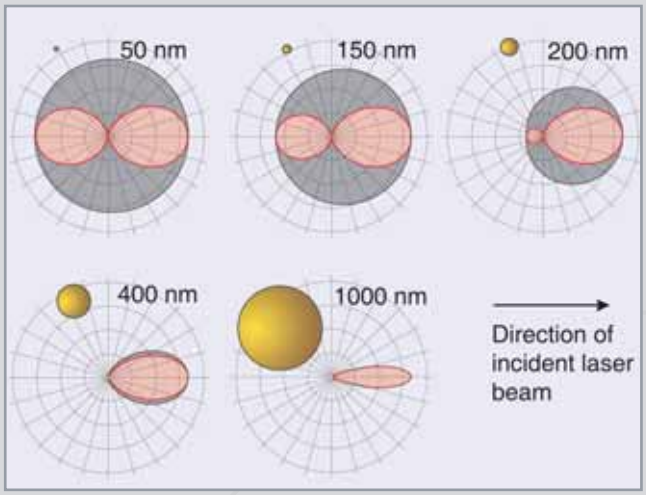
The COMPACT version offers a resolution of 62 channels.

Scattered light measurement

Scattered Light Measurement with the analysette 22

The scattering angle is inversely proportional to the particle size. Large particles scatter the light by a small angle (forward scattering, diffraction). The scattering by various particles can be well differentiated.

As particle size decreases, the light scattered forward contains less and less information. The scattering angle becomes increasingly large until the light is finally scattered to the side and backward. To identify such particles, the analysette 22 utilises side and backward detectors and the property that small particles scatter polarised light parallel and perpendicular to the polarisation direction in varying intensities.



polarisation-dependent scattered light diagrams

Fraunhofer / Mie Theory

The analysis of the scattered light information in the analysette 22 takes place according to Fraunhofer theory or Mie theory.

Fraunhofer theory, named after the German physicist Josef von Fraunhofer, applies in theory only for particles with a diameter greater than the wavelength of the light, in other words for small scattering angles. The measurement is independent of optical particle properties. For particles in the range of the wavelength and smaller, the Fraunhofer assumption of a constant extinction coefficient no longer applies, and the optical particle properties must be considered.

In this range, the analysette 22 applies Mie theory, named after the German physicist Gustav Mie. It describes the scattering of light as a resonance phenomenon. When a light beam of a specific wavelength encounters a particle, the particle undergoes an electromagnetic oscillation of the same frequency as the stimulating light. At the same time, it re-emits the absorbed energy like a relay station. According to Mie theory, there exists a relationship between the optically effective cross-section and particle size as well as between the light wavelength and refractive index of the particles and the medium.

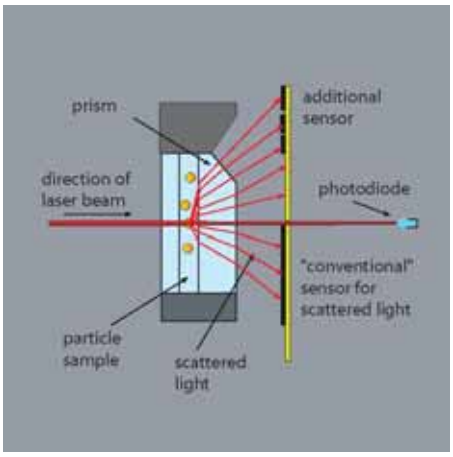
In order to apply Mie theory, the refractive index and absorption coefficient of the sample and the carrier medium must be known and taken into consideration in the measurement.

- To simplify the daily routine, these parameters of most materials are already stored in the software.

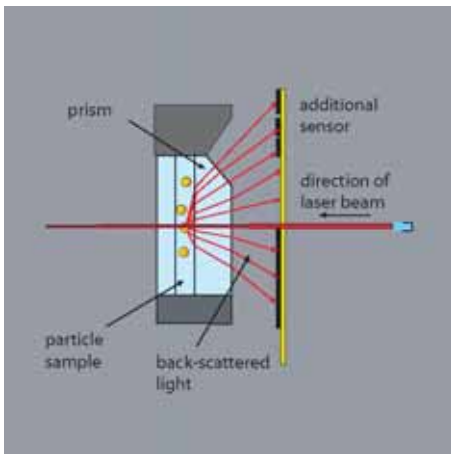
Fraunhofer / Mie Theory

particle sizing

www.fritsch.de



measurement with forward laser



measurement with backward laser

Forward Scattering

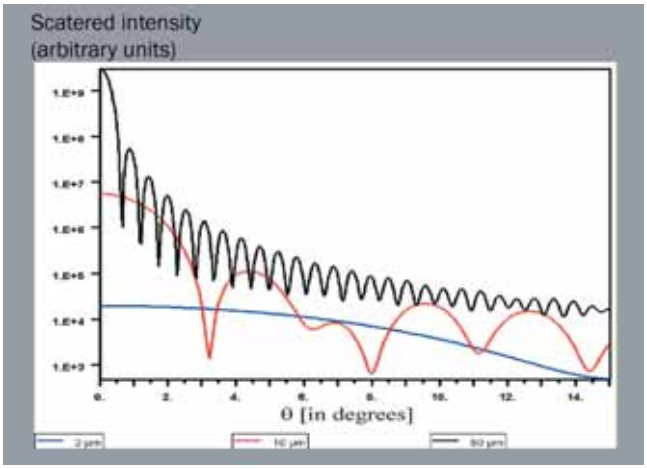
The light scattered in the measuring cell is detected in the forward direction by the light-sensitive elements of the scattered light detector. The detector has a micro-hole in the centre through which the laser light passes towards a photodiode for determination of the total absorption. Positioned around this micro-hole are concentric, light-sensitive elements with areas that become increasingly large toward the outside to compensate for the small scattering effect of small particles. In the inner region of the detector, the elements are very small so that even the scattered light of large particles can be measured with high resolution. The separation between the individual elements is achieved with state-of-the-art semiconductor manufacturing processes.

The scattered light cannot leave the measuring cell at arbitrarily large angles because total reflection occurs at a specific angle upon transition from an optically high dense to less dense medium. The optical measuring cell glasses of the analysette 22 therefore contain prism-shaped, wide-angle surfaces from which scattered light can escape at a large angle. This light is measured on the detector by special wide-angle elements. In the forward direction (lower measurement limit ~0.1 µm), a scattering angle range up to approx. 60° is possible with this design.

Backward Scattering

Nanometer particles scatter the light in significantly larger angle ranges. To measure this, the analysette 22 NanoTec utilises a backward laser that passes through the same micro-hole in the detector from behind and generates scattered light in the measuring cell that is captured by the detector as backward scattering in the angle range from 60 – 180°.

In addition, the optimised geometry of the detector makes it possible to capture and evaluate the various scattered effects of nano particles parallel and perpendicular to the polarisation direction of the laser. The lower measurement limit with this design is ~10 nm.



scattered light functions

laser diffraction measures nano particles

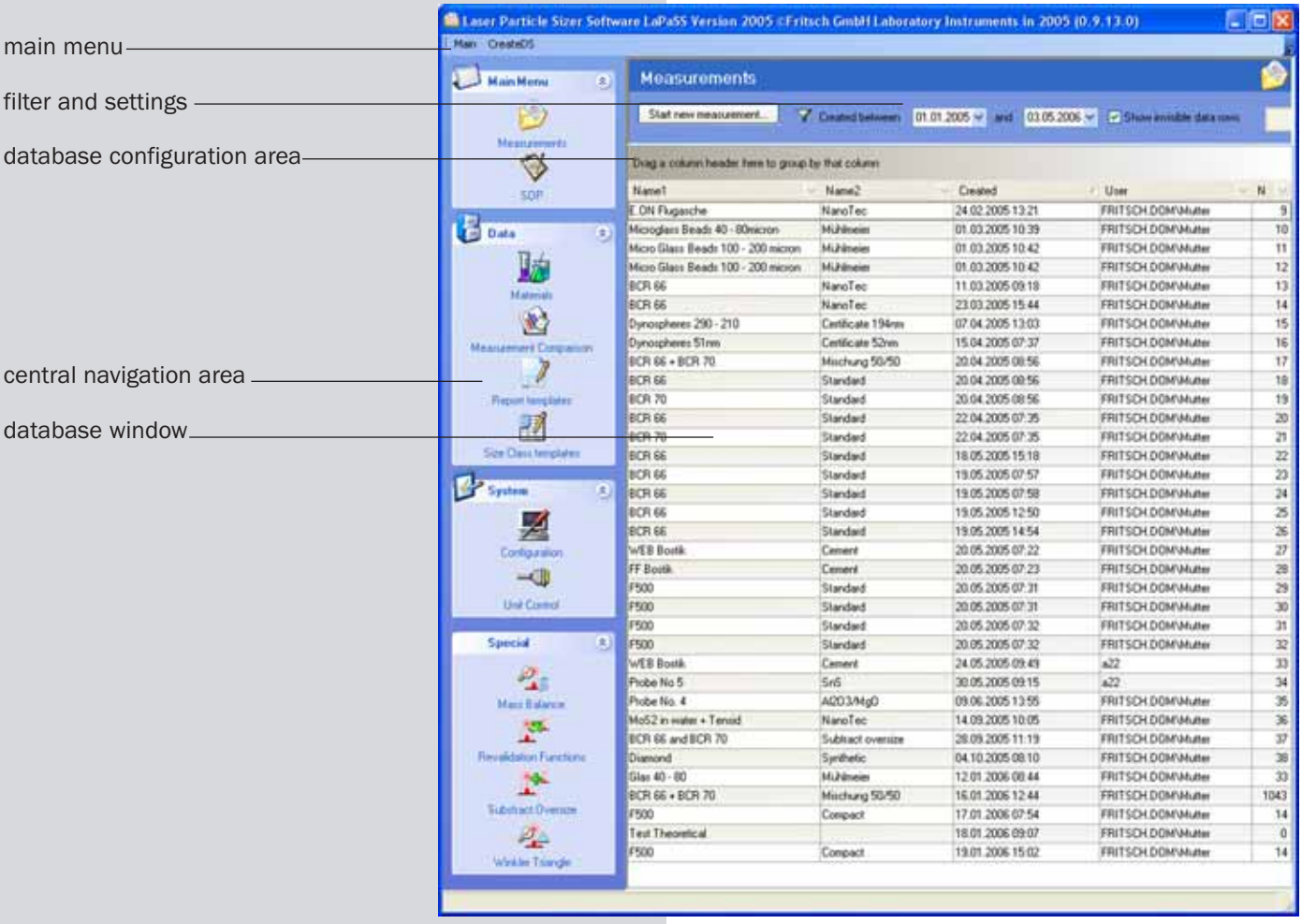
ZOOMSizer

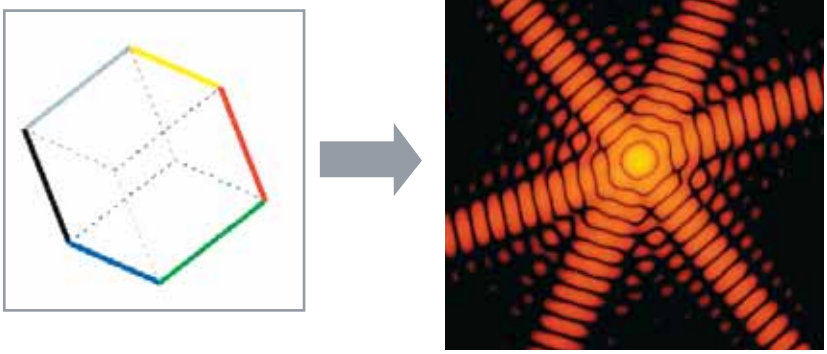
Software LaPaSS

Software LaPaSS

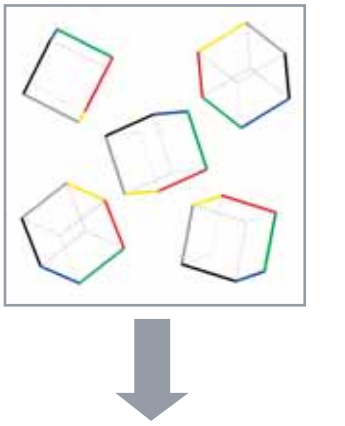
The new Laser Particle Sizer Software LaPaSS is based on a relational database in which all user entries, parameters and results are securely saved for later inspection. The software has the following features:

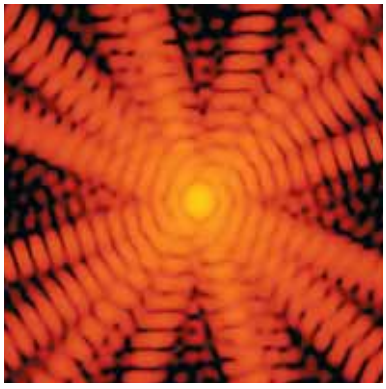
- Intuitive operation via central navigation area
- Easy to learn, thanks to Microsoft Office standard
- SQL database
- Device control via SOPs
- CFR 21 part 11 included as standard
- Individual reports and layouts
- Freely definable interfaces
- Comparison- and min-max-graphs
- User interface multi-lingual
- Evaluation according to Fraunhofer or Mie theory
- Consideration of sieving results
- Conversion to freely selectable particle sizes
- Statistical evaluation
- Entry of theoretical curves
- Conversion of the results to other methods of measurement
- Export of ISO 13320-1 values to Excel™





diffraction pattern of a cube





diffraction pattern of 5 cubes

Software for Shape Analysis

The information contained in the diffraction images can be used not only for determination of the particle size, but also for particle shape analysis. The analysette 22 NanoTec and MicroTec are the only instruments in the world which produces a particle size distribution and particle shape analysis in a single measurement.

Non-spherical particles scatter the light in preferred spatial directions. If there are not too many particles within the laser beam, particle shape analysis can be obtained from this information in the range from 2 µm to approx. 600 µm. In this case, FRITSCH utilises and expands the patented zoom function.

With the unique option to move the measuring cell within the convergent beam, the measuring cell can be positioned closer to the detector for the particle shape analysis so that the first diffraction maximum of the scattered light of average particles hits the shape-sensitive regions of the detector. Because the diameter of the convergent laser beam decreases as it approaches the detector, the small numbers of particles required for shape analysis are found within the laser beam. Azimuthally (beam-shaped) arranged detector elements capture the scattered light fluctuations, which are analysed by particle shape analysis software. The software allows the determination of the elongation ratio for the x50 value of a previously measured distribution as well as the evaluation of the “edginess” of the particles.

particle shape analysis NanoTec MicroTec

Models: NanoTec - MicroTec

analysette 22 NanoTec

The analysette 22 NanoTec is the top model in the FRITSCH Laser Particle Sizer range.

Taking into consideration backward scattering, a lower measuring limit of 0.01 µm is achieved. The total measuring range from 0.01 to 1000 µm can be switched to 15 - 2000 µm through beam expansion. The zoom-function resolves the particle size distribution of a sample in up to 520 measurement channels.

For particle characterisation, both the size distribution and shape parameters can be identified. The analysette 22 is the only instrument in the world with which you can obtain a particle size distribution and particle shape analysis in a single measurement.

ZOOMSizer

analysette 22 MicroTec

The analysette 22 MicroTec differs from the NanoTec only by its smaller measuring range. Because the backward scattering is not captured, the lower measuring limit is 0.1 µm. The upper measuring limit of 600 µm permits the use of a shorter optical bench, resulting in a very compact and inexpensive design.

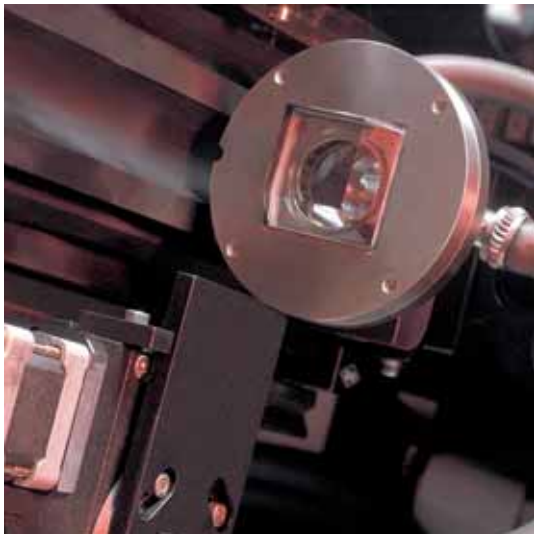
analysette 22 MicroTec XT

The analysette 22 MicroTec XT has a larger upper measuring range than the previous model of 2000 µm (XT = “extended”).

reversible measuring range

0.01 µm - 2 mm

ZOOMSizer



liquid measuring cell

Advantages

- Lower measuring limit of 0.01 µm
- Measuring time < 2 min
- Fully automatic switching between the dispersion modules
- Easy operation, excellent ergonomics and minimal space requirements
- Zoom-function for adaptation of the measuring range to your sample
- Size and shape analysis in a single step
- High measuring convenience thanks to SOPs
- Effective, automatic cleaning of the measuring circuit
- Integration into test equipment monitoring according to ISO 9001:2000
- Laser standard ISO 13320-1 is exceeded

Design Characteristics

- Liquid and dry measurement in the same instrument
- Compact design
- High-quality components “made in Germany”
- Auto-alignment for both laser beams
- Integrated measurement data collection without additional hardware
- Use of decentralised 16-bit flash processors
- Complete calculation of the Mie theory

Standard Operation
Procedure SOP
particle sizing

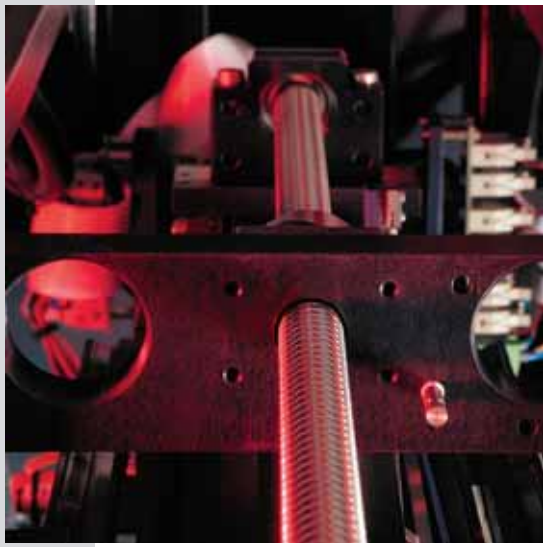
NanoTec - MicroTec

Technology

The optical bench is designed vertically to save space and is made of only high quality components. Two independent guides for liquid or dry measurements allow fully automatic change of the dispersion modules within seconds and without the need to remove or install components.

The fibre-coupled, robust 7 mW double laser diodes with polarization-preserving fibre, good temperature stability, high beam quality and long service life radiate in the visible range. A newly developed scattered light detector on a ceramic base “made in Germany” according to state-of-the-art manufacturing methods offers the best mechanical and thermal stability.

With the expansion for measurement of backward scattered light, the analysette 22 NanoTec covers a scattered angle range from 0° to approximately 180°. It has a double laser diode for scattered light measurements in the forward and backward directions. To expand the measurement into the nanometer range, the forward laser is blocked and a laser in the backward direction is activated. This generates light scattering in the measuring cell that can be captured by the detector as polarization-selective backward scattering in the angle range 60 – 180°. The extinction of the backward laser is captured by a photodiode swivelled to a position in front of the forward laser. This “nano” option cannot be activated with the dry dispersion.



cell displacement

4/2-way valve

particle size analysis

dry and liquid measuring

nano particles

Laser Particle Sizer analysette 22 for liquid dispersion

Laser Particle Sizer analysette 22 for wet dispersion

Configuration

Instrument for Liquid Dispersion

Fully automatic, efficient rinsing of the suspension without dead space is performed within the liquid dispersion module through the use of a motor-driven 4/2-way valve. With the integrated ultrasonic bath (approx. 500 ml volume, 50 watt output), even difficult to disperse samples can be measured without additional instruments. The digital ultrasonic generator keeps the specified output optimal and constant.

The powerful centrifugal pump with a capacity of 20 litres per minute transports even heavy particles that otherwise tend to sediment. The entire liquid volume can be completely pumped through within three seconds. The pump speed can be adapted to the properties of the sample. This technology ensures precise and reproducible measuring results.

All parts in contact with liquid are made of stainless steel and Viton. All functions are computer-controlled.

Instrument for Dry Dispersion

The dispersion module for dry samples prepares agglomerates using mechanical and pneumatic forces. The amount of sample supplied is metered by a high-tech, amplitude-controlled vibratory feeder. The dispersion takes place in a two-phase annular gap nozzle through air fins with aerodynamic wave formation at the nozzle outlet and high flow speed in the nozzle channel.

To operate the dry dispersion unit, a connection for oil-, water- and particle-free compressed air with a pressure of at least 5 bars and an air volume of at least 8 m^3/h are required.

The fully automatic measuring sequences can be freely programmed and saved. The entire functional process is controlled by an integrated microprocessor.

Combination Instrument for Liquid and Dry Dispersion

The combination instrument contains both modules for liquid and dry dispersion. The preferred dispersion type can be easily selected with a software command. Changing of the dispersion type is fully automatic – without the need for any action by the operator.

liquid and dry dispersion

particle sizing

NanoTec - MicroTec

Instrument with Small Volume Liquid Dispersion Unit

The dispersion unit for small quantities completely meets the requirements for measuring expensive samples or measuring in solvents.

150 ml of suspension volume are rinsed through fully automatically by a motor-driven 4/2-way valve with low consumption and without leaving any of the material behind. The output of the extremely powerful centrifugal pump for gentle transport of the sample can be controlled. All parts in contact with liquid are made of stainless steel, Teflon and Viton.

Depending on the model and equipment, the matching measuring cell including holder and accessories are supplied. The change of the dispersion module takes place fully automatically.

Small Volume Liquid Dispersion Unit

Accessories	NanoTec Liquid	NanoTec Dry	MicroTec Liquid	MicroTec Dry	MicroTec XT Liquid	MicroTec XT Dry
Small Volume Liquid Dispersion Unit - external 22.3830.00	✓	✓	✓	✓	✓	✓
Small Volume Liquid Dispersion Module 22.3831.00	✓		✓		✓	
Small Volume Liquid Dispersion Module 22.3832.00		✓		✓		✓

22.3830.00 – for extension of existing instruments, manual change of the dispersion module
22.3831.00 – for subsequent installation in instruments with liquid dispersion, automatic changing of the dispersion module
22.3832.00 – for subsequent installation in instruments with dry dispersion, automatic changing of the dispersion module

Technical data - NanoTec

Module	Dispersion	Measuring range	Measuring time	Sample quantity/ liquid volume	Weight	Dimensions (W x D x H)
Combination Instrument for Liquid and Dry Dispersion 22.2000.00	liquid/dry	liquid 0.01 - 2000 µm dry 0.1 - 2000 µm	approx. 10 s	liquid approx. 0.1 - 2 cm^3 in 500 ml liquid dry 5 - 50 cm^3	net 105 kg, gross 140 kg	80 x 65 x 122 cm
Instrument for Liquid Dispersion 22.2800.00	liquid	0.01 - 2000 µm	approx. 10 s	approx. 0.1 - 2 cm^3 in 500 ml liquid	net 89 kg, gross 124 kg	80 x 65 x 122 cm
Instrument for Dry Dispersion 22.2900.00	dry	0.1 - 2000 µm	approx. 10 s	5 - 50 cm^3	net 90 kg, gross 125 kg	80 x 65 x 122 cm
Instrument with Small Volume Liquid Dispersion Unit 22.2750.00	liquid	0.01 - 2000 µm	approx. 10 s	0.1 - 0.5 cm^3 in 150 ml liquid	net 89 kg, gross 124 kg	80 x 65 x 122 cm

Technical data - MicroTec

Module	Dispersion	Measuring range	Measuring time	Sample quantity/ liquid volume	Weight	Dimensions (W x D x H)
Combination Instrument for Liquid and Dry Dispersion 22.4000.00	liquid/dry	0.1 - 600 µm	approx. 10 s	liquid approx. 0.1 - 2 cm^3 in 500 ml liquid dry 5 - 50 cm^3	net 90 kg, gross 125 kg	80 x 65 x 94 cm
Instrument for Liquid Dispersion 22.4400.00	liquid	0.1 - 600 µm	approx. 10 s	approx. 0.1 - 2 cm^3 in 500 ml liquid	net 75 kg, gross 110 kg	80 x 65 x 94 cm
Instrument for Dry Dispersion 22.4500.00	dry	0.1 - 600 µm	approx. 10 s	5 - 50 cm^3	net 76 kg, gross 111 kg	80 x 65 x 94 cm
Instrument with Small Volume Liquid Dispersion Unit 22.4600.00	liquid	0.1 - 600 µm	approx. 10 s	0.1 - 0.5 cm^3 in 150 ml liquid	net 75 kg, gross 110 kg	80 x 65 x 94 cm

Technical data - MicroTec XT

Module	Dispersion	Measuring range	Measuring time	Sample quantity/ liquid volume	Weight	Dimensions (W x D x H)
Combination Instrument for Liquid and Dry Dispersion 22.4900.00	liquid/dry	0.1 - 2000 µm	approx. 10 s	liquid approx. 0.1 - 2 cm^3 in 500 ml liquid dry 5 - 50 cm^3	net 90 kg, gross 125 kg	80 x 65 x 122 cm
Instrument for Liquid Dispersion 22.4940.00	liquid	0.1 - 2000 µm	approx. 10 s	approx. 0.1 - 2 cm^3 in 500 ml liquid	net 75 kg, gross 110 kg	80 x 65 x 122 cm
Instrument for Dry Dispersion 22.4960.00	dry	0.1 - 2000 µm	approx. 10 s	5 - 50 cm^3	net 76 kg, gross 111 kg	80 x 65 x 122 cm
Instrument with Small Volume Liquid Dispersion Unit 22.4970.00	liquid	0.1 - 600 µm	approx. 10 s	0.1 - 0.5 cm^3 in 150 ml liquid	net 75 kg, gross 110 kg	80 x 65 x 122 cm

Model: COMPACT

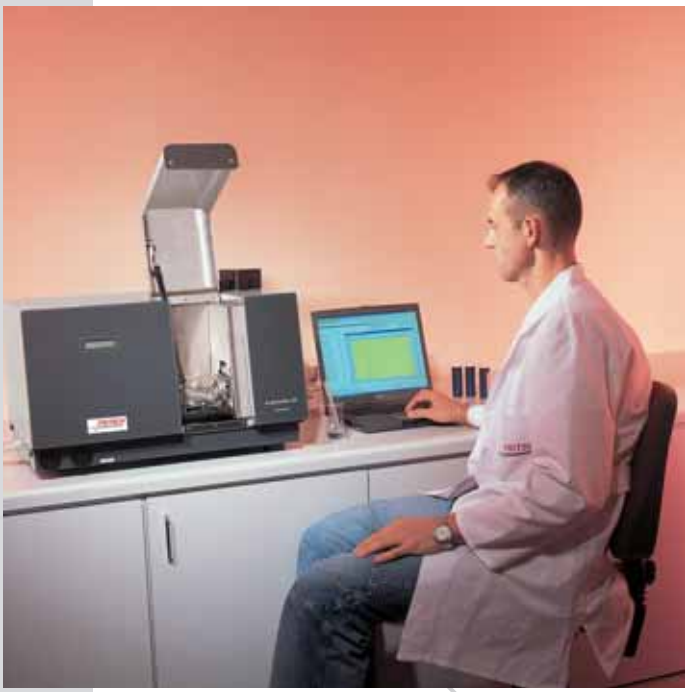
analysette 22 COMPACT

Our starter model, the analysette 22 COMPACT with a measuring range from 0.3 to 300 µm and an extremely attractive price to performance ratio is particularly interesting to users in need of a bench top instrument for routine particle size analysis that is simple to operate – either in the laboratory or in production.

The analysette 22 COMPACT is also an interesting alternative for any laboratories that has previously applied the classical methods (sieving, sedimentation) but would like to switch to the new laser diffraction technology. Standard programmes are provided that allow adaptation of the laser diffraction results to the classical methods.

Measurement processes can be completely programmed in advance and can be loaded with a single press of a button. The instrument therefore offers simple operation for beginners while offering the required flexibility for advanced users with the individual programmability.

Particle size distributions can be measured in suspension (liquid) or in airflow (dry).



COMPACT

routine particle
size analysis
single button operation
lab & production


dry measuring cell


liquid measuring cell

Advantages

- Starter model with excellent price-/performance-ratio
- Fully automatic measuring process
- Single button operation
- Liquid and dry dispersion unit in one instrument
- High reproducibility
- Can be calibrated according to ISO 9001:2000
- Fulfils ISO 13320-1 (Laser Diffraction)
- Measuring range can be changed without alteration of the instrument

Design Characteristics

- Selection of the dispersion unit via software
- Easy cleaning of all parts without tools
- Automatic beam adjustment
- Automatic positioning of the measuring cell
- Measuring cell rapid mounting
- Detector on a stabile ceramic base
- Interface for individual programming
- Fibre-coupled laser diode, red light 635nm, laser protection class 1
- Up to 6 measurements can be saved internally
- LCD display for displaying the current system status

fully automatic measurement process

0.3 - 300 µm

dry and liquid

COMPACT

Configuration

Instrument for Liquid Dispersion

The liquid dispersion module offers fully automatic rinsing of the measured suspension with a powerful centrifugal pump and an integrated ultrasonic bath with approx. 400 ml volume and 35 watts output. Even difficult-to-disperse samples can be measured without additional instrumentation. The required sample volume is approximately 0.1 – 2 cm^3.

Included is an easy-to-clean measuring cell of stainless steel for quick mounting.

Instrument for Dry Dispersion

The dispersion module for dry samples prepares agglomerates using mechanical and pneumatic forces. The amount of sample supplied is metered by a high-tech, amplitude-controlled vibratory feeder. The dispersion takes place in a two-phase annular gap nozzle through air fins with aerodynamic wave formation at the nozzle outlet and high flow speed in the nozzle channel. The required sample volume is approximately 5 – 50 cm^3.

To operate the dry dispersion unit, a connection for oil-, water- and particle-free compressed air with a pressure of at least 5 bars and an air volume of at least 8 m^3/h are required.

The fully automatic measuring sequences can be freely programmed and saved. The entire functional process is controlled fully automatically by the measuring unit.

The supplied measuring cell of stainless steel and sapphire glass with rapid mounting function is easy to clean.

Combination Instrument for Liquid and Dry Dispersion

The combination instrument contains both modules for liquid and dry dispersion. The desired dispersion type can be selected with a software command.

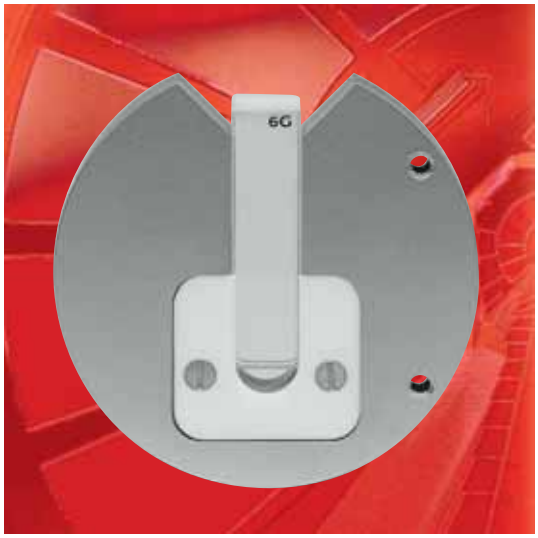
Laser Particle Sizer analysette 22 COMPACT

liquid and dry dispersion

particle sizing

smallest quantities

Small Volume Liquid Dispersion Unit



Liquid Mini-Cell

Small Volume Liquid Dispersion Unit

The dispersion unit for small quantities completely fulfils the requirements for measuring expensive samples or measuring in solvents.

The user is supported by the 100 ml suspension volume, a transparent glass container for observing the sample and rinsing of the measuring circuit by a single-lever valve (4/2-way ball valve). The output of the centrifugal pump can be adjusted for gentle transport of the sample and all parts in contact with liquid are made of stainless steel or Viton.

A liquid measuring cell is included.

Liquid Mini-Cell

When using the special holder with the Mini-Cell, 1 ml of suspension liquid is sufficient. Expensive, rare or hazardous samples down to approximately 10 µm particle size can be measured in this.

Technical data - COMPACT

Module	Dispersion	Measuring range	Measuring time	Sample quantity/ liquid volume	Weight	Dimensions (W x D x H)
Combination Instrument for Liquid and Dry Dispersion 22.3000.00	liquid/dry	0.3 - 300 µm	approx. 10 s	liquid approx. 0.1 - 2 cm^3 in 400 ml liquid dry 5 - 50 cm^3	net 65 kg, gross 90 kg	64 x 52 x 39 cm
Instrument for Liquid Dispersion 22.3500.00	liquid	0.3 - 300 µm	approx. 10 s	approx. 0.1 - 2 cm^3 in 400 ml liquid	net 49 kg, gross 74 kg	64 x 52 x 39 cm
Instrument for Dry Dispersion 22.3600.00	dry	0.3 - 300 µm	approx. 10 s	5 - 50 cm^3	net 50 kg, gross 75 kg	64 x 52 x 39 cm
Small Volume Liquid Dispersion Unit 22.6900.00	liquid	0.3 - 300 µm	approx. 10 s	0.1 - 0.5 cm^3 in 100 ml liquid	net 8 kg, gross 10 kg	14 x 14 x 32 cm
Liquid Mini-Cell 22.6300.00	liquid	0.3 - 10 µm	approx. 10 s	0.002 cm^3 in 1 ml liquid	net 0.5 kg, gross 0.8 kg	1.2 x 0.4 x 4.5 cm

NanoTec - MicroTec - COMPACT

General Accessories

The analysette 22 instrument family is a modular system. The general accessories are universally available for all models.

Calibration Standards

For calibration of the measuring instrument within the framework of a test equipment monitoring system as per ISO 9001:2000. The standards as per ASTM, BCR or FRITSCH internal standards are available individually.

Tests according to ISO 13320-1

The internal FRITSCH standard can be used for analysis of the Repeatability as per ISO 13320-1. A Primary Validation as per ISO 13320-1 can be performed with BCR samples from the European Community. The calibration system as per ASTM standard E-1458 is available for Secondary Validation.

Within the framework of instrument validation, FRITSCH also offers reports on “Installation Qualifications” and “Operating Qualifications”.

Exhaust System

An exhaust system is required for vacuuming of the sample when using the dry dispersion unit. FRITSCH offers two different mechanisms; but the user’s own exhaust system may be used if it meets the following specifications. MAK values must be observed in all cases.

Power consumption	max. 1.100 watts
Air flow	40 l/s
Vacuum	23 kPa
Vacuum output	270 W
Filter surface	2400 cm^2
Dust bag capacity	9.0 l

Computer

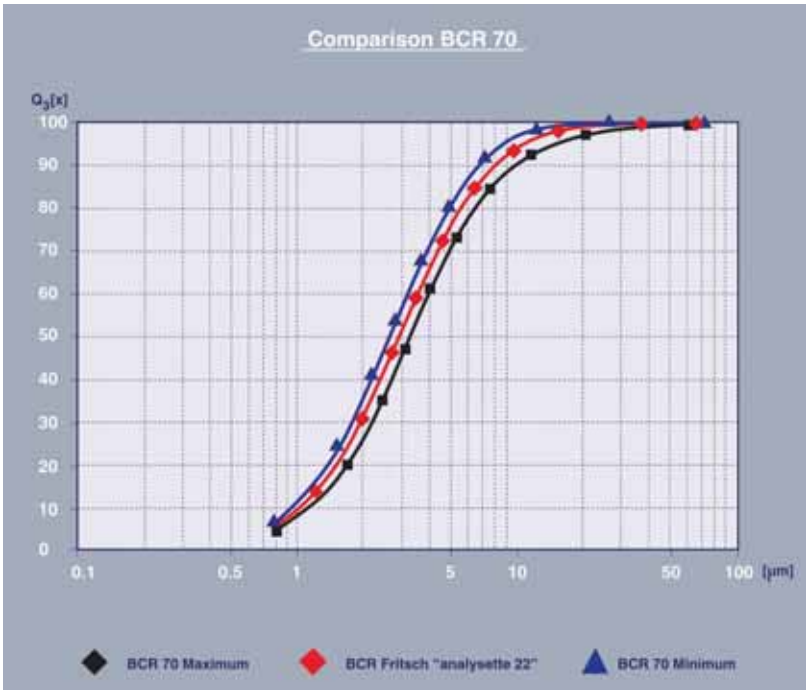
Conventional (or customer’s own) WINDOWS™ PC with at least 20 MB of free hard drive space, 512 MB RAM and 2.4 GHz processor. All models require an open RS232 port as well as a typical WINDOWS™-compatible printer for outputting the results.

The software for the analysette 22 is compatible with all WINDOWS™ NT, 2000 and XP operating systems.

ISO 9001:2000

calibration

validation



cumulated distribution undersize

General accessories for all models

Order No.	Description
	Calibration Standards
85.2100.00	FRITSCH-test powder F-500 (50 g), 0.5-50 µm
85.2110.00	FRITSCH-test powder F-70 (150 g), 100-400 µm
85.2120.00	FRITSCH-test powder F-220 (50 g), 2-250 µm
85.2000.00	BCR-test powder (10 g) BCR 70, 1.2-20 µm
85.2020.00	BCR-test powder (10 g) BCR 67, 2.4-32 µm
85.2010.00	BCR-test powder (10 g) BCR 69, 14-90 µm
85.2090.00	Mono disperse polystyrene particle 235 nm
	Certificates for tests according to ISO 13320-1
96.0020.00	Declaration of Repeatability
96.0030.00	Declaration of Primary Validation
96.0040.00	Declaration of Secondary Validation
96.0050.00	Calibration Certificate
96.0060.00	IQ / OQ documentation (questionnaire format)
	Exhaust Systems
43.9020.00	for dry measurement for 230 V/1~, 50-60 Hz, 1000 Watt
43.9030.00	with ultra-fine filter for dry measurement for 230 V/1~, 50-60 Hz
	Computer, colour inkjet printer and laser printer on request.

NanoTec - MicroTec - COMPACT

ISO 13320-1

The international standard ISO 13320-1 Particle Size Analysis – Laser Diffraction Methods describes the methods for determination of particle size distribution via laser diffraction. In the following table, we provide you with the technical specifications required by ISO 13320-1 for our models analysette 22 NanoTec, MicroTec and COMPACT. All laser diffraction instruments for particle size measurement from any manufacturer can be compared based on this table.

Table of the technical specifications demanded according to ISO 13320-1:

ISO 13320-1	Specification	NanoTec	MicroTec	COMPACT
Laser	Type	Solid state diode	Solid state diode	Solid state diode
	Wavelength	655 nm	655 nm	638 nm
	Power	7 mW	7 mW	0.8 mW
	Intensity stability (accepted level of fluctuation)	2 %	2 %	3 %
	Beam shape	Gauß	Gauß	Gauß
	Beam diameter	300 - 8000 nm	300 - 8000 nm	200 - 5000 nm
	Polarization	linear	linear	random
	Typical Lifetime	10000 h	10000 h	8000 h
Sample Circuit	Depth of the measuring plane in laser beam	4 mm	4 mm	2 mm
	Liquid pump rate	20 l/min	20 l/min	5 l/min
	Required air flow for dry dispersion units	8 m^3/h	8 m^3/h	8 m^3/h
	Ultra-sound power and frequency	80 W / 36 kHz	80 W / 36 kHz	80 W / 36 kHz
	Volume of sample circuit	500 ml	500 ml	500 ml
	Materials of system in contact with particles and dispersion liquids	Stainless steel, Viton	Stainless steel, Viton	Stainless steel, Silicone, Viton
	Maximum particle size which can be dispersed	2000 µm	2000 µm	300 µm
	Maximum density which can be handled	8 g/cm^3	8 g/cm^3	4 g/cm^3
Lens	Focal length	500 mm / 190 mm	350 mm	140 mm
	Working distance	20 - 385 mm	20 - 220 mm	17 - 114 mm
	Fixed or requires changing	fixed	fixed	fixed
Detector	Number of elements	80	80	31
	Geometry (e.g. half or quarter rings, segments, etc.)	Segments	Segments	Segments
	Alignment automatic or manual	automatic and manual	automatic and manual	automatic
	Detector elements calibrated	yes	yes	no
	Display of normal detector signals for blank measurements and their allowable limits	yes	yes	yes
	Overload level for detector elements	12-bit, 4096	12-bit, 4096	12-bit, 4096

ISO 13320-1	Specification	NanoTec	MicroTec	COMPACT
Measurement	Typical measuring time	10 s	10 s	10 s
	Minimum time between successive measurements	2 min	2 min	3 min
Computer	Processor Type	Conventional (or customer's own) WINDOWS™ PC with at least 20 Mbyte of available hard disc memory, 512 Mbyte RAM and 2.4 GHz processor. All models require an open RS232 port as well as a typical, WINDOWS™-compatible printer for outputting the results. The software for the analysette 22 is compatible with all 32-bit WINDOWS™ versions.		
	Memory size			
	Speed			
	Operating system			
	Drive type and size			
	Monitor type			
	Keyboard type			
	Real time interfaces printer type/protocol			
	Network functions/protocol			
Deconvolution	Calculation of model matrix	yes	yes	yes
	Multiple scattering calculation	yes, internal	yes, internal	no
	Type of optical models that can be applied	Mie, Fraunhofer	Mie, Fraunhofer	Mie, Fraunhofer
	Indicative description of mathematical procedure, for example weighting, constraints and smoothing	Regularization	Regularization	Iteration
Output	Measuring range, overall and during each analysis	0.01 - 2000 µm	0.1 - 2000 µm	0.3 - 300 µm
	Particle size class ranges, also whether fixed or adjustable	adjustable, up to 520	adjustable, up to 520	adjustable, up to 62
	Types of output, e.g. differential and cumulative distributions, values for specific particle sizes in given percentages and/or vice versa, moments; fits to distribution models	all types	all types	all types
	Data storage, availability of background and sample measurement values	ASCII, Access, Excel, all values stored	ASCII, Access, Excel, all values stored	ASCII, Access, Excel, all values stored
Performance	Repeatability within instrument	d_{50} <= 0.5 %	d_{50} <= 0.5 %	d_{50} <= 1 %
	Instrument to instrument	d_{50} <= 3 %	d_{50} <= 3 %	d_{50} <= 3 %
	Resolution and number of size classes	up to 520	up to 520	up to 62
	Lower detection limit for small portions of small and large particles in size distributions (within measuring range)	3 %	3 %	3 %
	How presence of particles outside measuring range is indicated	lower limit cumulative	lower limit cumulative	lower limit cumulative

Ordering data

Order No.	Description
22.2000.00	**Laser Particle Sizer analysette 22 NanoTec** **Combination Instrument for Liquid and Dry Dispersion** for 100-240 V/1~, 50-60 Hz
22.2800.00	**Instrument for Liquid Dispersion** for 100-240 V/1~, 50-60 Hz
22.2900.00	**Instrument for Dry Dispersion** for 100-240 V/1~, 50-60 Hz
22.2750.00	**Instrument with Small Volume Liquid Dispersion Unit** for 100-240 V/1~, 50-60 Hz
22.4000.00	**Laser Particle Sizer analysette 22 MicroTec** **Combination Instrument for Liquid and Dry Dispersion** for 100-240 V/1~, 50-60 Hz
22.4400.00	**Instrument for Liquid Dispersion** for 100-240 V/1~, 50-60 Hz
22.4500.00	**Instrument for Dry Dispersion** for 100-240 V/1~, 50-60 Hz
22.4600.00	**Instrument with Small Volume Liquid Dispersion Unit** for 100-240 V/1~, 50-60 Hz
22.4900.00	**Laser Particle Sizer analysette 22 MicroTec XT** **Combination Instrument for Liquid and Dry Dispersion** for 100-240 V/1~, 50-60 Hz
22.4940.00	**Instrument for Liquid Dispersion** for 100-240 V/1~, 50-60 Hz
22.4960.00	**Instrument for Dry Dispersion** for 100-240 V/1~, 50-60 Hz
22.4970.00	**Instrument with Small Volume Liquid Dispersion Unit** for 100-240 V/1~, 50-60 Hz
22.3830.00	**Special Accessories for NanoTec and MicroTec / MicroTec XT** **Small Volume Liquid Dispersion Unit - external** for 100-240 V/1~, 50-60 Hz
22.3000.00	**Laser Particle Sizer analysette 22 COMPACT** **Combination Instrument for Liquid and Dry Dispersion** for 100-240 V/1~, 50-60 Hz
22.3500.00	**Instrument for Liquid Dispersion** for 100-240 V/1~, 50-60 Hz
22.3600.00	**Instrument for Dry Dispersion** for 100-240 V/1~, 50-60 Hz
22.6900.00	**Special Accessories for COMPACT** **Small Volume Liquid Dispersion Unit** manual change of the dispersion module for 230 V/1~, 50-60 Hz
22.6300.00	**Liquid Mini-Cell** for measuring extremely small volumes of suspension, complete with holder for inserting into the Liquid Dispersion Unit
86.4630.00	**Transformer** to adapt voltage 115 V/1~ to 230 V/1~
22.1100.00	**Spare parts for NanoTec and MicroTec / MicroTec XT** flow measuring cell cpl. for inserting into the Liquid Dispersion Unit
22.1105.26	measuring cell glass 4 mm for 22.1100.00
22.1109.00	measuring cell glass cpl. 12 mm for 22.1100.00
22.2009.00	dry measuring cell cpl. for inserting into the Dry Dispersion Unit
22.0430.26	measuring cell glass for 22.2009.00
22.4450.00	**Spare parts for COMPACT** flow measuring cell cpl. for inserting into the Liquid Dispersion Unit
22.4470.26	measuring cell glass for 22.4450.00
22.6200.00	Mini-Cell for measuring extremely small volumes of suspension for 22.6300.00
22.0301.00	dry measuring cell cpl. for inserting into the Dry Dispersion Unit
22.0430.26	measuring cell glass for 22.0301.00
	Accessories for representative sample division **Rotary Cone Sample Divider laborette 27** Ask for detailed brochure!

a22e-06-03-5/P

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