# analysette® 22

## Laser-Particle-Sizer

- For rapid, automatic particle size analysis – dry and in suspension (Dual Channel)
- Patented FRITSCH measuring process with convergent laser beam
- Measuring range from 0.01 – 1000 µm
- Determination of particle size distributions and shape recognition in a single process

ZERKLEINERN PARTIKELMESSEN TEILEN MILLING PARTICLE SIZING DIVIDING ZERKLEINERN PARTIKELMESSEN TEILEN MILLING PARTICLE SIZING DIVIDING ZERKLEINERN PARTIKELMESSEN TEILEN

FRITSCH

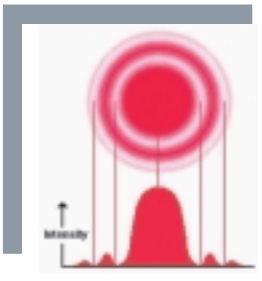
CE

TÜV CERT DIN EN ISO 9001

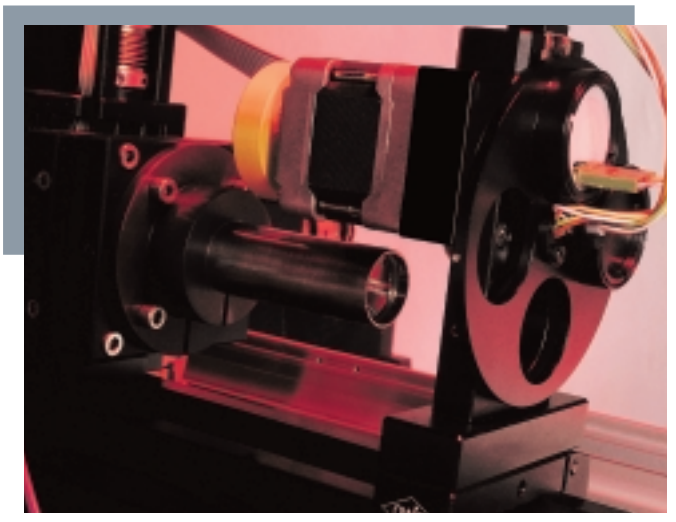
Made in Germany

# Laser-Particle-Sizer “analysette 22”

Fraunhofer-diffraction



intensity-distribution



## Field of Application

The Laser-Particle-Sizer “analysette 22” is a versatile instrument for determining the size distribution of suspensions, emulsions and powders via laser diffraction. The models NanoTec and MicroTec can also be equipped with a software option for shape recognition.

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

Accordingly, it has now established itself worldwide and supplanted traditional methods. By assembling the appropriate components, a measurement system can be designed which is precisely adapted to the task in hand, with reliability and efficiency guaranteed by FRITSCH as a specialist in particle measurement technology.

## Measuring Range

The measuring range of the “analysette 22” is from 0.01 to 1000 µm. Samples with a still broader distribution up to the millimetre range can, for example, be sieved first at one millimetre and the result easily integrated into the laser diffraction analysis.

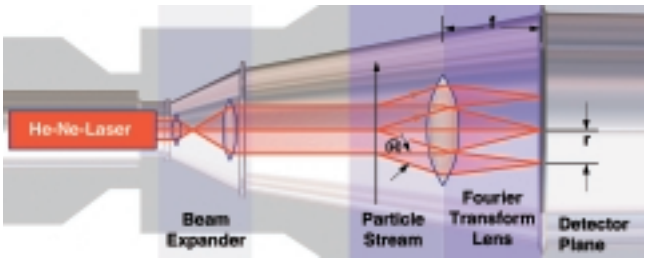
| Measuring Unit | Liquid Dispersing Unit | Dry Dispersing Unit |
|---|---|---|
| NanoTec | 0.01 - 1000 µm | 0.1 - 1000 µm |
| MicroTec | 0.1 - 600 µm | 0.1 - 600 µm |
| COMPACT | 0.3 - 300 µm | 0.3 - 300 µm |

## 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.

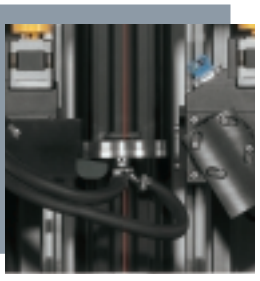
Particles in a parallel laser beam deflect the light in a fixed solid angle that depends on the diameter of the particles. A lens focuses the scattered light in a ring on a sensor that is mounted in the focal plane of the lens. Undiffracted light converges at the focal point on the optical axis.



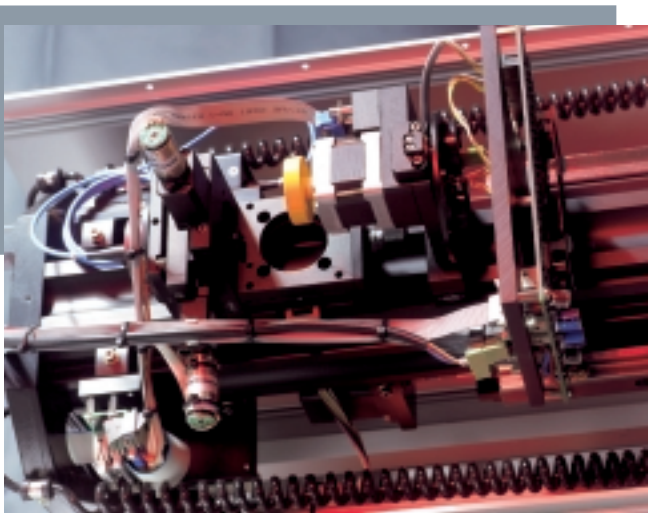

With the help of complex mathematics, the intensity distribution of the scattered light can be used to calculate the particle size distribution of the scattered particles. One obtains as a result a particle diameter corresponding to the laser diffraction with a diameter that is equivalent to a sphere with identical diffracted light distribution. Average volume diameters are measured and the resulting particle size distribution is a distribution over volume.

# Laser-Particle-Sizer “analysette 22”

measuring cell



beam adjustment



## The Conventional Design of the Parallel Laser Beam

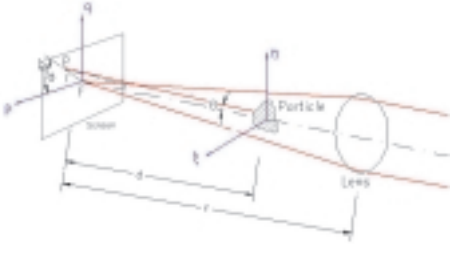
The diffraction image in the focal plane can be mathematically described with the help of Fourier optics. The measurement principle is based on the unique property of a convergent lens of performing a two-dimensional Fourier transformation on the incoming field. For this reason, the convergent lens situated in the **parallel** laser beam is also called a Fourier transformation lens.

The local frequencies of the Fourier components are directly proportional to the focal width of the convergent lens. Changing the measuring range therefore always requires changing the lens, involving reconfiguration of the instrument. Many manufacturers have therefore adopted an alternative measurement design in recent years, one that was invented by the FRITSCH company.

## The “Inverse Fourier Design” Convergent Laser Beam

The “analysette 22” offers an alternative optical design that is both “state-of-the-art” and impressively simple.

The design, which was included in ISO 13320-1 under the term “inverse Fourier optics”, has long been known as a part of Fourier optics. However, the advantages for particle size distribution measurement were first recognised, utilised and patented by FRITSCH.




The sample is placed within a **convergent** laser beam. The distance between the measuring cell and the detector is equivalent to the focal length of the convergent lens in conventional applications. One obtains the same diffraction image as with a conventional design without the disadvantages of reconfiguration in order to change the measuring range. The measuring range can be changed by simply moving the measuring cell as with a zoom lens. The user has full control over the local frequencies of the Fourier components.

- Large distance between measuring cell and detector (TELE) ⟶ Measuring of coarse particles
- Small distance between measuring cell and detector (MACRO) ⟶ Measuring of small particles down to the submicron range

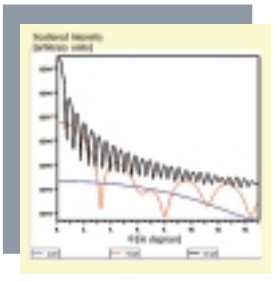
The Laser-Particle-Sizer “analysette 22” is the only instrument in which the measuring cell is moved along the optical axis to adjust the measuring range without the need to change the lens. The sample is therefore always measured with the greatest dynamic and optimal conditions.

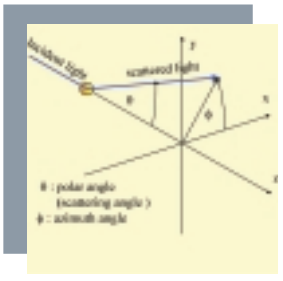
## Resolution

The inverse Fourier optics also allows measurement of a particle size distribution with extremely high resolution. With the fully automatic, computer-controlled positioning of the measuring cell within the convergent beam, a super matrix of up to 520 measurement channels can be created for calculations using the models NanoTec and MicroTec. The total measuring range from 0.01 to 1000 µm is available without limitation.

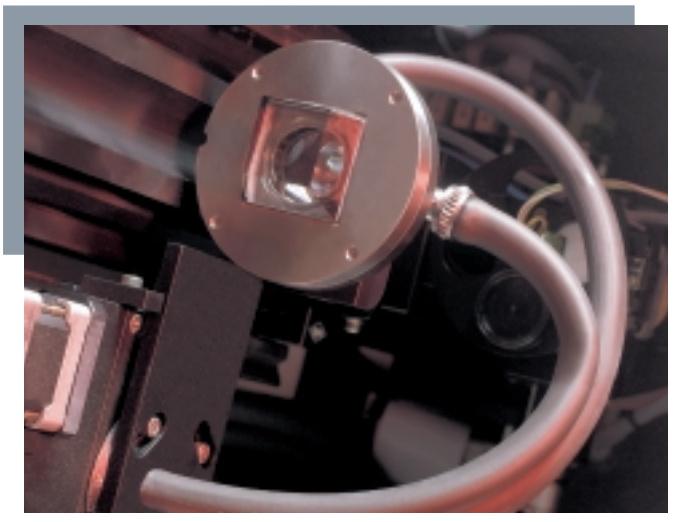
Even in the COMPACT version, a resolution of 62 channels can be achieved.

# Laser-Particle-Sizer “analysette 22”





liquid measuring cell



## Fraunhofer- / Mie-theory

The energy distribution measured in radially positioned sensor elements is evaluated and used to calculate the particle size distribution. In the “analysette 22”, this calculation can be performed according to either the Fraunhofer or the Mie theory.

The Fraunhofer theory, named after German physicist Josef von Fraunhofer and based on diffraction at the particle edges, applies only to fully opaque particles and small diffraction angle.

For particle sizes in the range of the wavelength and below, the Fraunhofer assumption of a constant extinction coefficient no longer applies. To account for the optical particle properties, the “analysette 22” makes use of the Mie theory, named after German physicist Gustav Mie. It describes the radiation in and around a homogenous, spherical particle in a homogenous, non-absorbing medium for all spatial directions. The particles can be transparent or completely absorbent.

The Mie theory states that light diffraction is a resonance phenomenon. If a light beam with a specific wavelength encounters a particle, the particle performs electromagnetic oscillations in the same frequency as the stimulating light – regardless of the relationship of the light wavelength to the particle diameter and the refractive index of the particles and medium. The particle is tuned to the reception of specific wavelengths and re-emits the energy like a relay station within a defined spatial angle distribution. According to the Mie theory, multiple oscillation states of varying probabilities are possible and there exists a relationship between the optically effective cross section and particle size, light wavelength and the refractive index of the particles and medium.

In order to apply the Mie theory, the refractive index and absorption coefficient of the sample and the medium must always be known. The software of the “analysette 22” contains these constants for many materials within its database. During measurement, an appropriate diffraction matrix is selected or calculated within seconds when new constants are entered.

## Measuring in the Nanometre Range

As the particle size decreases, the diffracted light contains less and less information. At the same time, the diffraction angles become very large and the intensity of the diffracted light decreases significantly.

As a result more elaborate instrument technology is required for the nano range.

### Forward Diffraction

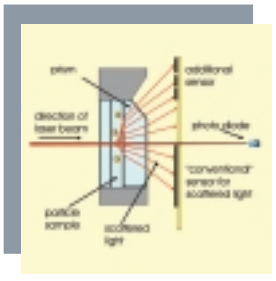
The light in the measuring cell is diffracted in a forward direction and captured by the light-sensitive elements of the light detector. In the centre of the detector there is a micro-hole through which the laser light encounters a photodiode to determine the total absorption. Light-sensitive elements are arranged concentrically around this micro-hole. These have increasingly large surfaces in the outer area to compensate for the small diffraction angle of smaller particles. In the inner region of the detector, the elements are much smaller so that the diffracted light of large particles can be measured with high resolution. The separation of the individual elements from each other is performed using “state-of-the-art” semiconductor manufacturing processes. The diffracted light cannot leave the measuring cell at arbitrarily large angles because total reflection occurs at a specific angle upon transition from an optically more dense to less dense medium.

The optical measuring cell glasses of the “analysette 22” are therefore given prism-shaped wide-angle surfaces from which diffracted light can escape at a large angle.

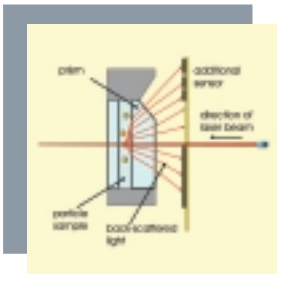
This light is measured on the detector by special wide-angle elements. In the forward direction (lower measuring limit ~0.1 µm), a diffraction angle range to approximately 60° is covered with this design.

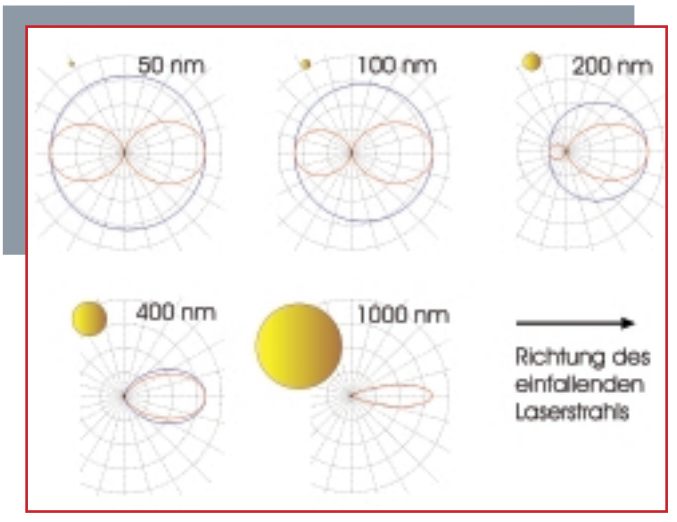
# Laser-Particle-Sizer “analysette 22”

measurement with forward laser



measurement with backward laser





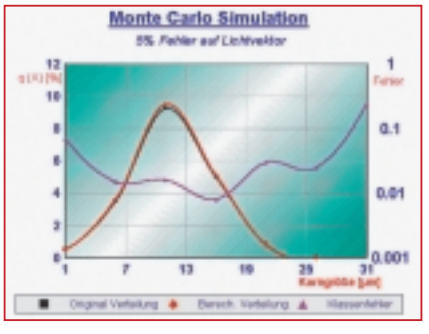

**Backward Diffraction**
To capture the diffracted light of nanometre particles, a significantly larger angle range must be covered. To accomplish this, the “analysette 22” NanoTec utilises a backward laser that passes through the same micro-hole in the detector and generates light diffraction in the measuring cell that is then detected as backward diffusion in an angle range from 60 – 180°.
In addition, the geometry of the detector makes it possible to capture and evaluate the various diffractive effects of nano particles parallel and perpendicular to the polarization direction of the laser. The lower measuring limit with this design is ~10 nm.

## Software

The WINDOWS™ software supplied with the “analysette 22” has been created according to the visual design guides of Microsoft and supports all options of the new 32-Bit operating systems. The standard functions are very comprehensive and allow the user to make custom programme modifications in many places.

- Icon-controlled “speed bars” for rapid selection of special programme functions

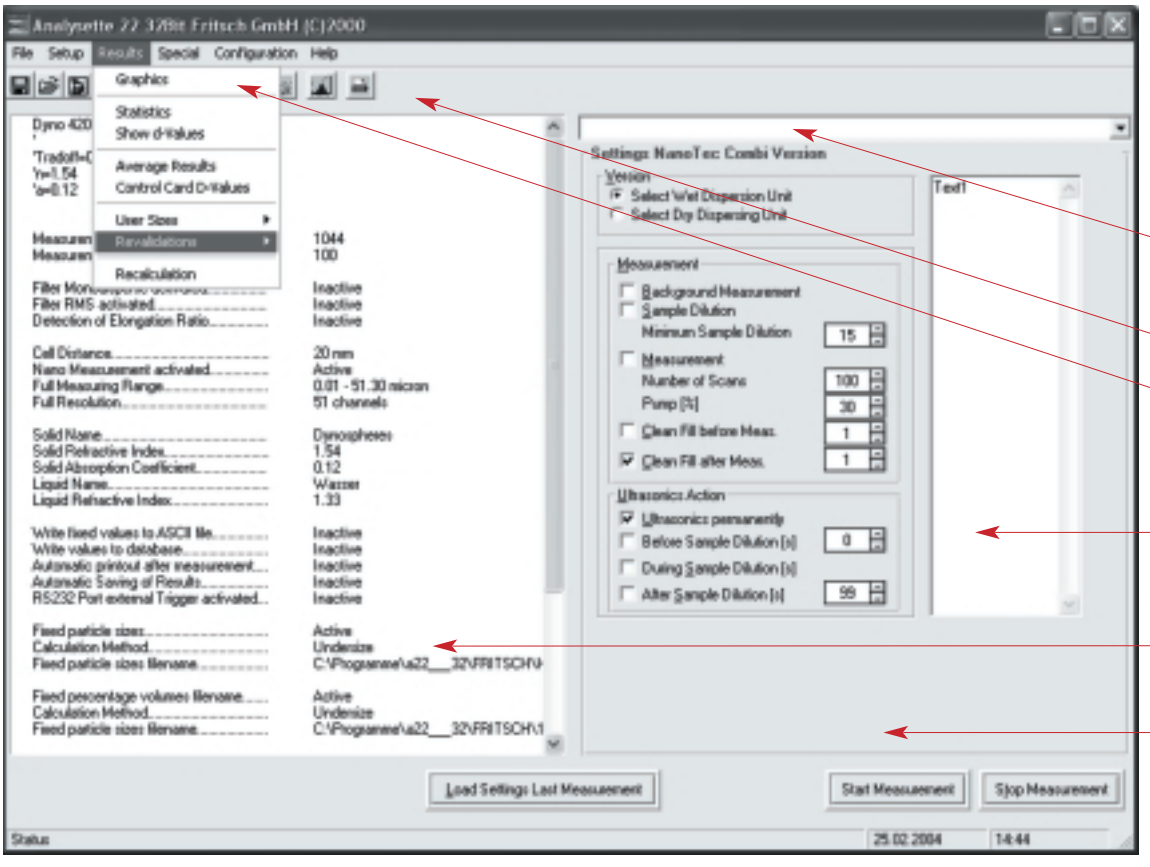
- Tool tips for quick information
- Selectable user language
- Evaluation according to the Fraunhofer or Mie theory to account for the optical particle properties
- Creation of individual, freely programmable result printouts (layouts)
- Layouts can be saved and reloaded
- Management of results according to ISO 9001:2000 via integrated database
- Average calculation with automatic generation of min-max curves



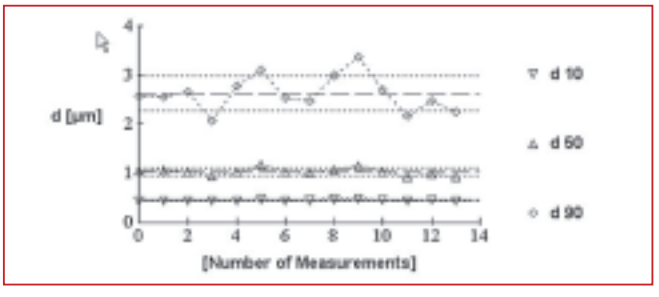

- Algorithm for calculation of the particle size distribution optimised for error tolerance
- Entry of theoretical curves
- Revalidation functions for conversion of the results to other methods of measurement
- Data export via DDE and OLE or as Lotus files (.wks)
- Direct integration of selected functions with Microsoft Excel™
- Export of values to Excel™ according to ISO 13320-1 for Repeatability, Primary Validation, Secondary Validation
- Integration of user objects (e.g. company codes)
- Tromp calculation
- Diverse display of results

# Laser-Particle-Sizer “analysette 22”

main screen of the programme

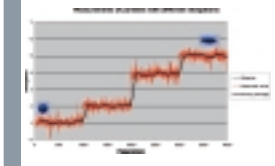



- Consideration of sieving results
- Conversion to freely selectable particle sizes
- Trend analysis

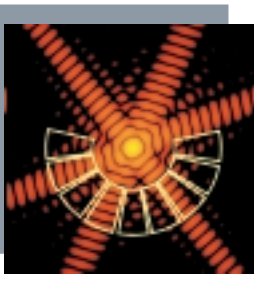



- Static evaluation
- Moments of distribution, averages

# Laser-Particle-Sizer “analysette 22”



scattered light of cuboids



Laser-Particle-Sizer “analysette 22” NanoTec/MicroTec

## “analysette 22” NanoTec

The “analysette 22” NanoTec offers everything that a user of modern Laser-Particle-Sizers expects. High quality optical, mechanical and electronic components combined with modern, flexible software for calculation of the Mie components, the particle size distribution and the resulting parameters guarantee state-of-the-art analysis instrument. The measuring range is 0.01 to 1000 µm.

As a unique feature, FRITSCH offers an optional software application for shape recognition for models “analysette 22” NanoTec and “analysette 22” MicroTec.

## “analysette 22” MicroTec

The “analysette 22” MicroTec is the measuring instrument for samples in the micron and submicron range. The reduced optical bench allows a very compact and inexpensive design. The MicroTec is the “little” brother of the NanoTec. All hardware and software components are identical with those of the “analysette 22” NanoTec except for the nano expansion. The measuring range is from 0.1 to 600 µm.

### NanoTec and MicroTec - Technology

The optical bench is designed vertically to save space and makes use of only high-quality components. Two independent guides allow fully automatic changing within seconds from the wet to dry measuring mode.

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 diffracted 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 diffracted light, the “analysette 22” NanoTec covers a diffracted angle range from 0° to approximately 180°. It has a double laser diode for diffracted light measurements in the forward and reverse directions. To expand the measurement in the nanometre range, the forward laser is switched off and a laser in the reverse direction is activated. This generates light diffraction in the measuring cell that can be captured by the detector as polarization-selective backward diffraction 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.

The “nano” option can be activated in connection with the module for liquid dispersion.

## Design Characteristics

- Compact design
- High quality components
- Liquid and dry measurements in the same instrument
- 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
- Direct solving of the integral equation without approximation methods

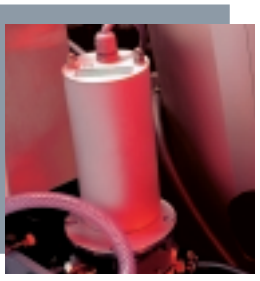
## Advantages

- Easy operation, excellent ergonomics and minimal space requirements
- Very attractive price-/performance-ratio
- Comprehensive automation

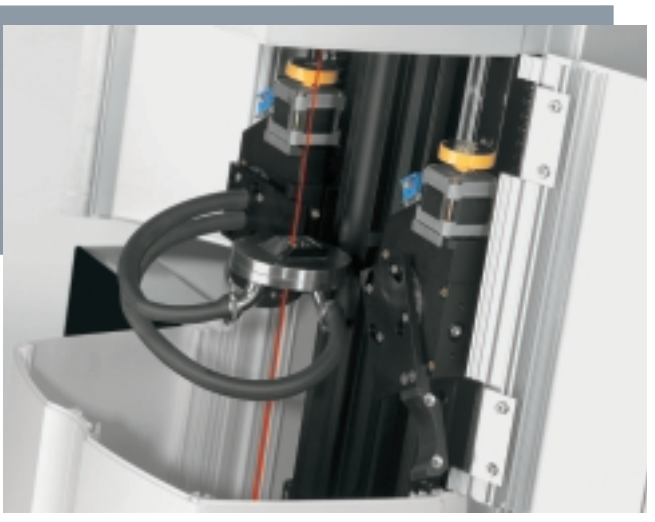
# Laser-Particle-Sizer “analysette 22”

cell displacement

4/2-way valve



Laser-Particle-Sizer “analysette 22” for liquid dispersion



- Large dynamic measuring range without lens change
- Patented “inverse Fourier design” with convergent laser beam
- High measuring comfort, all functional parts can be controlled by computer
- Accelerated measuring cycle of approx. 2 minutes, continuous use possible
- Automatic cleaning of the measuring circuit
- Integration into test equipment monitoring as per ISO 9001:2000
- Fulfils ISO 13320-1

## Configuration

### Instrument for liquid dispersion

The liquid dispersing module offers fully automatic rinsing of the suspension. By means of a motor-driven 4/2-way valve, the rinsing takes place without dead space. 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 100 Watt output also deals with particles with higher specific gravity and is suitable for continuous operation. The entire liquid volume can be completely replaced once within two seconds by the powerful pump. This makes the measurement independent of in homogeneities in the sample. The pump rotation speed and ultrasonic output can be adapted to suit the properties of the sample.

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

### Instrument for dry dispersion

The dispersing 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 dispersing 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 dispersing unit, a connection for oil-, water- and particle-free compressed air with a pressure of at least 5 bar and an air volume of at least 8 $m^3/h$ is 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 the module for liquid and for dry dispersion. The desired dispersion type can be selected with a software command.

### Software for Shape Recognition

The information contained in diffraction images can be used not only for determining the particle size but also the particle shape. A clever arrangement of sensor elements and the use of a “back-propagation neural network” in connection with a suitably selected measuring cell distance activates the areas on the detector that are responsible for the shape recognition. The optionally available software allows the determination of the elongation ratios for the x50 value of a previously measured distribution in a wide range.

# Laser-Particle-Sizer “analysette 22”

service position for the liquid measuring cell

Laser-Particle-Sizer “analysette 22” for dry dispersion

## Special Accessories

**Liquid dispersing unit for small quantities**

See special accessories, page 12

## Technical data - NanoTec

| Module | Liquid/Dry | Measuring range | Measuring time | Sample quantity/ liquid volume | Weight | Dimensions (W x D x H) |
|---|---|---|---|---|---|---|
| Combination instrument for liquid and dry measurement 22.2000.00 | liquid/dry | liquid 0.01 – 1000 µm<br>dry 0.1 – 1000 µm | approx. 10 s | liquid approx. 0.1 – 2 $cm^3$ in 500 ml liquid<br>dry 5 - 50 $cm^3$ | net 105 kg, gross 140 kg | 80 x 65 x 122 cm |
| Instrument for liquid measurement 22.2800.00 | liquid | 0.01 – 1000 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 measurement 22.2900.00 | dry | 0.1 – 1000 µm | approx. 10 s | 5 – 50 $cm^3$ | net 90 kg, gross 125 kg | 80 x 65 x 122 cm |
| Liquid dispersing unit for small quantities 22.6750.00 or 22.6700.00 | liquid | 0.01 – 1000 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 |

22.6750.00 - sufficient if the instrument for liquid dispersion is available
22.6700.00 - required if only the instrument for dry dispersion is available

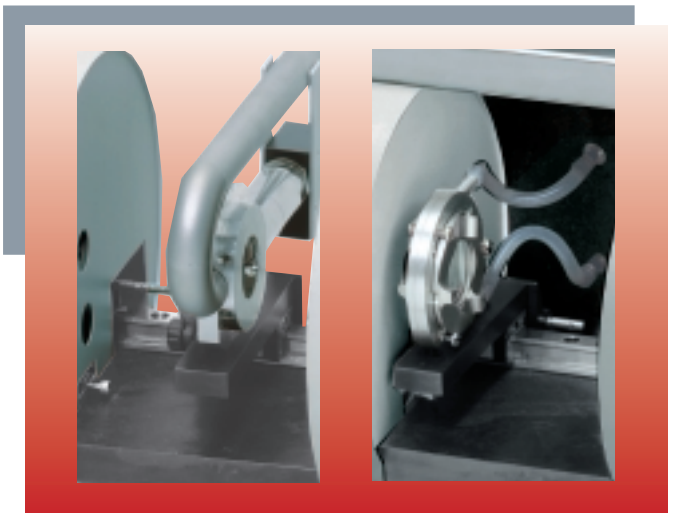
## Technical data - MicroTec

| Module | Liquid/Dry | Measuring range | Measuring time | Sample quantity/ liquid volume | Weight | Dimensions (W x D x H) |
|---|---|---|---|---|---|---|
| Combination instrument for liquid and dry measurement 22.4000.00 | liquid/dry | 0.1 – 600 µm | approx. 10 s | liquid approx. 0.1 – 2 $cm^3$ in 500 ml liquid<br>dry 5 – 50 $cm^3$ | net 90 kg, gross 125 kg | 80 x 65 x 94 cm |
| Instrument for liquid measurement 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 measurement 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 |
| Liquid dispersing unit for small quantities 22.6750.00 or 22.6700.00 | liquid | 0.1 – 600 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 |

22.6750.00 - sufficient if the instrument for liquid dispersion is available
22.6700.00 - required if only the instrument for dry dispersion is available

# Laser-Particle-Sizer “analysette 22”

dry measuring cell liquid measuring cell



## “analysette 22” COMPACT

Our starter model, the “analysette 22” COMPACT offers a measuring range of 0.3 to 300 µm at an unbelievably attractive price to performance ratio, and is particularly interesting to users in need of a benchtop instrument for routine particle size analysis which is simple to operate – either in the laboratory or on the shop floor.

Measurement processes can be completely programmed in advance and can be loaded with a single button press. The instrument, therefore, offers simple operation for less skilled operators and the individual programmability offers the required flexibility for advanced users.

The “analysette 22” COMPACT is also an effective option for laboratories more used to the traditional 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.

Particle size distributions can be measured in suspension or dry.

## Design Characteristics

- Liquid and dry dispersing unit in one instrument
- Selection of the dispersing unit via software
- Optical bench with fibre-coupled laser diode; wavelength 635 nm, visible range, laser protection class 1
- Automatic beam adjustment
- Automatic positioning of the measuring cell
- Measuring cell rapid mounting
- Monolithic silicon detector on ceramic base for maximum mechanical and thermal stability
- RS232 interface for individual programming
- Remote-controlled operation via RS232
- Up to 6 measurements can be saved internally
- LC display for displaying the current system status
- Easy cleaning of all parts without tools

## Advantages

- Starter model with excellent price-/performance-ratio
- Single button operation
- Fully automatic measuring process
- High reproducibility
- Fulfils the requirements of ISO 9001:2000 for test equipment monitoring, can be calibrated according to ISO 9001:2000
- Fulfils ISO 13320-1
- Patented measuring principle
- Measuring range can be changed without alteration of the instrument

# Laser-Particle-Sizer “analysette 22”

Laser-Particle-Sizer “analysette 22” COMPACT

## Configuration

### Instrument for liquid dispersion

The liquid dispersing module with fully automatic rinsing of the suspension offers a centrifugal pump for gentle transport of the particles. With the integrated ultrasonic bath with approx. 400 ml volume and 35 Watt 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 with quick mounting bracket.

### Instrument for dry dispersion

The dispersing 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 dispersing 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 dispersing unit, a connection for oil-, water- and particle-free compressed air with a pressure of at least 5 bar and an air volume of at least 8 $m^3/h$ is required.

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

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

### Combination instrument for liquid and dry dispersion

The combination instrument contains both the module for liquid and for dry dispersing. The desired dispersing type can be selected with a software command.

## Special Accessories

### Liquid dispersing unit for small quantities

See special accessories, page 12

### Liquid mini-cell

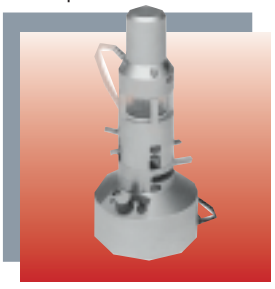
See special accessories, page 12

## Technical data

| Module | Liquid/Dry | Measuring range | Measuring time | Sample quantity/ liquid volume | Weight | Dimensions (W x D x H) |
|---|---|---|---|---|---|---|
| Combination instrument for liquid and dry measurement 22.3000.00 | liquid/dry | 0.3 – 300 µm | approx. 10 s | liquid approx. 0.1 – 2 $cm^3$ in 400 ml liquid<br>dry 5 – 50 $cm^3$ | net 65 kg, gross 90 kg | 64 x 52 x 39 cm |
| Instrument for liquid measurement 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 measurement 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 |
| Liquid dispersing unit for small quantities 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 |

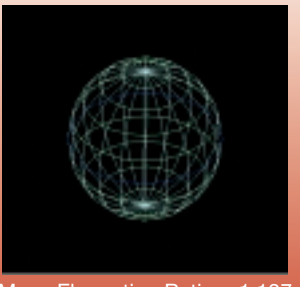
# Laser-Particle-Sizer “analysette 22”

liquid dispersing unit for small quantities



liquid mini-cell

elongation ratio



Mean Elongation Ratio = 1.137
Minimum Elongation Ratio = 1.061
Maximum Elongation Ratio = 1.193
Standard Deviation = 0.0240

## Special Accessories

The instrument family “analysette 22” is a modular system. The special accessories only work with specific models.

### Liquid dispersing unit for small quantities

The dispersing unit for small quantities competely 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 for gentle transport of the sample can be controlled and all parts contacting liquid are made of stainless steel or Viton.

Depending on the model and equipment, the matching measuring cell including holder and accessories are supplied. To expand an “analysette 22” NanoTec or MicroTec instrument for dry dispersion, the complete housing for fastening and automation of the liquid measuring cell is also required (included with 22.6700.00).

### Software for Particle Shape Recognition

The "analysette 22” NanoTec and MicroTec are the first instruments for determining particle size distribution in the world to offer an option for shape recognition based on laser diffraction.

Elongation ratios from 4.5 to 0.2 can be detected with the software for particle shape recognition. The use of a “back-propagation neural network” and an intelligent analysis provides information on the elongation ratios of the x50 value of the previously measured particle size distribution within minutes.

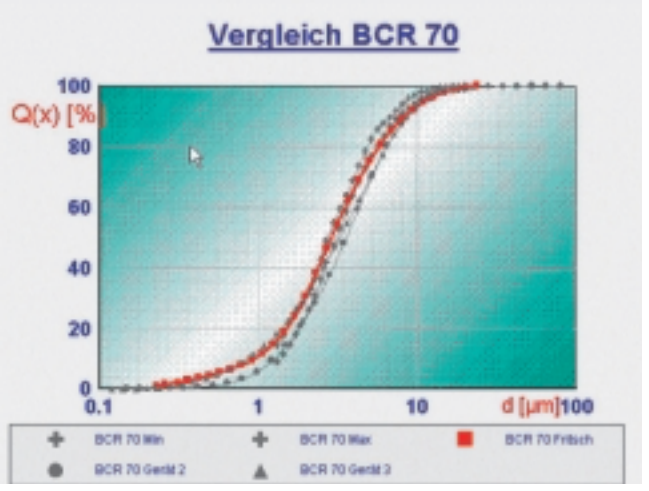
### Liquid mini-cell

When using the special holder with the mini-cell, 1 ml of suspension fluid is sufficient. Expensive, rare or hazardous samples to approximately 10 µm particle size can be measured in the mini-cell.

| Accessory | NanoTec Liquid | NanoTec Dry | MicroTec Liquid | MicroTec Dry | COMPACT |
|---|---|---|---|---|---|
| Liquid dispersing unit for small quantities 22.6900.00 | | | | | ● |
| Liquid dispersing unit for small quantities 22.6750.00 | ● | | ● | | |
| Liquid dispersing unit for small quantities 22.6700.00 | | ● | | ● | |
| Software for particle shape recognition 22.2910.00 | ● | | ● | | |
| Liquid mini-cell 22.6300.00 | | | | | ● |

# Laser-Particle-Sizer “analysette 22”

cumulated distribution undersize




## 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, EC or FRITSCH internal standards are available individually.

### Tests according to ISO 13320-1 Calibration Standards

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”.

| Article Number | Certificate |
|---|---|
| **96.0020.00** | Declaration of Repeatability ISO 13320-1 for “analysette 22” |
| **96.0030.00** | Declaration of Primary Validation ISO 13320-1 for “analysette 22” |
| **96.0040.00** | Declaration of Secondary Validation ISO 13320-1 for “analysette 22” |
| **96.0050.00** | Calibration Certificate for “analysette 22” |
| **96.0060.00** | IQ / OQ documentation for “analysette 22” |

### Calibration system

ASTM 1458 photo mask with holder for installation in the measuring instrument. Comparison with the standard leads to calibration.

### Exhaust system

A exhaust system is required for vacuuming of the sample when using the dry dispersing unit. FRITSCH offers a mechanism for this; but the user's own exhaust system may be used with the following data. MAK values must be observed in all cases.

| | |
|---|---|
| Power consumption | max. 1100 Watt |
| Air flow | 40 l/s |
| Vacuum | 23 kPa |
| Vacuum output | 270 W |
| Filter surface | 2400 cm² |
| Dust bag capacity | 9.0 l |

### Computer

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 that can be operated with a baud rate of up to 115k 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.

## 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) | 5 % | 5 % | 3 % |
| | Beam shape | Gauß | Gauß | Gauß |
| | Beam diameter | 0.3 – 8 mm | 0.3 – 8 mm | 0.2 – 5 mm |
| | 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 dispersing units | 8 $m^3$/h | 8 $m^3$/h | 8 $m^3$/h |
| | Ultrasonic 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 | 4096 by 12-Bit | 4096 by 12-Bit | 4096 by 12-Bit |
| Measure-ment | 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.<br>All models require an open RS232 port that can be operated with a baud rate of up to 115k as well as a typical, WINDOWS™-compatible printer for outputting the results.<br>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 | | | |

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

| ISO 13320-1 | Specification | NanoTec | MicroTec | COMPACT |
|---|---|---|---|---|
| Decon-volution | 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 – 1000 µm | 0.1 – 600 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 |
| Efficiency | Repeatability within instrument | $d_{50} \leq 1$ % | $d_{50} \leq 1$ % | $d_{50} \leq 2$ % |
| | Instrument to instrument | $d_{50} \leq 3$ % | $d_{50} \leq 3$ % | $d_{50} \leq 3$ % |
| | 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 % |
| | Presence of particles outside the measuring range | Lower limit cumulative | Lower limit cumulative | Lower limit cumulative |

## Service

As specialists in particle size analysis, we naturally provide more than just instruments; we also offer you an extensive range of services:

- Our in-house engineering lab and our agents will furnish you with test analysis free of charge and without obligation to ensure that you choose the right instrument.
- Our mobile lab or our customer consultant will be glad to come to your company to demonstrate an instrument on site or to discuss a specific application.
- We offer our current customers maintenance contracts and recalibration plus free support by telephone.

## Ordering Data

| Order No. | Description | For rapid fax quotation tick here! |
|---|---|---|
| | **Laser-Particle-Sizer “analysette 22”** | |
| 22.2000.00 | **“analysette 22” NanoTec**<br>**Combination instrument for liquid and dry measurement**<br>for 100-240 V/1~, 50-60 Hz | |
| 22.2800.00 | **Instrument for liquid measurement**<br>for 100-240 V/1~, 50-60 Hz | |
| 22.2900.00 | **Instrument for dry measurement**<br>for 100-240 V/1~, 50-60 Hz | |
| 22.4000.00 | **“analysette 22” MicroTec**<br>**Combination instrument for liquid and dry measurement**<br>for 100-240 V/1~, 50-60 Hz | |
| 22.4400.00 | **Instrument for liquid measurement**<br>for 100-240 V/1~, 50-60 Hz | |
| 22.4500.00 | **Instrument for dry measurement**<br>for 100-240 V/1~, 50-60 Hz | |
| 22.3000.00 | **“analysette 22” COMPACT**<br>**Combination instrument for liquid and dry measurement**<br>for 100-240 V/1~, 50-60 Hz | |
| 22.3500.00 | **Instrument for liquid measurement**<br>for 100-240 V/1~, 50-60 Hz | |
| 22.3600.00 | **Instrument for dry measurement**<br>for 100-240 V/1~, 50-60 Hz | |
| 22.6750.00 | **Accessories for Laser-Particle-Sizer “analysette 22” for the models «NanoTec», «MicroTec» and «COMPACT»**<br>**Liquid dispersing unit for small quantities**<br>**for model «NanoTec» and «MicroTec»**<br>(if the liquid dispersing unit is also available)<br>for 230 V/1~, 50-60 Hz | |
| 22.6700.00 | **Liquid dispersing unit for small quantities**<br>**for model «NanoTec» and «MicroTec»**<br>(if only the dry dispersing unit is available)<br>for 230 V/1~, 50-60 Hz | |
| 22.6900.00 | **Liquid dispersing unit for small quantities**<br>**for the model «COMPACT»**<br>for 230 V/1~, 50-60 Hz | |
| 22.6300.00 | **Liquid mini-cell**<br>**for the model «COMPACT»**<br>for measuring extremely small sample quantities, complete with holder,<br>for use in the liquid dispersing unit «COMPACT» | |
| 43.9030.00 | **Exhaust system**<br>with fine filter for dry measuring<br>for 230 V/1~, 50-60 Hz | |
| 22.2910.00 | **Software for particle shape recognition** (optional)<br>**for model «NanoTec» and «MircoTec»**<br>for liquid measurement | |
| 86.4630.00 | Transformer for voltage conversion 115 V/1~ to 230 V/1~ | |
| 20.6000.00 | Voltage stabilizer for 230 V/1~ | |
| 20.6100.00 | Voltage stabilizer for 115 V/1~ | |
| 85.2100.00 | **Calibration standards**<br>Fritsch-test powder F-500 (50 g) for liquid dispersion | |
| 85.2110.00 | Fritsch-test powder F-70 (150 g) for dry dispersion | |
| 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 | Monodisperse polystyrene particle 235 nm | |
| 85.2040.00 | Calibration system as per ASTM 1458 (photo mask with holder) | |
| 96.0020.00 | **Test according to ISO 13320-1 Calibration Standards**<br>Declaration of Repeatability ISO 13320-1 | |
| 96.0030.00 | Declaration of Primary Validation ISO 13320-1 | |
| 96.0040.00 | Declaration of Secondary Validation ISO 13320-1 | |
| 96.0050.00 | Calibration Certificate | |
| 96.0060.00 | IQ / OQ documentation | |
| 22.1100.00 | **Replacement parts**<br>Flow measuring cell complete for inserting into the liquid dispersion unit<br>«NanoTec» and «MicroTec» | |
| 22.4450.00 | Flow measuring cell complete for inserting into the liquid dispersion unit «COMPACT» | |
| 22.6200.00 | Liquid mini-cell for extremely small sample quantities for 22.6300.00 | |
| | Computer, colour inkjet printer and laser printer on request. | |
| | **Accessories for representative sample division**<br>**Rotary Cone Sample Divider “laborette 27”**<br>Detailed brochure available on request. | |

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