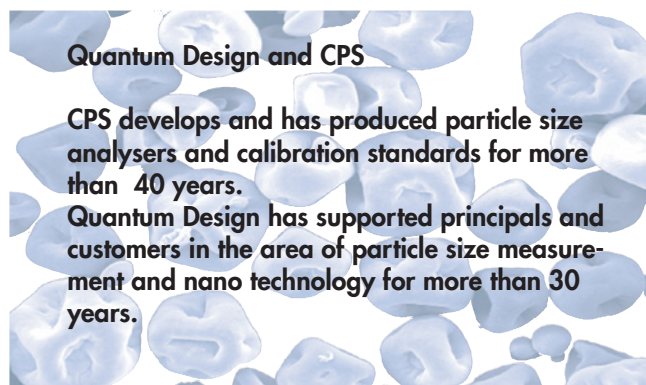


# CPS Disc Centrifuges

## A well proven method with modern technology

Particle size measurement  
in the size range 3 nm to 75  $\mu\text{m}$  with:

- Highest resolution
- Highest accuracy
- High sensitivity
- Wide dynamic range for all samples, dispersed in water or solvents

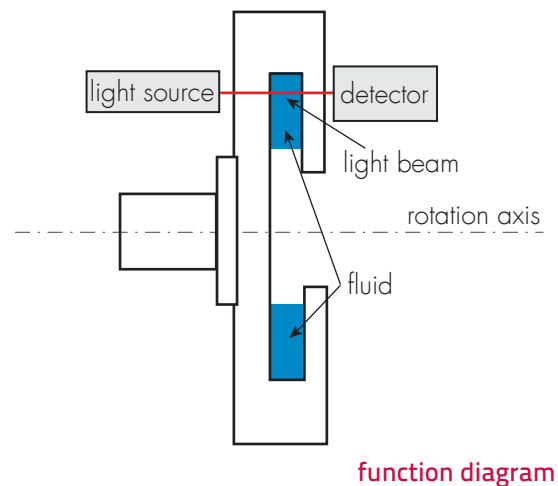


As the disc is spinning with a very high rotation speed, all particles are moving in a short time to the edge of the disc. Particles of the same size settle at the same speed, build up a thin band of particles and arrive at the detector at the same time. Large particles reach the detector earlier than the small particles. Particle families with nearly the same size reach the detector beam at noticeably different times and can be differentiated exactly. The beam of a 405 nm light source at the outer edge of the disc is absorbed if particles are detected.

The time the particles need to sediment from the center of the disc to the light source and the absorption of the light is transformed to the particle size distribution according to Stokes' Law and Mie Theory of Diffraction of Light.

How does a CPS Disc Centrifuge work?  
Some background information!

The CPS disc centrifuge measures particle size distributions using sedimentation, a well known and reliable method of particle size analysis. Particles settle in a fluid under a gravitational field according to Stokes Law. Sedimentation velocity increases as the square of the particle diameter, so particles that differ in size by only a few percent settle at significantly different rates. Large particles sediment faster than small particles. This is why sedimentation is the preferred method to measure the particle size with high resolution and accuracy. The disadvantage of sedimentation is that small particles with low density might take a long time to sediment. This disadvantage can be overcome by using the high centrifugal forces of the CPS particle size analyzer. All particles start to sediment at the same time in the center of the disc.



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### Advantages of a CPS Disc Centrifuge

#### Speed of Rotation

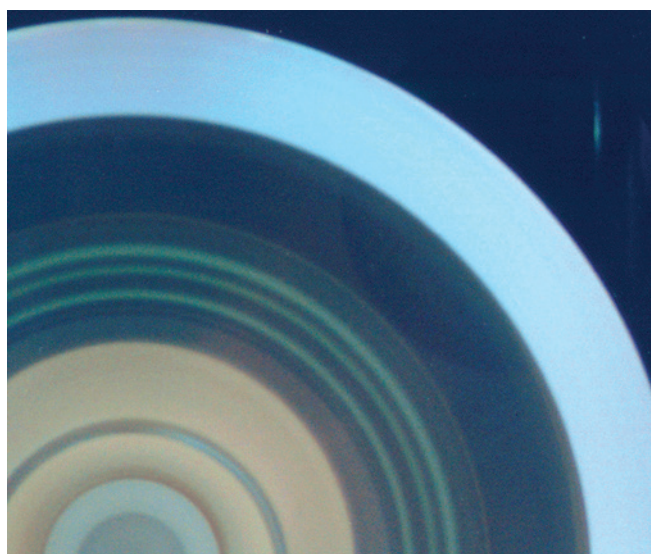
Depending on the CPS disc centrifuge model you are choosing you can run the system with a rotation speed of up to 24000 rotations per minute. The high rotation speed allows you to measure even very small and very light particles in a short measurement. This is how the CPS disc centrifuge overcomes the main disadvantage of old disc centrifuges, which very often needed several hours to measure particles with a size below 100 nm. The flexible adjustment of the rotation speed between 600 and 24000 rpm (DC 24000 UHR) allows for an exact size measurement of large and small particles.

#### Accuracy and Precision

All analyses are run against a known calibration standard, so high accuracy of our CPS disc centrifuge is assured. Calibration can be either external (calibration standard injected before the unknown), or internal (calibration standard mixed with the unknown). You can calibrate each run or up to each tenth run. Typical precision of reported sizes is about  $\pm 0.25\%$ . Replicate runs of the same sample produce virtually duplicate results in all cases. Two calibration standards are part of the standard delivery.

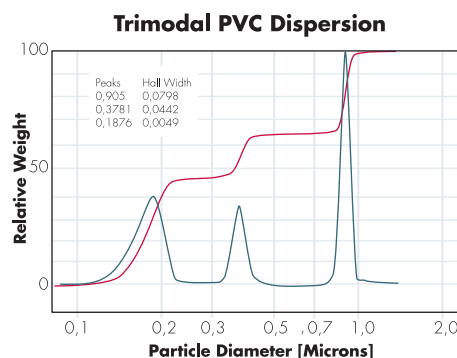
#### Resolution

The high resolution of our CPS disc centrifuge is unbeatable and allows you to detect unknown details of your samples which you have never seen before. Particle families which only differ by less than 1.5% in size can be recognized and differentiated. This is why other measurement methods only show one peak but the disc centrifuge results can even separate this and show clear differences.



#### Wide Dynamic Range

The CPS disc centrifuge allows the measurement of nano particles together with large particles with high precision in short measurement times. The CPS disc centrifuge has a practical dynamic range of up to 1000 using the unique Speed Ramping Disc.



#### Speed Ramping Disc

CPS has developed a special disc design that allows the centrifuge speed to be changed during an analysis. This is why large particles can be measured together with very small particles in one run, with shortest measurement time and highest accuracy possible. The centrifuge speed can be ramped up and down over the whole range of rotation speeds. This is why one can start a measurement with a small rotation speed in order to acquire high precision size measurements of large particles. Then the rotation speed will be ramped up and even very small particles can be measured in the same run with high accuracy but in a short time of measurement.

Using the unique Speed Ramping Disc the CPS disc centrifuge has a practical dynamic range of up to 1000.

#### Solvents

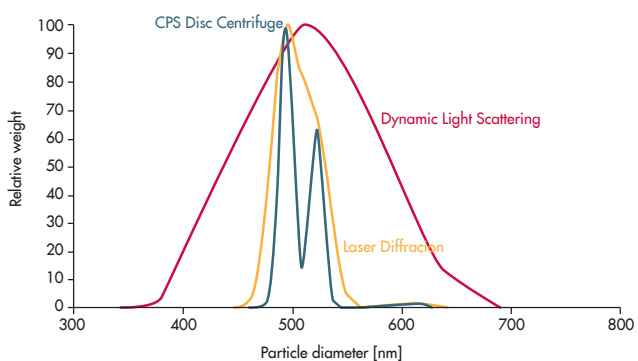
Our CPS Disc Centrifuge allows you to choose the dispersing agent which is best for your samples. Regardless whether you like to disperse your samples in water or whether you need to keep them in oil or solvents the CPS supports you with the right disc. Even aggressive solvents like DOP and MEK can be used for measurements. Even the standard disc available with the CPS system is able to withstand aggressive solvents.

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### Low Noise

The LED light source and detector and electronics are carefully designed to minimize noise. The disc is sealed off light to prevent interferences. The A/D conversion in the CPS Disc Centrifuge is better than 20 bits at 31 readings per second. Typical signal to noise ratio is in the range of ~50,000. Low noise in the signal gives very high sensitivity: the detectable weight for a narrow peak is usually  $10^{-6}$  gram. High resolution analysis of a few micrograms (active) weight is routine.



### Needles in the Haystack

When competing measuring techniques are used, small amounts of little particles usually either disappear in the peak of the more important particle fraction or are simply ignored in the analysis. Our disc centrifuge lets you also measure smaller parts of a particle family in a sample that is dominated by larger particles. Approximately 0.5% of the particles of the entire sample may be detected apart from the main particle group.

### Low Density Particles

CPS has developed a new differential technique (US Patent 5,786,898), where the sample is delivered to the bottom of the centrifuge chamber, rather than to the fluid surface. This method allows particles that are lower in density than the fluid to float toward the fluid surface. Even neutrally buoyant particles in water (density ~1.0 g/ml) can be measured by conducting the analysis in deuterium oxide (density 1.108 g/ml) instead of water. Many materials (like oil emulsions, wax emulsions, adhesive latexes, and liposomes) that were difficult or impossible to measure by differential sedimentation can now be measured easily and with very high resolution. The discs can be easily exchanged in one minute. The Low Density Feature can be integrated in the standard disc too.

### Designed for Reliability

The CPS disc centrifuge is designed for long life without maintenance.

### Worth knowing

Rotation speed	depending on the model 600 to 24000 rpm Variable adjustable
Measuring range	depending on the model, typically 100 $\mu$ m to 3 nm
Resolution	typically better 1.5%
Accuracy	typically 0.25%
Repeatability	typically 0.5%
Dynamic range	1.000

### Chemical Applications

- Polymer latexes and emulsions
- Fillers ( $\text{CaCO}_3$ , clay, barites, etc.)
- $\text{SiO}_2$  dispersions
- Abrasives (of all types)
- Impact modifier particles

### Pharmaceutical & Biological Applications

- Virus particles/virus-like particles
- Cells (culture) and cell fragments
- Protein clusters
- Liposomes
- Particles in diagnostic tests
- Micro-encapsulated drugs



### Printing and painting

- Pigments - water and oil based
- Printer/copier toner powders
- Inkjet inks
- Carbon black
- Microdiamonds
- Magnetic iron oxide

### Accessories

- Low density disc
- Speed ramping disc
- Automatic gradient builder
- Automatic sample injector
- Calibration standards

All disc options can be combined and can be implemented in only one disc.

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### The CPS Ssoftware

<b>Typical parameters</b>	To prepare the measurement you define procedures. They can be easily adapted for different kinds of samples and can be changed by a mouse click.
<b>Multitasking</b>	While one measurement is running, you can retrieve, edit or print the data acquired before.
<b>Results</b>	Will be displayed as graphs and tables.
<b>Graphs</b>	Weight, surface, number, and absorption distributions Logarithmic or linear, with adjustable scaling. With comments, graphical overlays of up to 20 distributions, subtraction graphs.  Create averages of multiple distributions.
<b>Tables</b>	Ranges customized or standard, e.g. undersize, oversize, total weight, total number...
<b>Export</b>	Export of raw data as CSV file is possible
<b>Control</b>	The CPS Disc Centrifuge is completely controlled by the operation software.
<b>Delivey</b>	The CPS Disc centrifuges are delivered completely, including hard- and software, monitor, keyboard and mouse. No need for an additional computer.
<b>License</b>	The software can be copied without limitation. Measurements and analysis can be performed on different PCs.

### Our models

- DC 12000 with 12000 rotations per minute maximal (recommended for measurements of particles down to 40 nm).
- DC 18000 with 18000 rotations per minute maximal (recommended for measurements of particles down to 20 nm).
- DC 24000 UHR with 24000 rotations per minute maximal (recommended for measurements of particles down to 3 nm, particles of high density can even be analyzed at 3 to 5 nm size).

### Calibration standards

CPS also produces calibration standards with narrow distribution, dispersed in water or solvents, with solids content of 0,3% to 0,5%.

Various standards of PVC, PS and PB in water or mono-crystalline diamond in solvents are available.

