The higher resolution

for particle sizing and counting

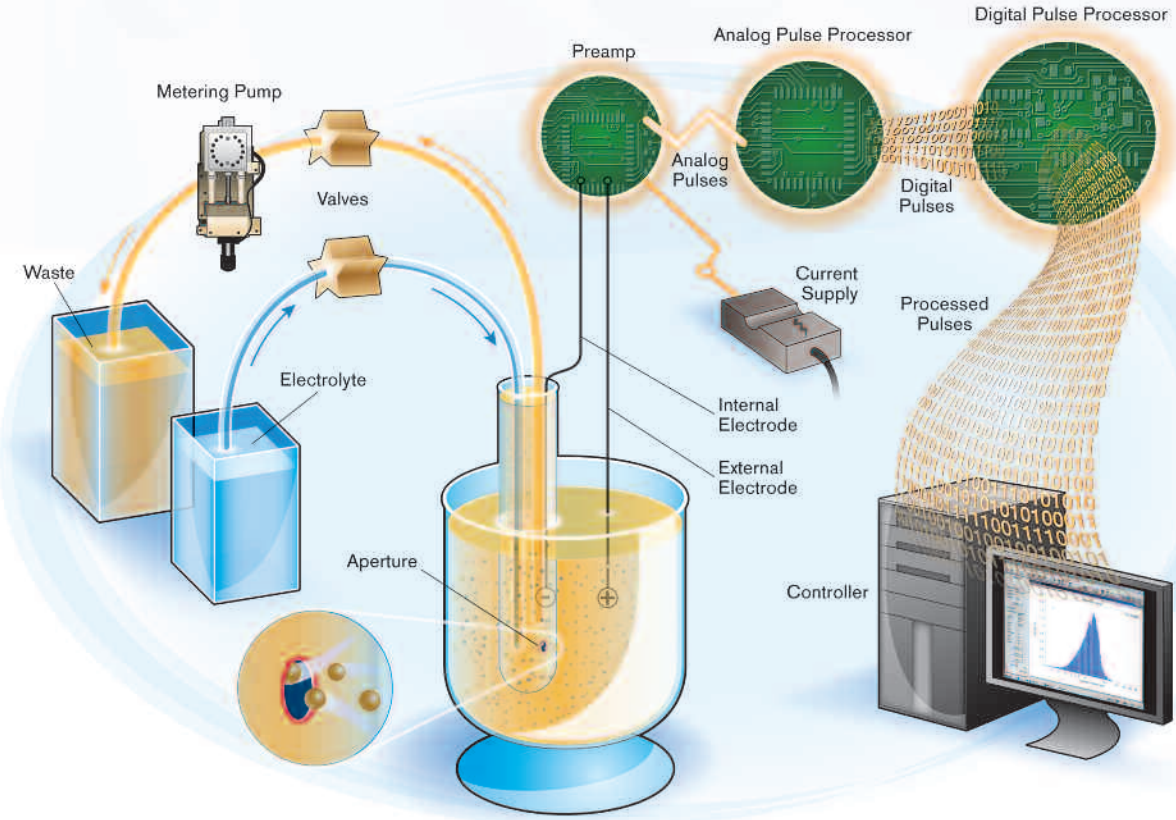
Multisizer 4 COULTER COUNTER

Particle Characterization
Proteomics
Genomics
Cell Analysis
Centrifugation
Lab Tools
Bioseparation
Lab Automation

Multisizer 4 COULTER COUNTER

Discover the most versatile and accurate particle sizing and counting analyzer on the market. Using the Coulter Principle, also known as Electrical Sensing Zone (ESZ), the **Multisizer 4 COULTER COUNTER** provides size distribution in number, volume and surface area in one measurement, with an overall sizing range of 0.4 µm to 1600 µm. Its response is unaffected by particle color, shape, composition or refractive index.

The Coulter Principle is the leading technology in high resolution and accuracy and it is enhanced even further in the Multisizer 4 by using a Digital Pulse Processor (DPP). DPP provides ultra-high resolution, multiple channel analysis and accuracy that is unattainable by other technologies. It all makes the Multisizer 4 indispensable for any research project involving sizing and/or counting. An equally powerful tool for quality control, the Multisizer 4 provides analysts with an easy-to-use system that is so technologically advanced, it can solve most particle sizing problems.



The Coulter Principle Applied in the Multisizer 4

The Coulter Principle

Particles suspended in a weak electrolyte solution are drawn through a small aperture separating two electrodes through which an electric current flows. The voltage applied across the aperture creates a "sensing zone". As each particle passes through the aperture (or "sensing zone") it displaces its own volume of conducting liquid, momentarily increasing the impedance of the aperture.

This change in impedance produces a tiny but proportional current flow into an amplifier that converts the current fluctuation into a voltage pulse large enough to measure accurately. The Coulter Principle states that the amplitude of this pulse is directly proportional to the volume of the particle that produced it. Scaling these pulse heights in volume units enables a size distribution to be acquired and displayed. In addition, if a metering device is used to draw a known volume of the particle suspension through the aperture, a count of the number of pulses will yield the concentration of particles in the sample.

The Coulter Principle Goes Digital

While retaining and enhancing the analog circuits developed and refined by Coulter over many years – and the Digital Pulse Processor (DPP) used for the first time in the Multisizer 3 – the new Multisizer 4 incorporates the latest advances in both analog and digital circuits. High-speed digitalization of the signal enables the use of multiple parameters for more accurate particle characterization. Plus the possibility of dynamic size measurement is a reality on the Multisizer 4. The measurement data for each particle is analyzed and stored. The data can be analyzed and formatted in numerous ways, or stored and re-analyzed at a later date – no need to analyze the sample again.

Proven Technology

- More than half a century of experience counting and sizing particles and cells
- More than 6,000 documented references using the Coulter Principle and nine approved ASTM methods
- Technology defined by the International Standard ISO 13319
- Accurate sizing, counting and high resolution technology preferred by the industry for particle counting and size distribution
- It provides size, based on direct measurement of a real parameter of a particle – its volume. Color or refractive index does not affect results
- Capable of counting and sizing particles at concentration levels not detected by other technologies
- Dynamic size measurement. Pulse time stamp allows size change measurement in real time

Superior Instrument Design

- Ease-of-use. Instrument operation is completely controlled from the computer. Intuitive software with wizards are ideal for beginners, while simple menus assist experienced operators
- Volumetric metering pump is compatible with both aqueous and organic fluids
- Extended dynamic range
- Improved performance in dusty environments
- Sample management system using Smart Technology provides a great level of consistency for running the analyses
- EZAccess fluid management system
- Electronic aperture blockage detection
- Automatic startup user-selectable routine

Quality Assurance Friendly System

- User-defined Standard Operation Procedure
- Multiple security levels
- Software enables 21 CFR Part 11 compliance
- Powerful and flexible software allows the processing and presentation of data to fit all needs, including industrial applications, biological applications, academic applications, research and quality control
- Automated calibration and calibration verification ensures reliable results for both size and counts
- V-Check validation package offers a comprehensive solution for today's quality assurance requirements
- Certification program to ensure instrument performance

Digital Pulse Processor (DPP)

In a traditional counter, analog circuits are designed and constructed to perform a set number of functions in real time. The definition of “pulse” needs to be set in advance so that measurements can be made while particles travel through the aperture. Each pulse is analyzed; its parameters are stored, then “forgotten” – to be replaced by the next pulse arriving in the analyzer. This type of device undoubtedly operates at amazingly high speed, and for simple counting or sizing purposes, it is often adequate. However, for advanced applications of the Coulter Principle, digital technology has obvious advantages.

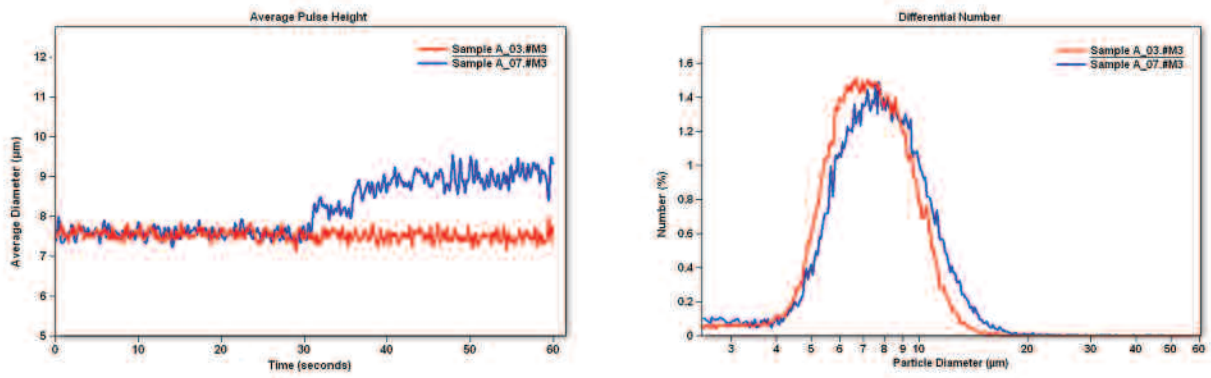
The proprietary technology of digital pulse processing (DPP) employed in the Multisizer 4 involves sampling analog signals at a rate of millions of times per second. The digital values come from an analog-to-digital converter (ADC), which receives the analog output from the signal amplifier. The accuracy and resolution of the digital values depend on the fidelity of the amplifier and the number of bit of the ADC. Differently from analog instruments that capture and report a single value for each pulse, e.g. the peak height, the DPP yields a stream of values with magnitudes that rise and fall as particles pass through the aperture. Instead of a single number, multiple parameters that describe the entire pulse are saved.

The DPP affords maximum flexibility in analyzing the data. The data no longer must be processed and compressed on the fly. Instead, the pulse data generated by each particle is stored and saved without loss of information. They can be “rerun” any number of times using different analysis parameters. Furthermore, the pulses can be re-examined at any time after analysis, using software alone without the need to change hardware.

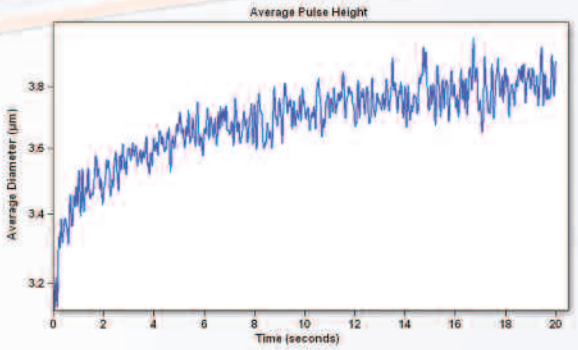
In analog systems the number of channels is set in a chosen range of size for each measurement. This means that once the data has been obtained, the resolution is fixed. Increasing the resolution in a part of that size range can only be done by re-measuring the sample under a higher resolution setting. With the DPP, the data is always at a higher resolution. The grouping of data into channels is entirely for convenience or display. Channels are defined solely by the software algorithm and can be changed at any time – even after analysis. The ability to reanalyze the data in a narrower size range at a higher resolution is one of the most useful features of the DPP.

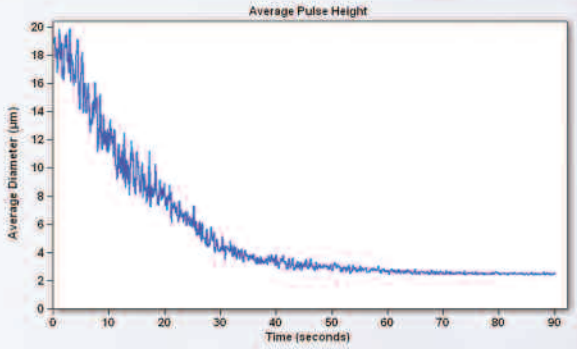
Detecting Size Changes Over the Length of the Sample Analysis

Analog instruments are only capable of offering the size distribution of the particles throughout the measurement. As a result, the size distribution is satisfactory only in cases where the size of the particles and the sample preparation are stable over the length of analysis time. In cases where particles could change during the length of the analysis (e.g. dissolution, aglomeration), the size information from an analog instrument could be erroneous.



These two figures show the overlay of the pulse data from two analyses of the same toner sample. Looking only at the size distribution, it is impossible to detect any problem during the analyses.





Dynamic Size Measurement

Dynamic Size Measurement

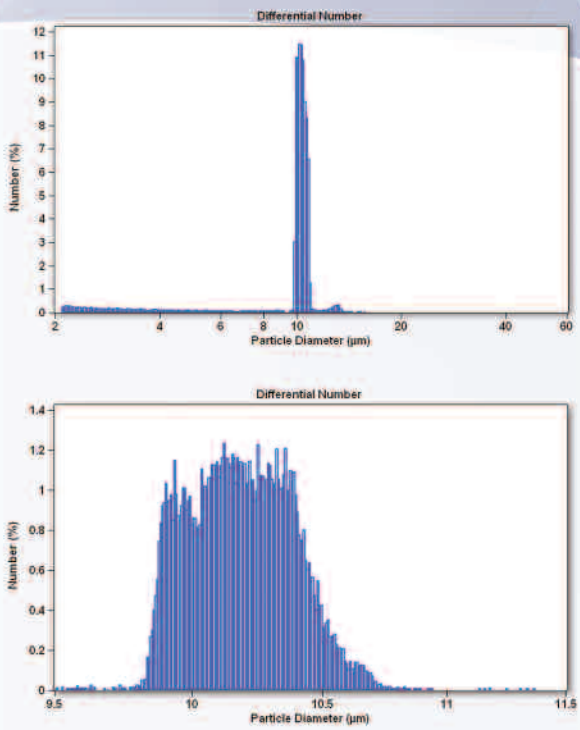
Time stamping the pulses now makes it possible to measure dynamic size changes of cells in real time in a single sample analysis.

The Higher Resolution for Size Distribution Analysis

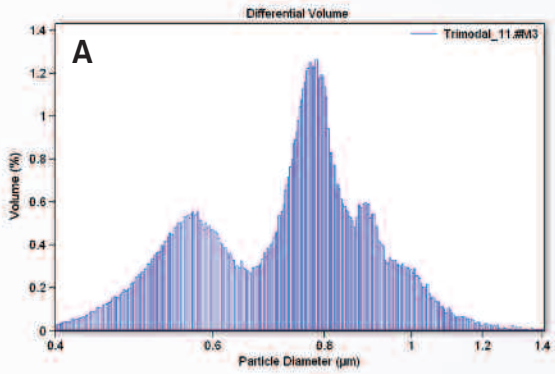
The reprocessing of the stored pulse data enables users to change the size range for the results and obtain detailed information for the size distribution. Instead of just "zooming in" to enlarge a portion of the size distribution, the pulse data is processed and re-analyzed for the selected size range. This results in enhanced resolution of the size distribution.

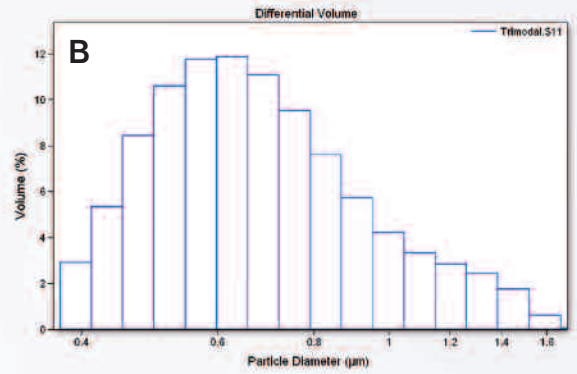
The figures to the right show a size distribution obtained using a 100 µm aperture and reprocessed for a narrower range to enhance the resolution of the distribution. In this case the original range is 2 to 60 µm and is recalculated from 9.5 to 11.5 µm

Resolution is the capability to differentiate between different particle sizes. Higher resolution means more detailed size information. The Multisizer 4 provides a higher resolution for particle size distribution by measuring a real parameter of a particle – its volume. It can discriminate between two similar-sized particles better than other instruments. The two graphs at the bottom show how particles that are distributed under different size categories by the Multisizer 4 might be placed under one size category by other instruments or technologies. Therefore, if your particles or cells change in size, they may not be detected by another instrument.



Reprocessing of pulse data to achieve higher resolution





Analysis of a narrow size trimodal sample using the Multisizer 4 (A) and a lower resolution instrument (B).

Smart Technology

The Smart Technology designed into the Multisizer 4 makes it the most reliable and easy-to-use Coulter Counter instrument on the market today. Its design ensures the repeatability and uniformity of analysis conditions for all samples and therefore ensures reliable results. EZAccess, a new reagents management system, provides easy handling of reagents and waste on the Multisizer 4.

EZAccess Reagents Management System

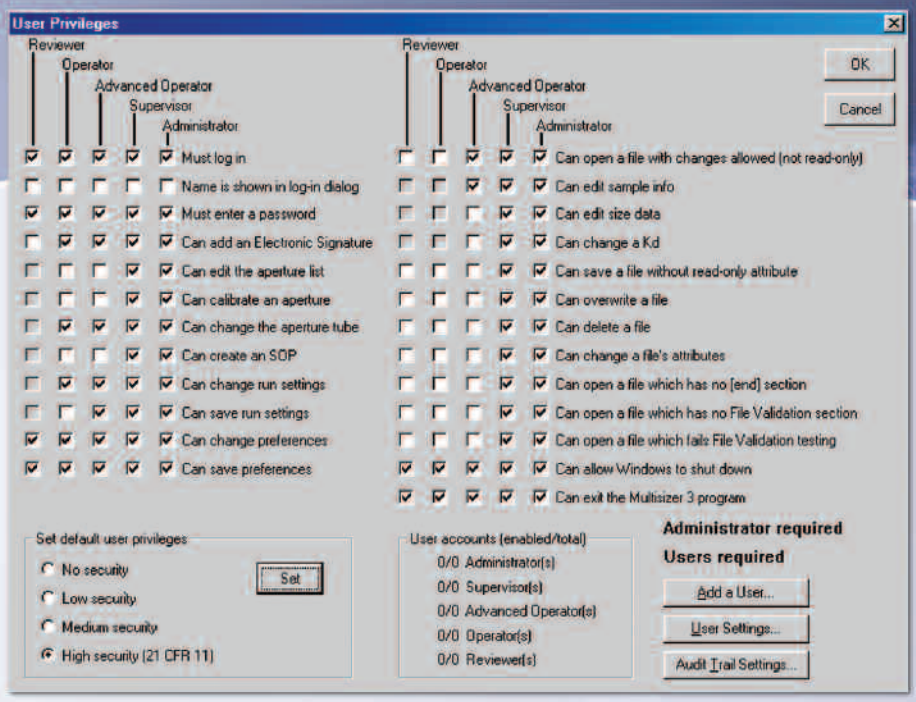
New sample compartment and beaker platform ensure consistency for analysis conditions.

Barcode reader

Regulatory Compliance with 21 CFR Part 11

The Electronic Records and Electronic Signatures Rule (21 CFR Part 11) was established by the FDA to define the requirements for submitting documentation in electronic form and the criteria for approved electronic signatures. This rule, in effect since August 20, 1997, does not stand in isolation; it defines the standards by which an organization can use electronic records to meet its record-keeping requirements. Organizations that choose to use electronic records must comply with 21 CFR Part 11. It is intended to improve an organization's quality control while preserving the FDA's charter to protect the public. Since analytical instrument systems like the Multisizer 4 generate electronic records, these systems must comply with the Electronic Records Rule.

By selecting the 21 CFR Part 11 option in the software, the system automatically reconfigures to comply with these regulations. In addition to 21 CFR Part 11, the software offers other security levels you may customize to your individual needs.

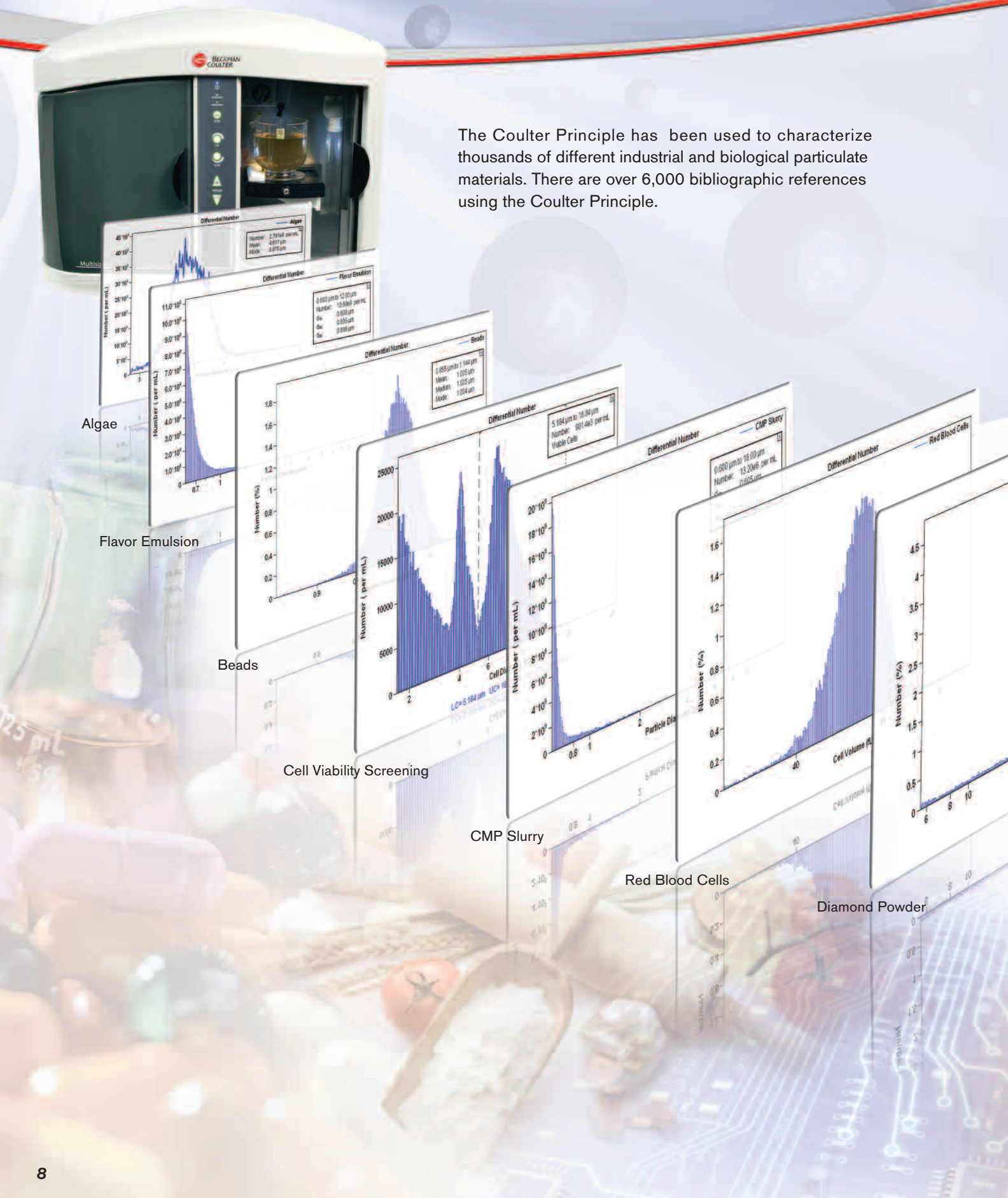


V-Check Program

The V-Check Program is a comprehensive package that covers appropriate aspects of a product's life cycle, from instrument development to verification (e.g. SQ, DQ, IQ, OQ). The V-Check Program contains the necessary documentation for instrument validation. It consists of a number of functional inter-linked components, which have been designed to give you assurance that the product is fit for its designed purpose and will deliver consistent performance. Where other instrument manufacturers leave off, Beckman Coulter and its V-Check Program assist with ongoing quality checks of the instrument – demonstrating the value of a manufacturer who not only understands your needs, but is also willing to develop a partnership for the future.

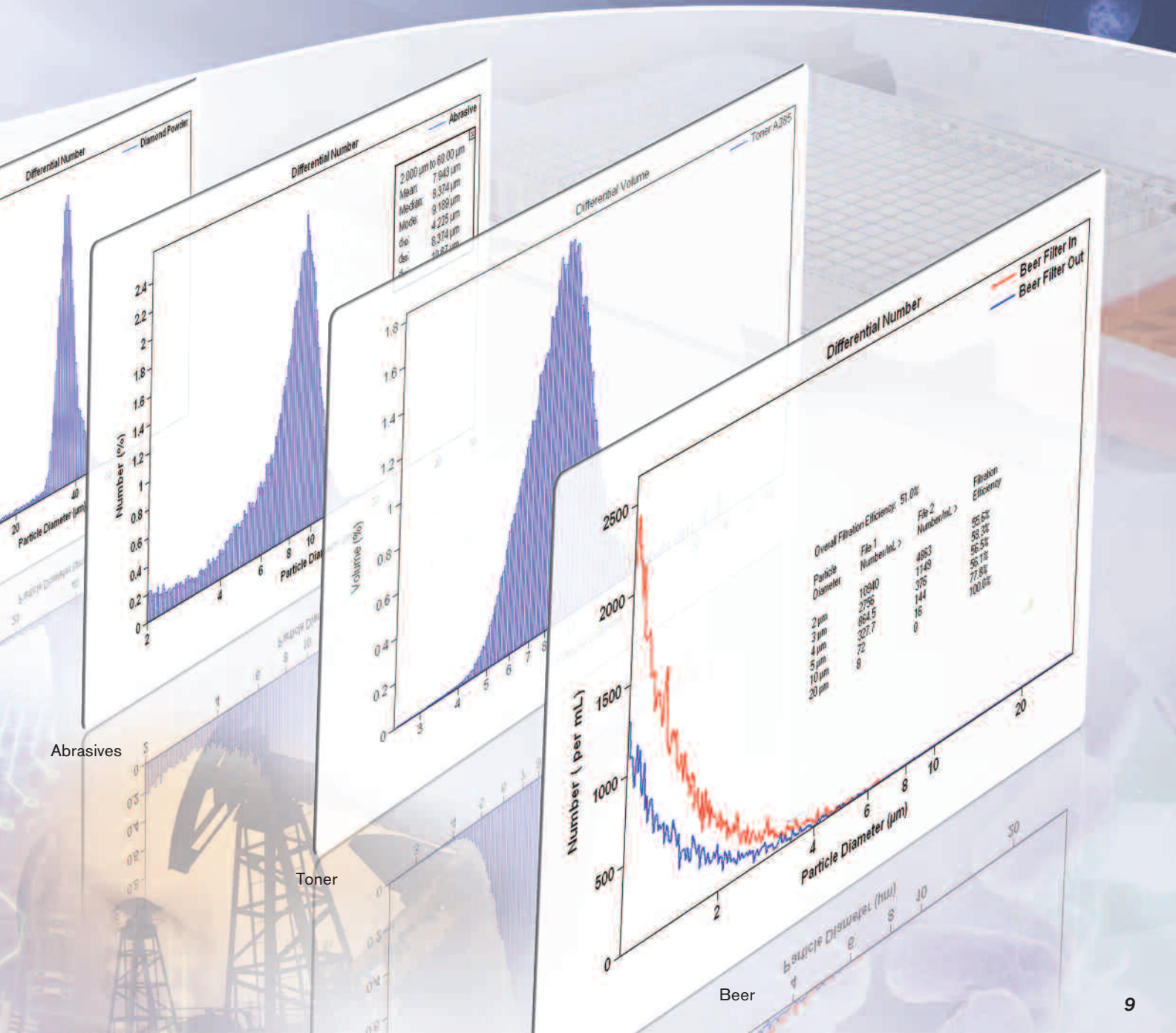
Applications

The Coulter Principle has been used to characterize thousands of different industrial and biological particulate materials. There are over 6,000 bibliographic references using the Coulter Principle.



Industries and Applications

- Abrasives
- Air Contamination
- Bacteria
- Beverages
- Biomedical
- Biotechnology
- Construction Industry
- Cell Biology
- Ceramics
- Chromatographic Material
- Clays
- Cosmetics
- Crystals
- CMP
- Environmental
- Emulsion
- Electronic Industry
- Filtration & Filter Efficiency
- Food Industry
- Fish Farming
- Fuel
- Hydraulic Fluids
- Lubricants
- Metals
- Marine Biology
- Microspheres
- Paints & Pigments
- Paper Industry
- Pharmaceuticals
- Petrochemical Industry
- Pesticides
- Photo Industry
- Oils
- Toners
- Vaccines
- Water Contamination

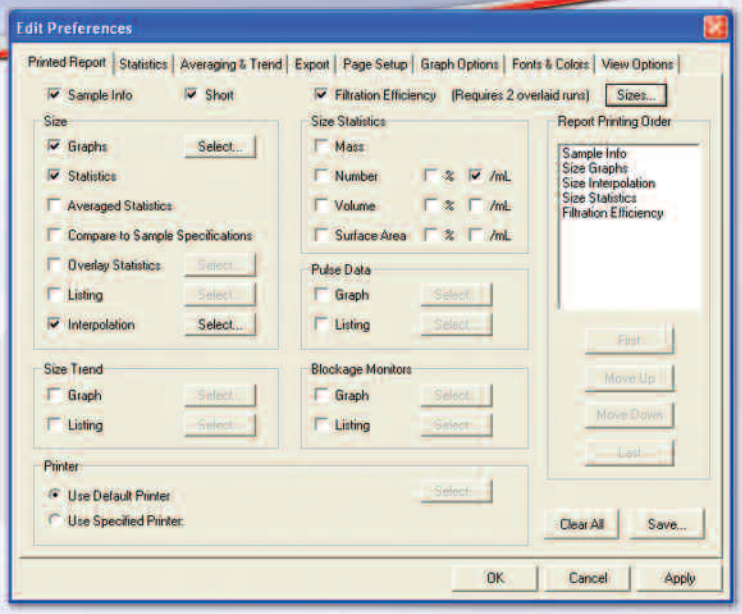


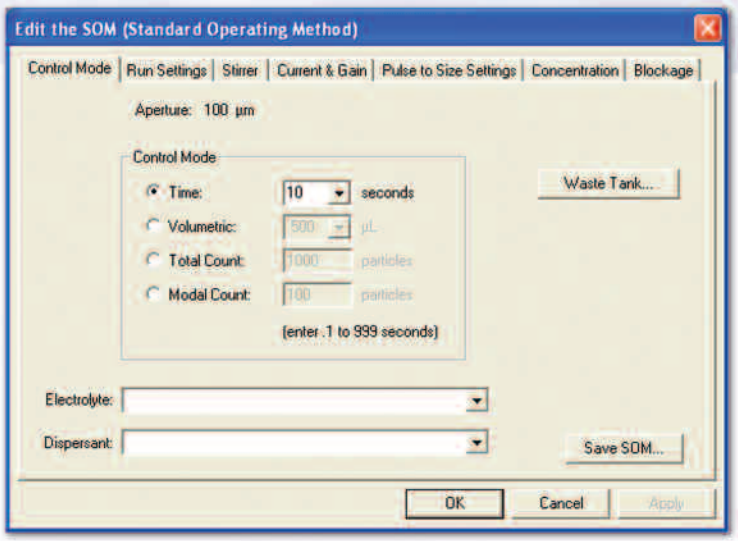
Software

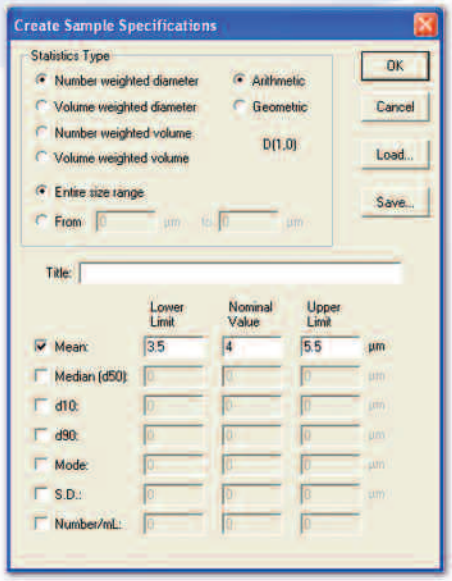
User-Friendly and Intuitive Software

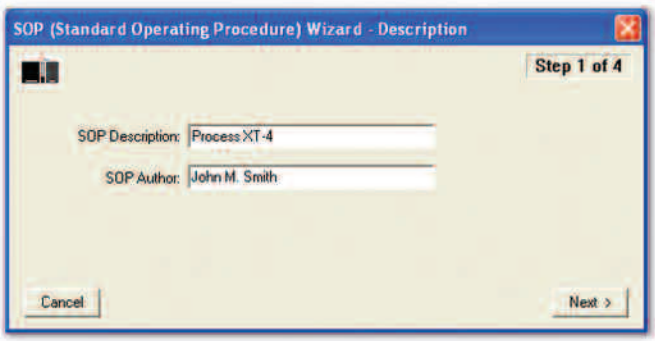
The Multisizer 4 software is easy to use for both beginners and experienced users alike. For beginners, the setup of test procedures and the reporting of the results is made simple through wizards included in the software. For experienced users, the Multisizer 4 software provides user-friendly dialog boxes with quick access to all settings.

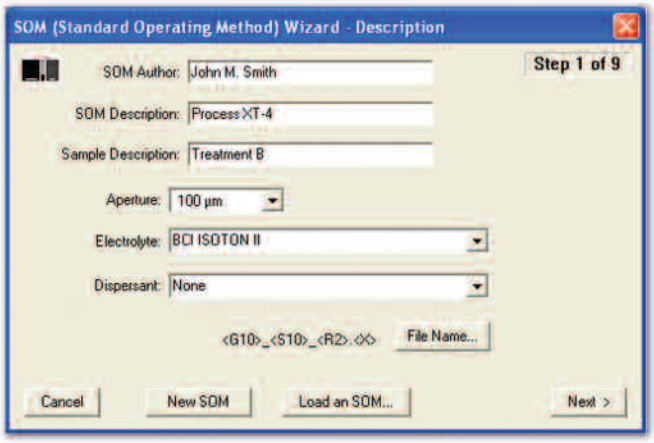
"Create Sample Specifications" is a new feature that allows users to set their desired specifications for a sample. Results out of specifications will be highlighted by the software.

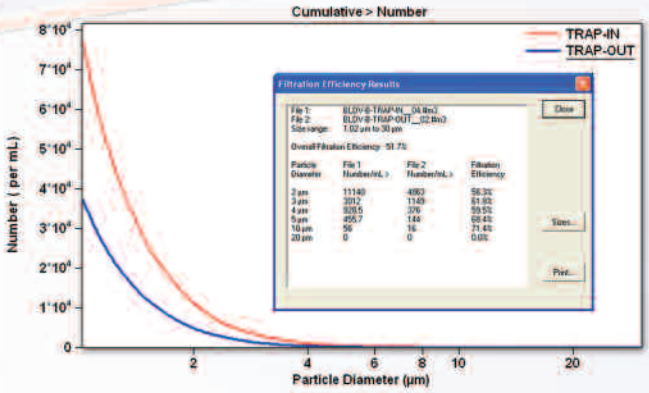




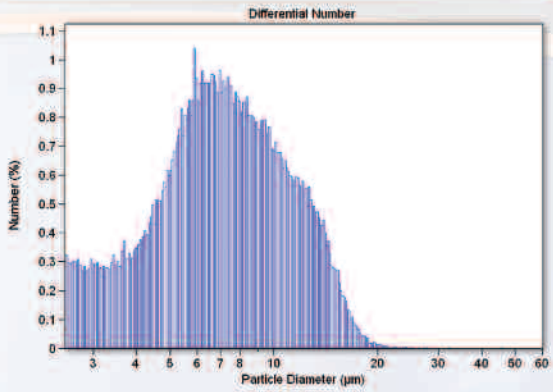




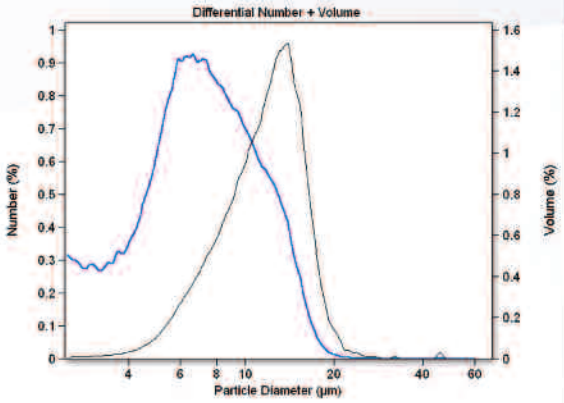




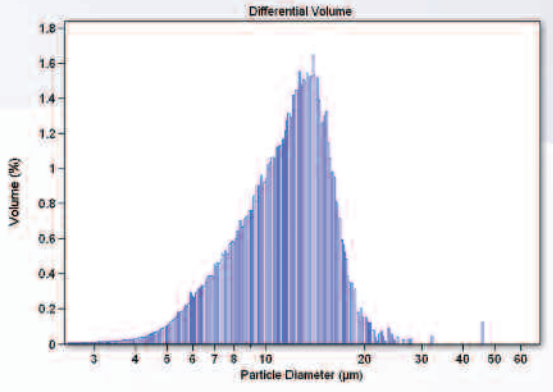
Automated Determination of Filtration Efficiency



Number Size Distribution



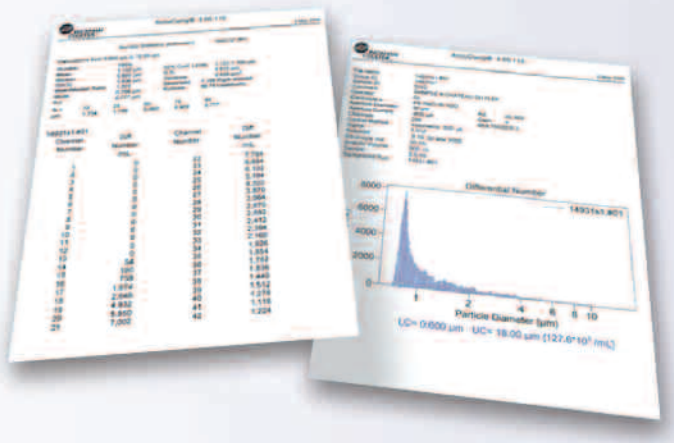
Number + Volume Size Distribution

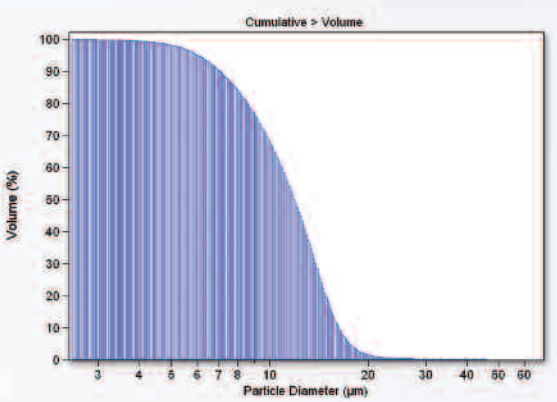


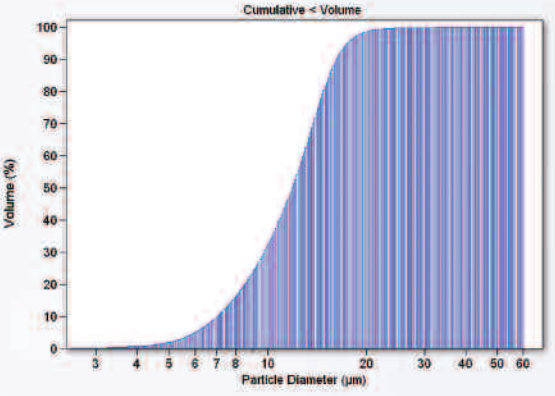
Volume Size Distribution

Comprehensive Software

The software provides size and pulse data in numerous formats. A broad range of statistical parameters are automatically calculated by the Multisizer software. All the results are presented in a customized report.







Cumulative Distributions

Multisizer 4 COULTER COUNTER Specifications

Overall Particle Size Range

0.4 µm to 1600 µm in diameter. 0.033 fL to 2.145 x 10^9 fL or µm³ in volume

Aperture (Nominal Diameter, µm)	Range (µm)			Range (µm³ or fL)		
	Total	Standard	Extended	Total	Standard	Extended
20†	0.4-16	0.4-12	12-16	0.034 – 2.14 x 10^3	0.034 – 905	905 – 2.14 x 10^3
30†	0.6-24	0.6-18	18-24	0.113 – 7.24 x 10^3	0.113 – 3.05 x 10^3	3.05 x 10^3 – 7.24 x 10^3
50††	1-40	1-30	30-40	0.524 – 33.5 x 10^3	0.524 – 14.1 x 10^3	14.1 x 10^3 – 33.5 x 10^3
70††	1.4-56	1.4-42	42-56	1.44 – 92.0 x 10^3	1.44 – 38.8 x 10^3	38.8 x 10^3 – 92.0 x 10^3
100††	2-80	2-60	60-80	4.19 – 268 x 10^3	4.19 – 113 x 10^3	113 x 10^3 – 268 x 10^3
140††	2.8-112	2.8-84	84-112	11.5 – 736 x 10^3	11.5 – 310 x 10^3	310 x 10^3 – 736 x 10^3
200††	4-160	4-120	120-160	33.5 – 2.14 x 10^6	33.5 – 905 x 10^3	905 x 10^3 – 2.14 x 10^6
280	5.6-224	5.6-168	168-224	92.0 – 5.88 x 10^6	92.0 – 2.48 x 10^6	2.48 x 10^6 – 5.88 x 10^6
400	8-320	8-240	240-320	268 – 17.2 x 10^6	268 – 7.24 x 10^6	7.24 x 10^6 – 17.2 x 10^6
560	11.2-448	11.2-336	336-448	736 – 47.1 x 10^6	736 – 19.9 x 10^6	19.9 x 10^6 – 47.1 x 10^6
1000†††	20-800	20-600	600-800	4189 – 268 x 10^6	4189 – 113 x 10^6	113.1 x 10^6 – 268 x 10^6
2000†††	200-1600	200-1200	1200-1600	4.19 x 10^6 – 2.14 x 10^9	4.19 x 10^6 – 905 x 10^6	905 x 10^6 – 2.14 x 10^9

† Range depends upon system cleanliness and environmental electromagnetic noise †† Available in high resolution apertures ††† Range depends upon sample density

Aperture Diameter	20 µm to 2000 µm apertures (nominal diameters)
Aperture Dynamic Range	Standard 1:30 (by diameter) Total 1:40 (by diameter) Standard 1:27,000 (by volume) Total 1:64,000 (by volume)
Aperture Range	Total range: 2% to 80% of aperture diameter. Standard Range: 2% to 60% of aperture diameter. Extended Range: 60% to 80% of aperture diameter
Resolution	User selectable
Number of Channels	Pulse data is digitized and can be processed to achieve up to 400 size channels for a selected pulse range. Number of channels and range can be reprocessed as necessary
Electrolyte Solutions	All aqueous and non-aqueous electrolyte solutions recommended for use with aperture technology will be suitable for use with the Multisizer 4. Electrolytes should be compatible with glass, fluoropolymers, fluoroelastomers and stainless steel
Digital Pulse Processor	Proprietary high-speed digitalization of the signal
Pulse Data	Time stamped pulses up to 525,000 per single analysis
Size Distribution Data	Size distribution by diameter, volume and area for number, number%, number/ml, volume, volume%, volume/ml, surface area, surface area% and surface area/ml
Pulse Distribution Data	Pulse distribution by time, sequence and width for pulse height diameter, pulse height volume, pulse height volt, pulse width, pulse area, average pulse height diameter, average pulse height volume and average pulse width. Number distribution by width
Linearity	± 1% for diameter ± 3% for volume
Aperture Current Range	30 µA - 6000 µA in 0.2 µA steps
Aperture Current Accuracy	± 0.4% of setting
Polarity Error	Less than 0.5%
Time Mode	0.1 to 999 seconds, selectable in 10 ms increments. Typically, time analysis is 10 to 90 seconds
Total Count Mode	50 to 500,000 counts
Modal Count Mode	10 to 100,000 counts
Volumetric Mode	Continuously selectable from 50 µl to 2000 µl
Metering System	Mercury-free, wide range metering pump
Volumetric Pump Accuracy	Better than 99.5%
Regulatory Compliance	The software enables 21 CFR Part 11 compliance
Dimensions and Weight	Weight, dimensions and power (excluding computer) Unpacked weight: 45 kg (99 lb) Width: 64 cm (25 in) Depth: 61 cm (24 in) Height: 51 cm (20 in) Input voltage within set ranges: 100 - 120 VAC; 230 - 240 VAC ± 10%; single phase
Supply Frequency	47 to 63 Hz inclusive
Power	Less than 55 volt-amps (watts)
Fuse Types	250 V, IEC (5x20 mm), Time delay (TD), 2.0 A
Environmental Conditions	a) This instrument is safe for indoor use only. b) Installation category: 11 c) Pollution degree: 1
Operating Temperature	5°C to 40°C
Relative Humidity	10% to 80% without condensation
Altitude	Up to 2000 m (6560 ft)

For more information on our Particle Characterization products, please visit us at www.particle.com

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