Vision
A N A L Y T I C A L

Pi Sentinel PRO
Dynamic Image Analyzer for
Particle Shape Analysis

SentinelPro: Dynamic Image Analyzer for Particle Shape Analysis

The Pi Sentinel PRO is a class-leading dynamic image analyzer that is ideal for applications where particle shape, not just the particle size, may be critical information for predicting raw material quality and to maintain a high level of process control.

Particle morphology provides important information regarding the physical shape properties of your sample. It has been shown that shape can affect flowability, dispersion, packing density, segregation, aggregate formation, and microstructure character.

The fully automated Pi Sentinel PRO is a well-suited research grade instrument or for use in a full production environment where speed, accuracy, and ease of use with its Pass/Fail shape control limits feature can be utilized.

Pi Sentinel PRO Design Benefits

• High-Speed, 127 frames per second rated digital camera with up to 5 Mpix resolution, captures live images of thousands of particles

• Over 30 shape parameters are recorded, including circularity, ellipticity, opacity, mean diameter, smoothness, aspect ratio, fiber length and many more

• All analyzed particles have thumbnail images saved for post-run viewing and shape analysis, both in grey scale and binary views

• Ability to compare different analyses via histogram overlays for all analyzed shape parameters

• Scatter plot correlates two shape measurements and can be utilized as a process quality control criterion as an at-line application within unit operations

• Unique and powerful software permits the use to simplify data processing to a pass/fail reporting or choose to extend data analysis to a full suite of post processing image and shape analysis reports

• Multi-Run sample trending: Statistical Process Control capability and ability to track shape changes over user defined time intervals

• Instrument Qualification feature includes NIST standards and detailed Quality Assurance documentation

• Particle Concentration Correlation: adjust concentration reporting to correlate to traceable reference concentration standards

Principles of Operation

Particles are suspended in a flowing stream, backlit by a high speed, Xeon strobe and then photographed by a high-resolution digital camera at up to 127 frames per second. Individual particle images are viewed directly and captured as a video file for post run processing.

The dynamic turbulent flow path provides a three-dimensional, random orientation, direct view of the moving particles within the sensing zone. Dynamic imaging provides greater particle detail regarding convexity, sphericity, symmetry and aspect ratio when compared to static imaging.

8.23

Aspect Ratio

2.96 micrometers

Size

1

2

3   4

Polygon Order

Smoothness

7 micrometers
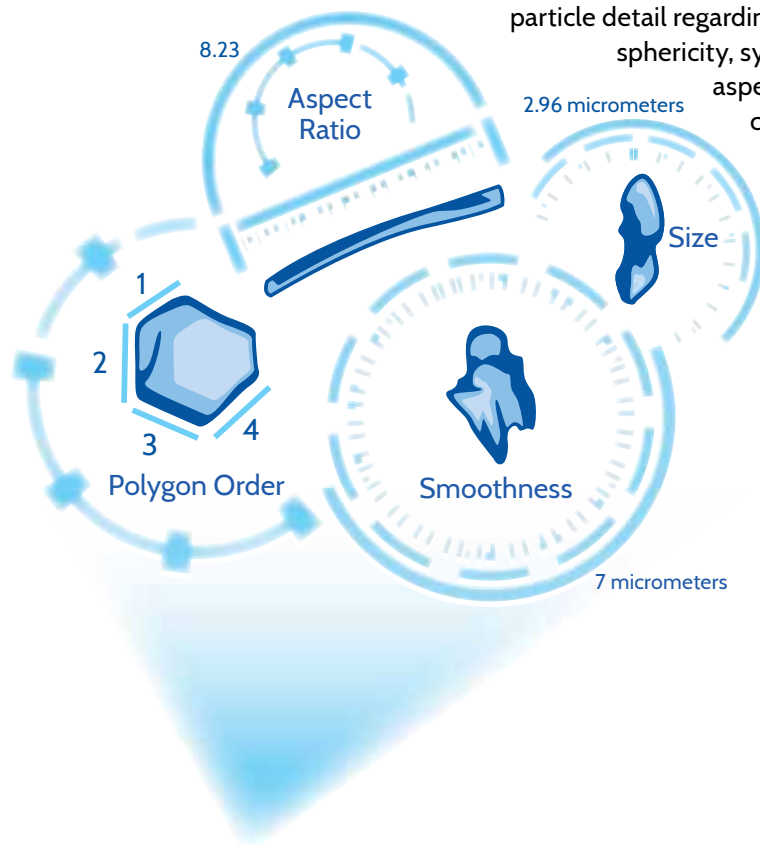
Dynamic Image Analysis

A recirculating liquid system transports the suspended sample through the analysis cell where a digital camera takes an image of the particles, converts the image to a digital format, and sends the information to the software for final analysis in real time.

Image Recorded

Digital Camera

Light Source
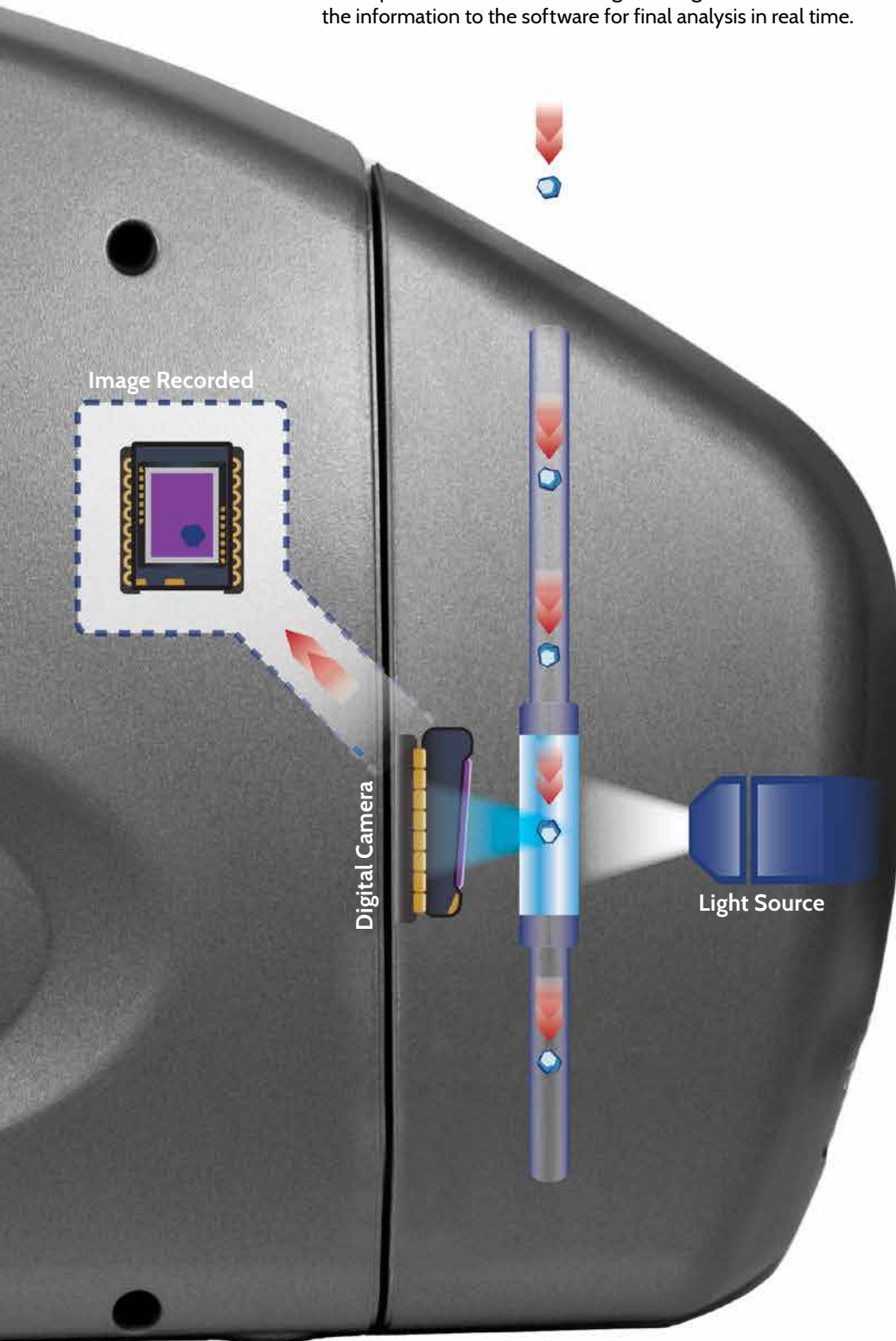
Shape Model Descriptions

Circle Models
- Perimeter circularity
- Equivalent circular area diameter
- Equivalent circular perimeter diameter
- Bounding circle diameter
- Mean radius diameter
- Circularity
- Smoothness
- Compactness

Ellipse Models
- Equivalent elliptical area, width, length
- Bounding ellipse width, length
- Elliptical aspect ratio
- Ellipticity

Rectangle Models
- Bounding rectangle length, width
- Bounding rectangle aspect ratio
- Rectangularity

Polygon Models
- Polygon order
- Interior angle
- Convexity

Fiber Models
- Fiber length, width
- Fiber aspect ratio
- Fiber curl

Irregular Models
- Feret length, width
- Feret aspect ratio
- Surface uniformity

Pixel Intensity
- Opacity
- White Fractions

Two Models Available

Pi Sentinel PRO Stand-Alone Instrument

This model is a fully independent, stand-alone instrument to process samples for Shape analysis by Dynamic imaging. Unit includes an internal peristaltic pumping system with chemically resistant tubing throughout the fluid path.

Its flexible design enables automatic fluidic cycling, optic conversions for extending the particle size range and permits customization for higher viscosity samples to meet your specific needs.

Particle Size Range

1-300um
10-800um

Two Models Available

Pi Sentinel PRO Shape Module

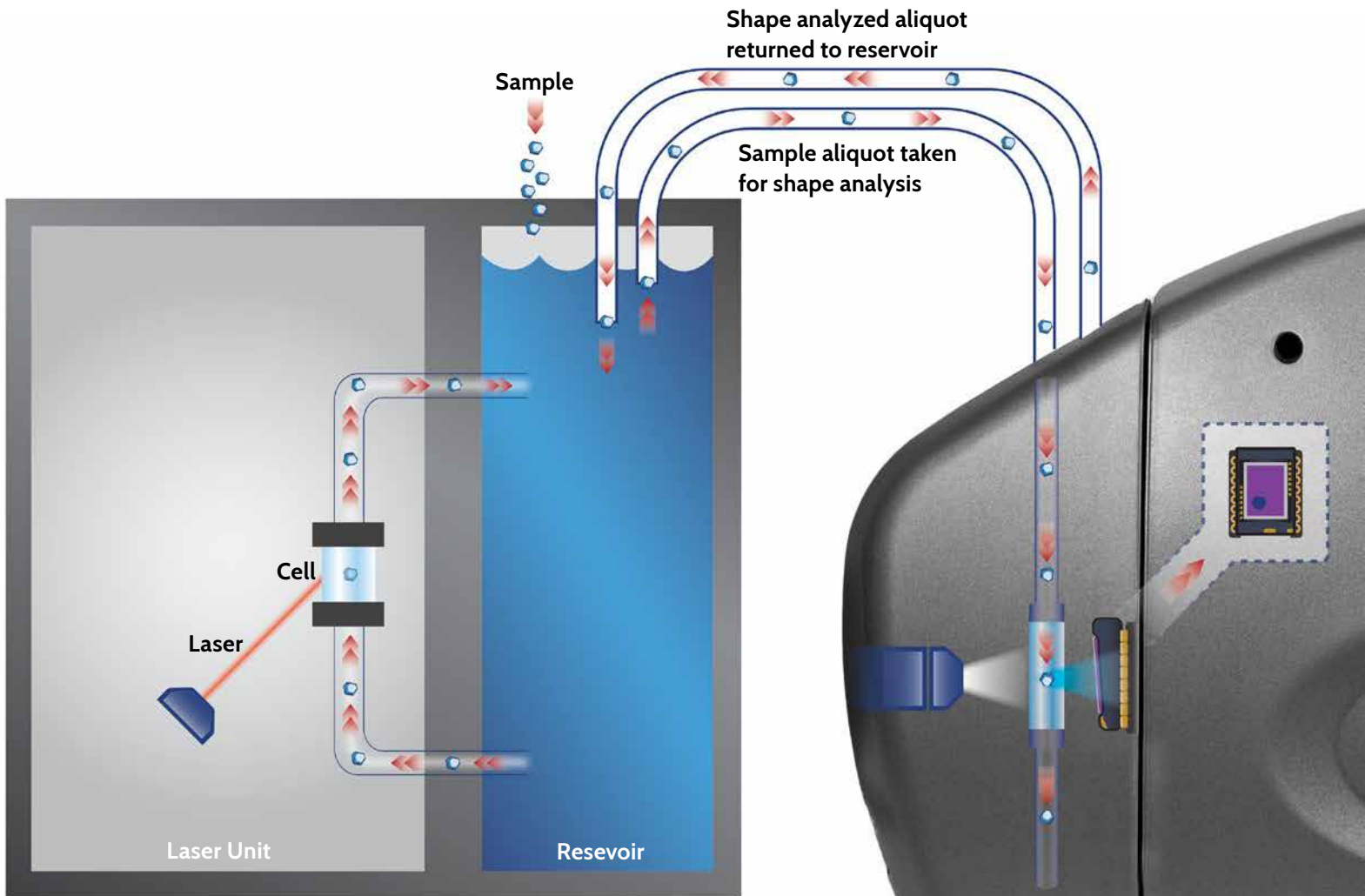*Fully integrates Into Your Current Particle Sizing Workflow Without Compromise...*

The Pi Sentinel PRO Shape Module automatically takes an aliquot of sample from the reservoir of your current laser light scattering instrument.

No need to change or re-validate your currently established method or process, instead easily integrate the Shape Module within the fluid path of your existing size-only instrumentation.

As the sample is being analyzed, the Shape Module taps into the sample reservoir of your sizing instrument, removes an aliquot of no more than 30ml of the sample, performs real-time shape analysis and returns the sample to the existing instrument without jeopardizing sample or the integrity of your particle sizing instrument.

Particle Size Range

1-300 um
10-800 um
100-2500 um

Shape analyzed aliquot returned to reservoir

Sample

Sample aliquot taken for shape analysis

Cell

Laser

Laser Unit

Resevoir

Static Light Scattering Laser Instrument
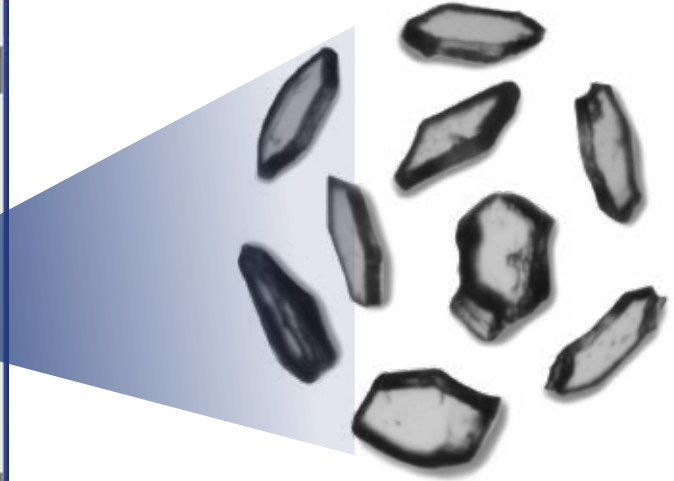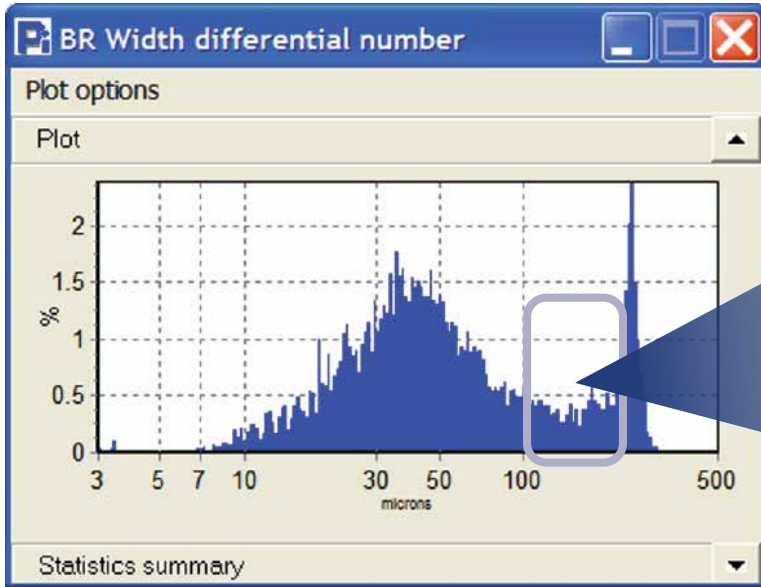
Pi Sentinel PRO Features

- High speed, high resolution

- Real-time results

- More than 30 size and shape measures

- Particle thumbnails

- Multi-run overlaying of shape data

- Sieve correlation capability

- Organic fluid capability

- Security and regulatory compliance

- Flexible, fluidic design

- Four size range model options

- Real-time data backup for remote viewing

- Automated recirculating sample handling module

- 3-Dimensional analysis with random orientation

- Simple hardware for low maintenance

- Unique integration with smartphone app allows for remote data analysis of all results and thumbnails in real time

- Particle classification feature allows users to automatically have a full analysis for each subcomponent in a mixed sample

- High speed, high resolution 5 Mpix optics

- Real time image results

- Gray Scale and binary particle thumbnails

- Sieve Mesh Direct Correlation

- Particle Concentration Capability

- Toner particle circularity Option

- Particle rare event detection

- Upgradeable optics to extend particle range

- Multi run overlaying of shape data

- Designed for at bench for R&D or at-line process-unit operations

- Security and regulatory compliant process included

- Remote data analysis and reporting enabled design

Pi Sentinel PRO Features

## Thumbnail Extraction from Specific Points in Histogram

The Pi Sentinel PRO employs two important features: random orientation and recirculation of the sample. These two features help to ensure a true representation of the sample, as well as accurate data.

The SentinelPro allows the user to have a true analysis of all dimensions of the particles. In addition, the user is able to selectively see each particle that created a certain area of any shape histogram.
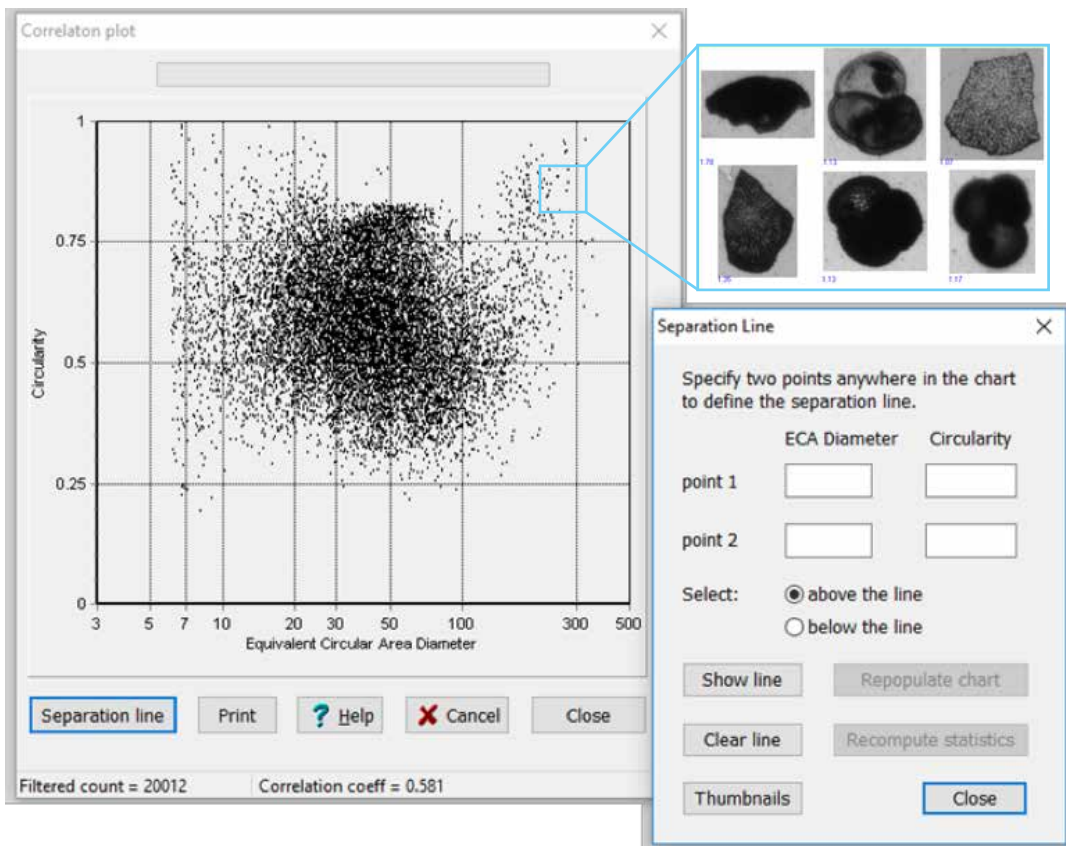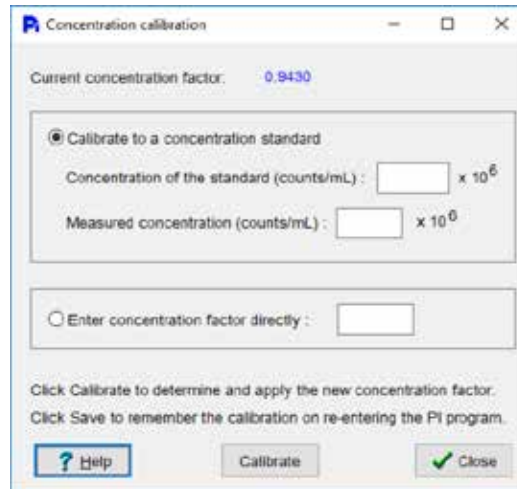
Pi Sentinel PRO Features
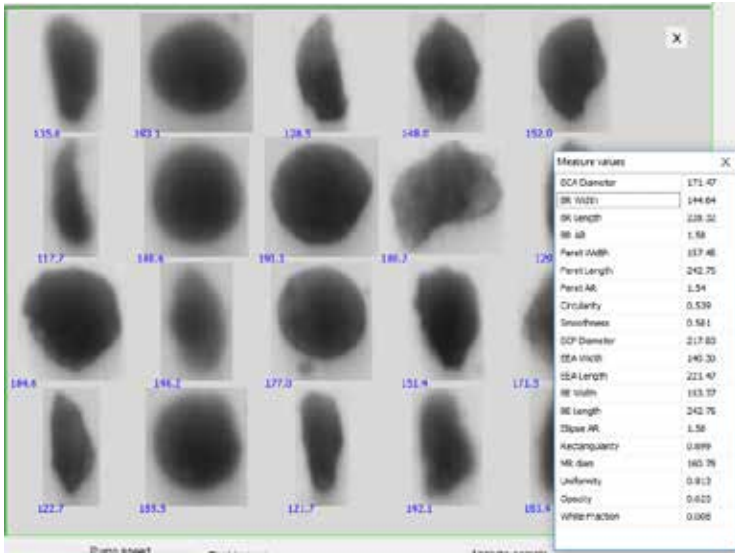
When viewing particle thumbnails, the left-mouse button will display all the shape measurement values for that selected thumbnail.

The right-mouse button will allow the user to eliminate that specific particle from the database and statistics. Useful when, for example, a single air bubble is not wanted in the database.

Particle Concentration Correlation

• Adjust concentration reporting to correlate to reference concentration standards.

• More accurate, improved concentration results.

• References to traceable and recognized count standards

## Smartphone and Tablet Application for Pi Sentinel PRO

View and perform additional statistical analysis on the go. A unique feature allowing automatic real-time secure cloud based data transfer from the Pi Sentinel PRO to the palm of your hand. As results are completed, data is uploaded where authorized users can download and not just view results but also perform statistical analysis.

Pi Sentinel PRO Features

## Compare Samples with Shape Overlays

The Pi Sentinel PRO allows for sample-to-sample comparisons that can visually show the differences in shape aspects of particles. By overlaying sample histograms for all the available shape parameters, the user can compare different samples and make determinations based not only on size, but on shape as well.
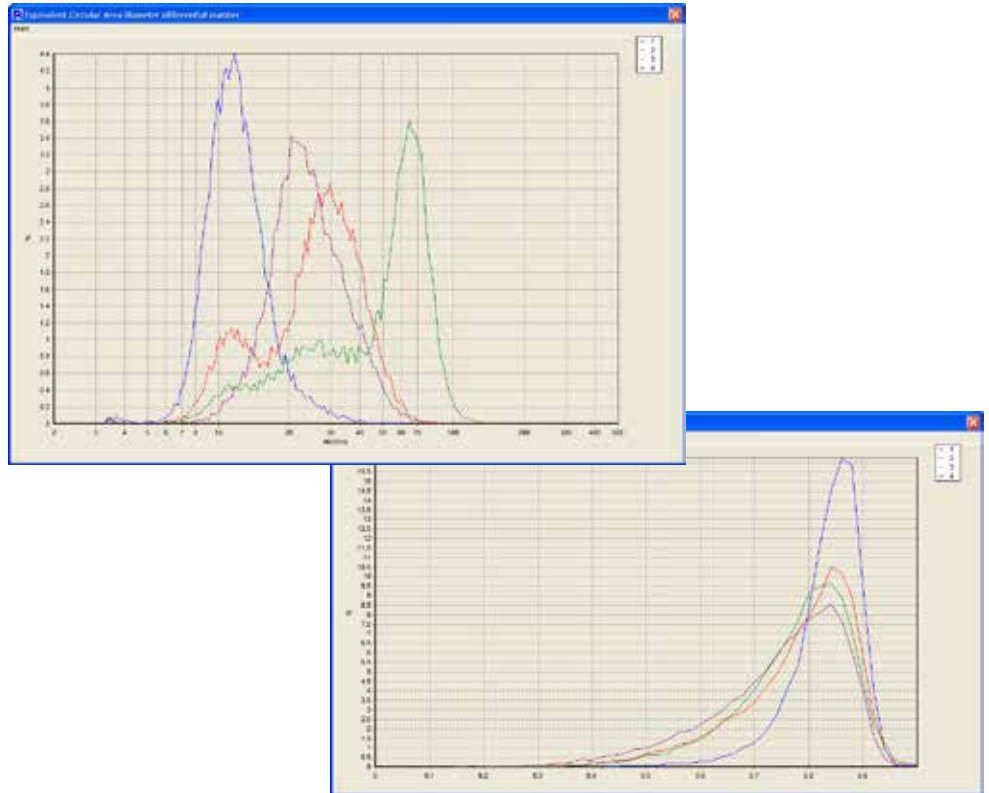
Most particle size analyzers assume particles to be spherical without taking into account other critical shape factors. In the above example, the difference in two samples, similar in size when assumed to be spherical, are clearly demonstrated in overlays of both circularity and smoothness. Only a particle shape analyzer can render such critical shape information.

Scatter Plot Correlates Two Shape Measures

The correlation between any two shape results of the same sample can give the user unique information about their process and their particles. The correlation coefficient calculation can also be used as quality control criteria for process control. This Pearson coefficient is widely used as a measure of the strength of linear dependence between two variables.
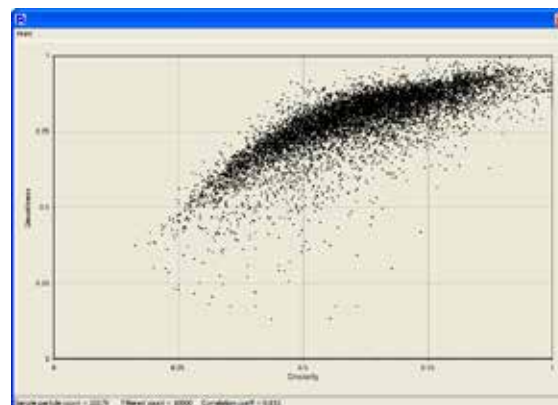

In this example, 10,000 flake-like particles analyzed in just minutes show an important trait of the sample. As can be seen by the correlation, as the flakes become more circular, they also become smoother.

Pi Sentinel PRO Features

Process Monitoring

To simplify manufacturing process control, the Pi Sentinel PRO incorporates a process monitoring feature that shows simple pass/fail indicators for any shape measurement. It is no longer necessary to control an incoming or outgoing process by particle size alone. This feature can also be used to classify particles as required by industry standards such as ISO 4406 and NAS 1638 for the oil industry, and USP <788> for therapeutics.
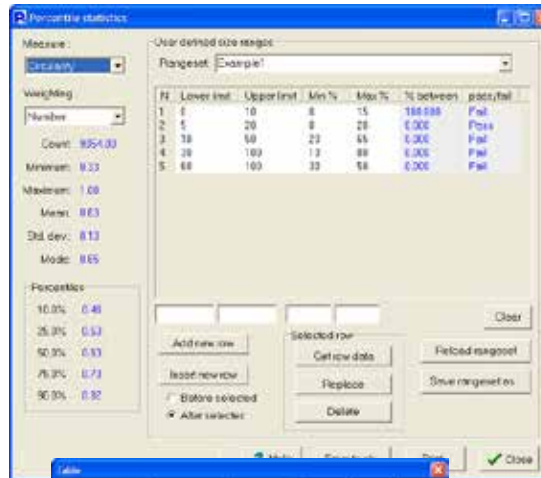
Data Generated in Either Graphical or Spreadsheet Formats

In addition to creating up to 30 shape result histograms in real-time, the Pi Sentinel PRO can also display data and images in many formats. Statistical information can be shown and printed for all shape measures including sieve-correlations and the automatic creation of spreadsheet files enabling users to have shape information for each particle analyzed.
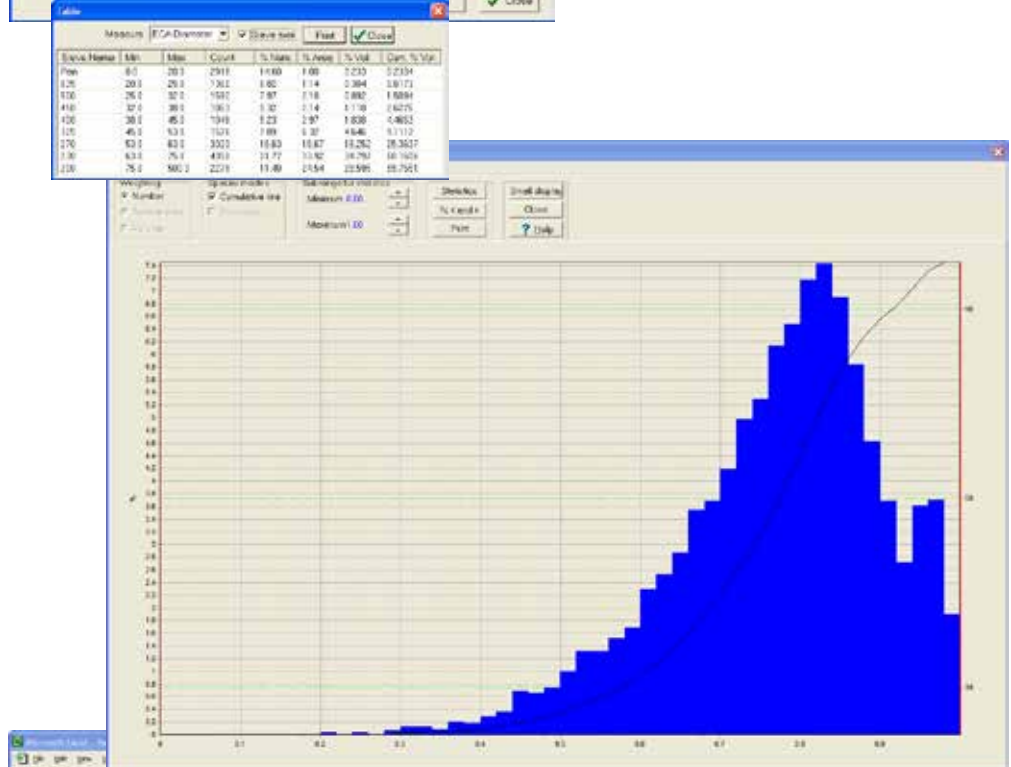
Expanded Correlation Plots

• Compare any shape measure to identify rare events

• View thumbnails directly from correlation plot area of interest.

• Ideal tool to identify very rare event particles

• Rare events detection and analysis is important information for process and performance evaluations
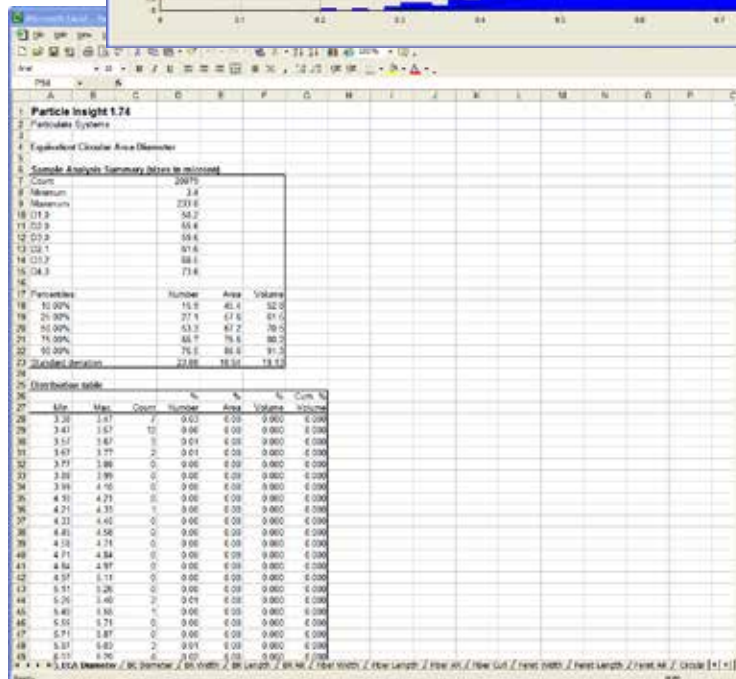
Pi Sentinel PRO Features

Compliment Your Existing Processes

No need to change or re-validate your currently established method or process instead easily integrate the Pi Sentinel PRO within your fluid path of your existing size-only instrumentation. As the sample is being analyzed, the Pi Sentinel PRO taps into the sample reservoir of your sizing instrument, removes an aliquot of no more than 30ml of the sample, performs real-time shape analysis and returns the sample to the existing instrument without jeopardizing sample or instrument integrity.
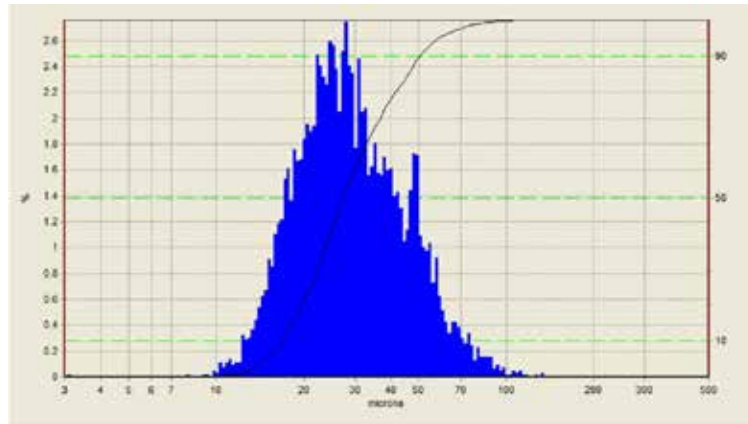
View Collected Data and Thumbnails of Each Sub-Component

The Classification window allows the user to view statistics for each desired type of particle, examine their statistical listing, modify any parameters to adjust what particles to classify, and most importantly, see each and every particle that has been classified.
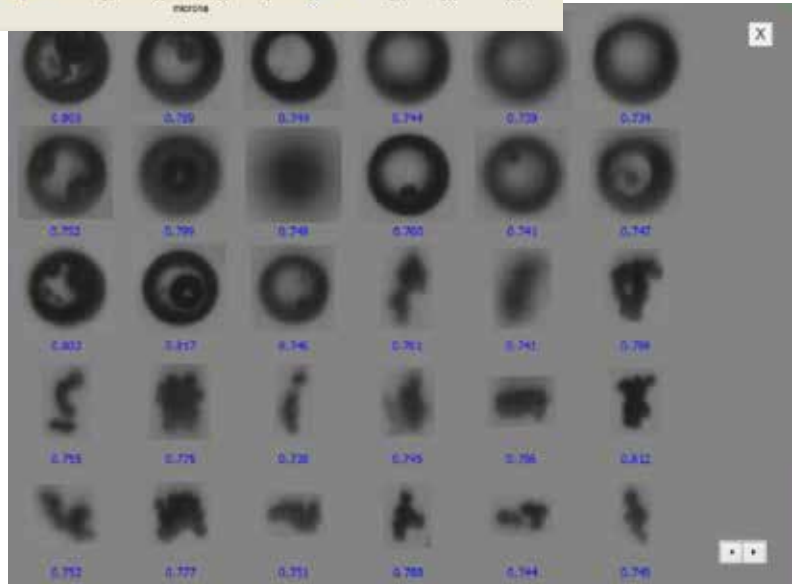
No longer assume that particle size distribution, as a single measurement, assures the quality of your material. Utilize the knowledge of shape and its influence to product behavior and performance to optimize your material or process.

The Pi Sentinel PRO Shape Module is a universal, full-featured, dynamic image analysis instrument that is designed to be fully integrated with many established particle size instruments.

As a user of laser diffraction, electrical sensing zone, light blockage, or other methods the Shape Module allows you to keep your current methods and add this shape module within your established workflow to give you a broad array of additional critical information.

Vision
ANALYTICAL

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To request a quote or additional product infomation, visit
particleshape.com

Contact your local Vision Analytical sales representative
or our Customer Service Department at
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