DYNAMIC IMAGE ANALYSIS

Measure materials from 2 to 135,000 microns

Patented 3D Analysis | Wet & Dry Measurements | Over 30 Morphological Parameters

AGGREGATES | GLASS BEADS | 3D PRINTING | PLASTICS | ABRASIVES | FOOD/AGRICULTURE

FERTILIZER | PHARMACEUTICALS | CHEMICALS | METAL POWDERS | COATINGS | INDUSTRIAL MINERALS
Microtrac’s Patented 3D Technology

How Our Patented 3D Measurement Works

Tracking is the key. The high speed, digital camera will take multiple images of each particle, showing it in all orientations. The PartAn™ software will then measure length, width, thickness, perimeter, and area of the particle as it maps it in pixels.

PartAn Technology Differentiation — Morphological Parameters

More than 30 size and shape parameters enable researchers to experiment and learn more about their material than they thought possible. For QA/QC labs, engineers are able to define their product more specifically than before and set tighter specifications. They will realize improved final product quality and production efficiency.

<table>
<thead>
<tr>
<th>Size</th>
<th>Shape/Form</th>
<th>Surface Roughness</th>
<th>Other</th>
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</thead>
<tbody>
<tr>
<td>Da</td>
<td>Sphericity</td>
<td>Convexity**</td>
<td>Transparency***</td>
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<tr>
<td>Dp</td>
<td>Circularity</td>
<td>Solidity**</td>
<td>Curvature</td>
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<tr>
<td>FLength</td>
<td>Roundness</td>
<td>Concavity**</td>
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<tr>
<td>FWidth</td>
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<td>Krumbein Roundness</td>
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<tr>
<td>FThickness*</td>
<td>Extent</td>
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<tr>
<td>ELength</td>
<td>Ellipse Ratio</td>
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<td>EWidth</td>
<td>W/L Aspect Ratio</td>
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<td>EThickness*</td>
<td>T/L Aspect Ratio*</td>
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<td>Area</td>
<td>L/T Ratio*</td>
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<td>Volume</td>
<td>L/W Ratio</td>
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<td>Perimeter</td>
<td>T/W Ratio*</td>
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<tr>
<td>Surface Area</td>
<td>W/T Ratio*</td>
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<td>CHull Area</td>
<td>Ellipticity</td>
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<td>CHull Surface Area</td>
<td>Angularity</td>
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<tr>
<td>Sieve*</td>
<td>Rectangularity*</td>
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<tr>
<td>Cylinder Diameter*</td>
<td>Compactness</td>
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<tr>
<td>Cylinder Length*</td>
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<tr>
<td>Fiber Length</td>
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<tr>
<td>Fiber Width</td>
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</tbody>
</table>

*3D Only  
**Surface measurements describe the smoothness of particles. Rough surfaces can create dust and poor flowability.  
***Transparency measures the light intensity passing through a particle to identify off-spec material.

Total List Microtrac Morphological Parameters

Measure Length, Width, and Thickness for More Accurate Data

Key elements of PartAn 3D System

Light Source

Microtrac - Image Analysis Experts Since 1987

With more than 30 years at the forefront of technological advances in measuring material size and shape in real-time, Microtrac is the established leader in delivering innovative particle analysis solutions.

Dynamic Image Analysis is the most recent and advanced commercial particle characterization technique. DIA characterizes particles in motion by digitizing photographs of each particle and storing them in an image file. Each particle is measured in real time while the software calculates morphological parameters based on the known size and location of the pixels in each image. DIA can measure either dry material or suspensions and emulsions. Unlike manual microscopy, DIA can automatically measure large, representative and statistically valid samples of particles in only a few minutes.

Microtrac’s patented 3D technology utilizes an innovated scheme of tracking particles. By tracking, the PartAn™ obtains multiple images of each particle enabling our software to see the particles in many different orientations. This results in the most accurate measurements of length, width, and the third dimension, thickness. From these measurements, we are able to calculate more than 30 size and shape parameters.
Microtrac Lab-based Image Analysis Systems

Exclusive 3D technology!
- The only particle size analyzer that tracks particles, using 3D particle measurement
- The 3D imaging technology and software are the same for PartAn3D and PartAn3D Maxi
- All three major particle axes length, width, and thickness are measured
- PartAn3D is the only instrument that can provide shape ratios of thickness/width, width/thickness, length/thickness, thickness/length
- All tracked particles are stored in a library and can be recalculated to obtain any size and shape distribution
- The filter function in the SOP offers a customized result calculation and presentation
- The 3D tracking technology enables identification of the minimum-, maximum-, and average-values of size and shape of a single particle automatically

Above, particle #158195 has been imaged 13 times, to provide a size of 2.451mm, a maximum size of 3.763mm (length), and a minimum size of 1.243mm (thickness)

PartAn3D

Bench-top 3D size and shape analyzer
- Characterizes over 40 morphological parameters
- Measurement of dry, free flowing particles ranging in size from 22µm to 35,000µm
- Analyzes more than 100 frames per second with our high-speed, high-resolution camera
- Key applications: Proppants (Hydraulic Fracturing), Granular Fertilizer, Reflective Glass Beads, Drug Time Release Capsules, Extrusions (Granulation), Abrasives

PartAn3D Maxi

Large particle 3D size and shape analyzer
- Characterizes over 40 morphological parameters
- Measurement of dry particles ranging in size from 160µm to 135,000µm
- Analyzes more than 100 images per second with our high-speed, high-resolution camera
- Rugged and adaptable for any laboratory or pilot plant
- Key applications: Proppants (Hydraulic Fracturing), Granular Fertilizer, Reflective Glass Beads, Drug Time Release Capsules, Extrusions (Granulation), Abrasives, Aggregates

Powerful, Patented 3D Measurement Software
Provides Users with Unparalleled Analysis Capability
- The filter function allows users to focus on areas of interest. With the filter function you can:
  - Identify, isolate, and compare parameters of interest for further investigation and analysis
  - Permanent set-up of a Standard Operating Procedures is ideal for multiple users, across multiple shifts
  - All filters can be reported as individual distributions to provide a more detailed understanding of areas of interest during the analysis
  - Allows exclusion of filters from measurement – only report needed information
  - Easy to export to other software platforms

Understand the composition of your material with our classification function. One analysis in less than a minute can provide you with a detailed percentage breakdown of your material. Here is a sample breakdown of a glass bead sample:
- 45% “Good Beads”
- 35% “Bad Beads”
- 20% Sand

Reporting: Simple, Powerful, Flexible
- Comprehensive reporting for R&D and methods development
- Users can choose number of channels and channel widths
- Choose from more than 30 morphological parameters in 1 to 6 tabular columns
- Streamlined for at-a-glance QC “pass/fail”
- Image library querying

ISO 13322-2
Dynamic Imaging Analysis Compliant
The Power of On-line Measurement

- Microtrac’s line of on-line dynamic image analyzers includes both wet and dry solutions
- Real-time measurements enable optimum control of production or quality control of final product
- Sampling systems are customized to fit any production line
- Robust design for long life and minimum maintenance
- Results integrated with DCS in control room
- Very sensitive to even small changes in size and shape distribution
- Gives operator immediate confirmation when changes are made to the process

PartAn 3D PRO

For size range 22μm to 35,000μm

PartAn 3D Maxi PRO

For large materials 160μm to 135,000μm

PartAn SI PRO

This liquid particle analyzer is an on-line measuring system

PartAn SI PRO particle size and shape analyzer for wet dispersions ranging in size from 2μm to 2,000μm. The PartAn SI PRO can be integrated into any process loop and features a proprietary sample extraction process that ensures optimal conditioning of your material.

Plus, the PartAn SI PRO sample volume requirement is scalable to fit your analysis needs.

The Microtrac Advantage

With over 30 years of experience in on-line particle size and shape measurements, Microtrac understands the needs of the process environment.

See what sets us apart from the competition:

- The Microtrac PRO series features a self-cleaning mechanism that utilizes compressed air to ensure the optical chamber remains dust-free — reduces downtime and operator intervention
- Explosion-proof when needed
- The PRO series is engineered for ruggedness enabling it to handle the toughest environments
- This powerful tool enables process engineers to optimize the set of process parameters and easily detect deviations in product quality in real time

Deliver higher quality products with the PartAn PRO series

- Tailor made sampling solution for frequent representative sampling
- Reduce poor quality product returns
- Ensure top dollar for product you produce
- Increased production capacity

ROI is very quick. Contact us for estimates compared to sieves or other techniques.

See what a Microtrac PartAn PRO customer says about our solutions:

"The PartAn PRO is a very easy to use instrument and is more accurate and representative when measuring large amounts of material compared to using a small amount in a sieve. The instrument saves our operators a lot of valuable time because they are not manually running the instrument, which frees up their time to concentrate on other critical tasks.

-Laboratory Engineer for a global material engineering company"
Introducing the Sync

Microtrac’s synchronous size and shape analyzer, Sync, integrates the world’s leading laser diffraction technology with the world’s leading dynamic image analysis technology – Same bench, same sample, same run, same flow cell, same user interface. Users can now get their tried and true particle size distribution together with particle morphology in a single, easy to use graphical user interface.

Using our patented methodology, the Sync interrogates particles, wet or dry, with laser light while simultaneously a high-speed digital camera takes images. The data collected is processed by our FLEX software and presents the user with particle size and shape information. While the software is powerful, the graphical user interface is intuitive and easy to use. The Sync enables users to get more detailed information about their material than ever before and will quickly render size-only instrumentation outdated and incomplete.

Microtrac’s TurboSync delivers a properly dispersed sample to the measuring cell allowing for consistent and repeatable particle size analyses of dry powders.

- Laser diffraction and image analysis integrated in one instrument
- Measurement capability from 0.01 to 4000 microns
- Measure over 30 size and shape parameters
- Easily switch between wet and dry measurements
- High and low concentrations
- Small bench footprint

Microtrac’s TurboSync delivers a properly dispersed sample to the measuring cell allowing for consistent and repeatable particle size analyses of dry powders.

- Measurement time is typically 10 seconds with the TurboSync autoscan.
- Sample volumes can be as small as 0.1 cc.
- Compressed air and flow conditions settings allow the operator to achieve optimal dispersion usually associated with fluid dispersal systems for highly agglomerated materials such as alumina. Dispersion conditions can be fine-tuned for measurement of the most fragile materials.

Wet particle size and shape analyzer integrated with diffraction

- Whether your process requires agglomeration or you simply want to avoid it, now you can visually validate your material with the Microtrac S3500 SI
- Proven laser diffraction technology measures size distribution of particles ranging from 0.01µm to 2000µm, while the dynamic image analyzer measures over 30 morphological parameters
- Sample recirculator has various speed settings and in-line sonication providing greater degree of flexibility for sample dispersion

Microtrac’s S3500 SI can be operated as a stand-alone unit with one of our dispersion devices, the SDC or USVR. The S3500 SI can be added right away when the diffraction system is installed, or at a later time as an upgrade.
The DustMon measures the amount of dust in powder and granulates, determines the dust index, and calculates particle size distribution of the dust particles.

Microtrac’s DustMon consists of a dosing control system (sample beaker [1] with a valve and a tube [2]), which is easily detachable for cleaning and transportation, a sample collector [3], a light source [4] and a detector [5].

The sample is poured into the sample beaker [1]. By starting the measurement, the valve opens and the sample drops down the tube [2] into the sample collector [3].

The dust generated in the sample collector will be measured by the detector [5] and the resulting dust index will be displayed.

Results
- Maximum dust concentration in % (0-100% of complete dust concentration)
- Dust concentration after 30 seconds
- Dust index (maximum and concentration after 30 seconds)

Microtrac’s DustMon characterizes the amount of dust in powders and granulates. It is our state-of-the-art system for dust measurement.

There are two system operating modes:
- Standalone (no PC control)
- Control via Windows PC

Selected features of the DustMon Windows software:
- Ability to save results including sample information, time and date of measurements
- Data export to an external database such as LIMS or Excel
- Ability to set up and configure the DustMon for various applications including more advanced settings for R&D
- Graphical display of measurements with the ability to overlay historical data to analyze and compare

Robust design
- Temperature range from 0°C to +40°C
- Completely sealed sample beaker
- Consistent results between multiple systems
- Long-life light source (min. 100,000 hours)
- Easy to handle, easy to clean
- Analysis based on the CIPAC MT 171 method
- USB interface
Dynamic Image Analyzers

Microtrac’s line of Dynamic Imaging Analyzers are available in a variety of measurement ranges so that you are better matched with the best system for your specific application.

Microtrac’s DIA instruments can measure particles from 2 to 135,000 microns in size.

All Microtrac DIA analyzers are compliant with ISO 13322-2.

<table>
<thead>
<tr>
<th></th>
<th>PartAn³D/PRO</th>
<th>PartAn³D Maxi/PRO</th>
<th>PartAn Si/PRO</th>
<th>Sync</th>
<th>DustMon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Medium</td>
<td>Dry</td>
<td>Dry</td>
<td>Wet</td>
<td>Wet &amp; Dry</td>
<td>Dry</td>
</tr>
<tr>
<td>Detection Range</td>
<td>22µm-35,000µm</td>
<td>160µm-135,000µm</td>
<td>2µm-2,000µm</td>
<td>0.2µm-4,000µm(Dry)</td>
<td>0.01µm-2,800µm(Wet)</td>
</tr>
<tr>
<td>Number of morphological parameters of your material including 3D</td>
<td>40</td>
<td>40</td>
<td>&gt;30</td>
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<tr>
<td>Complies with ISO 13322-2</td>
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<td>Process version</td>
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Contact:
USA: 1-888-643-5880
Europe: +49 2151 361-389-0
www.microtrac.com