

Particle size 

Particle shape 

Morphologi G2



G2

Advanced image analysis for **high sensitivity**
particle characterization

Introducing a new concept in image analysis

The Morphologi G2 high sensitivity particle analyzer is more than just a microscope. It brings together the very best hardware and software in a single integrated package and provides the very highest level of automation and validation of results.



- Analyze 100s of thousands of particles at the push of a button
- Particle shape and count as well as size information
- Record high resolution images of every particle
- Automatic optics selection, focus and light intensity control
- Provides technical compliance with 21CFR Part 11
- Dedicated sample preparation device

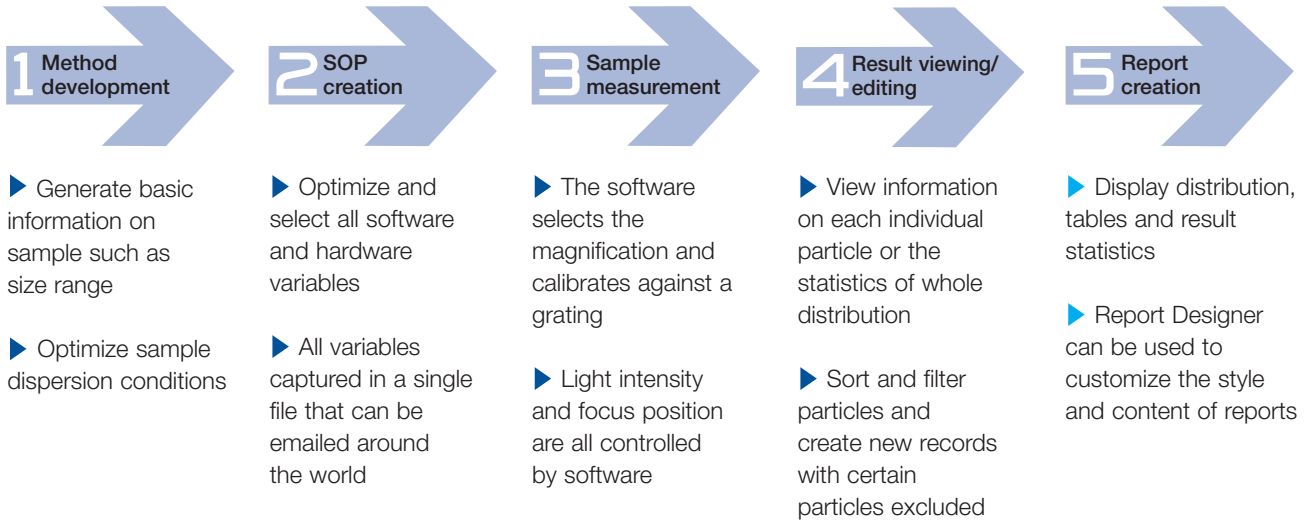
The new Morphologi G2 high sensitivity particle analyzer provides repeatable and routine characterization of particle size, shape and count.

Morphologi G2 is equipped with the renowned Nikon CFI 60 optical system coupled with a high resolution digital camera for high definition aberration-free images.

Microscope-quality images and statistically significant histograms offer both qualitative and quantitative information which eliminates operator bias and saves precious man-hours.

Whether you work in R&D, process analysis or quality control, the Morphologi G2 delivers reliable, repeatable and validated results in minutes.

5 steps to a perfect measurement

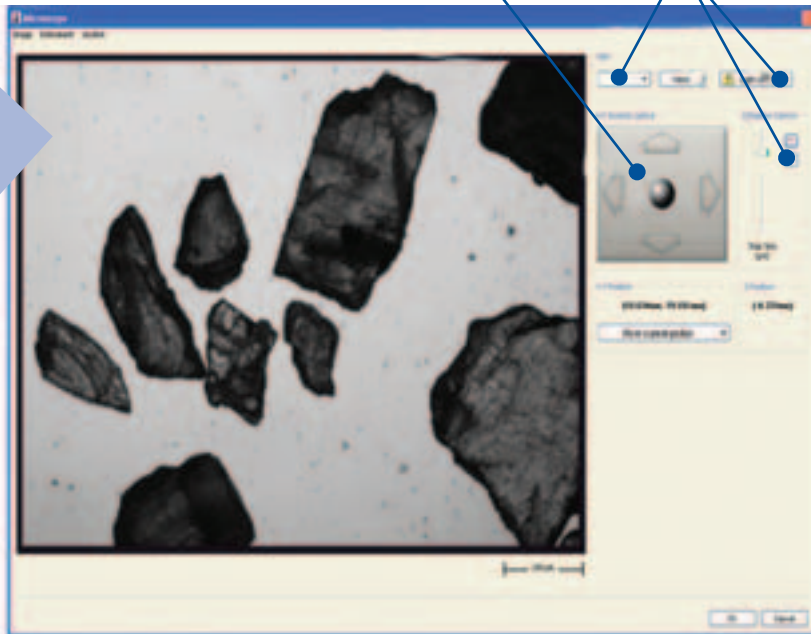


A “manual microscope” mode is available to quickly and easily move around and view the sample in order to check basics such as the dispersion quality or the approximate size range

Virtual joystick

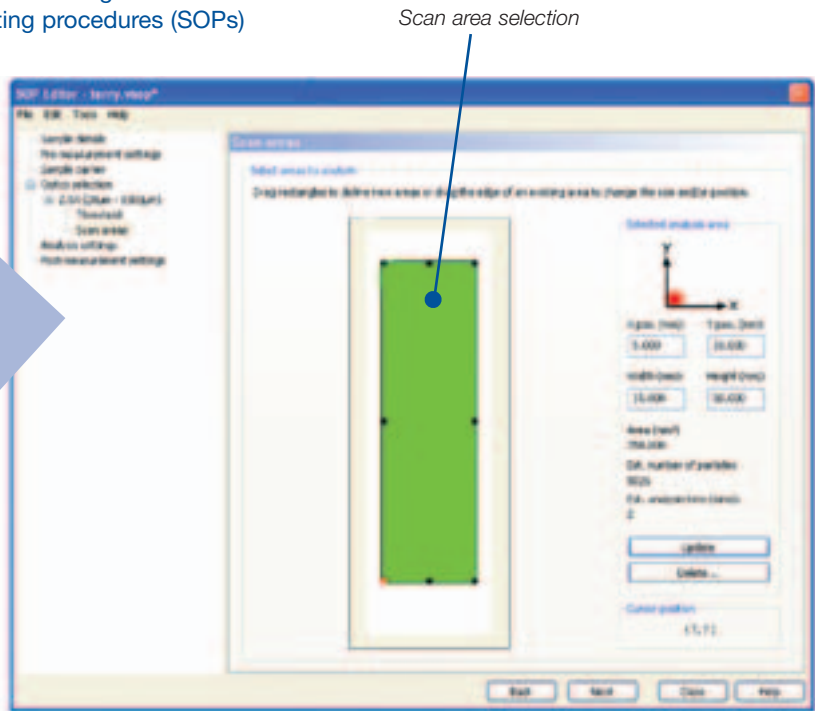
Focus, light and magnification control

1 Method development



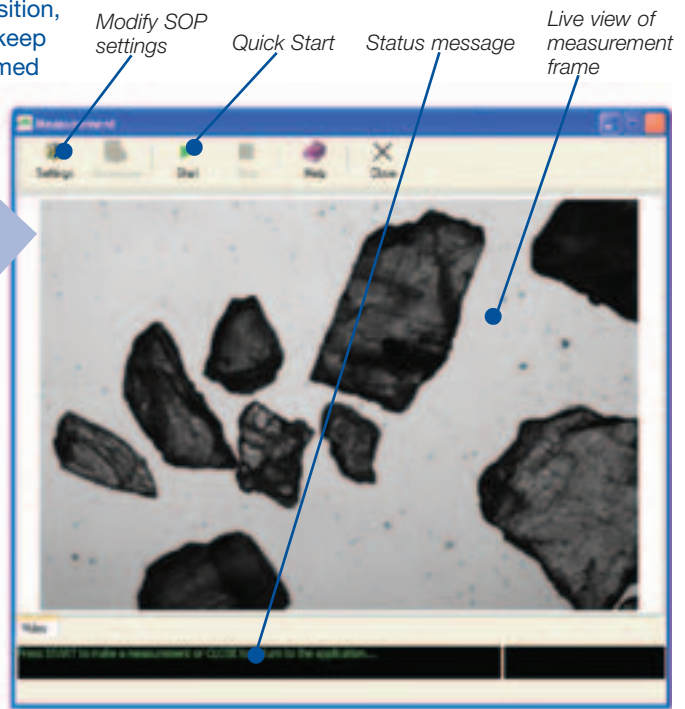
A "wizard" assists in the generation of standard operating procedures (SOPs)

2 SOP creation



During data acquisition, status messages keep the operator informed of progress

3 Sample measurement

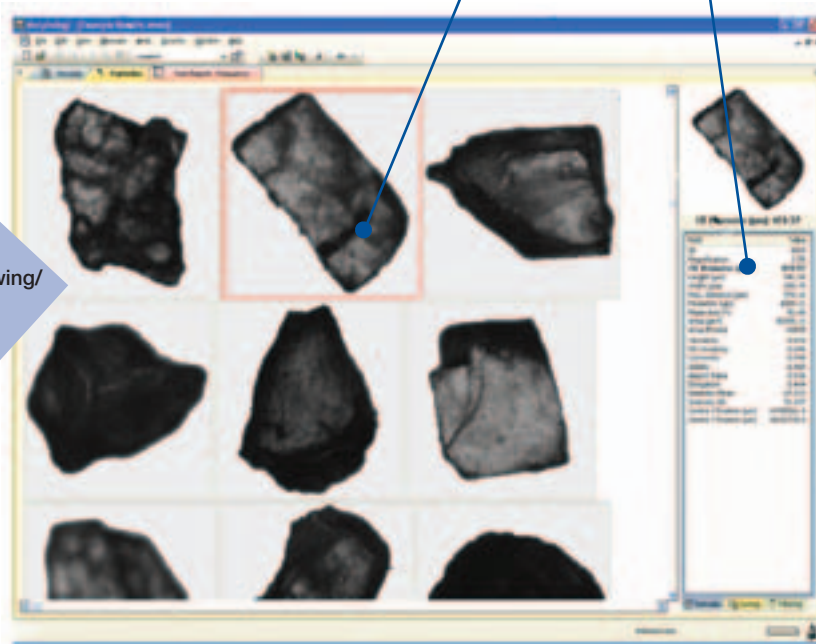


Images of all particles are recorded and can be sorted and filtered on any shape parameter and new records created with the filtered data

Sort and filter particles on any parameter

Morphological parameter list of highlighted particle

4 Result viewing/editing



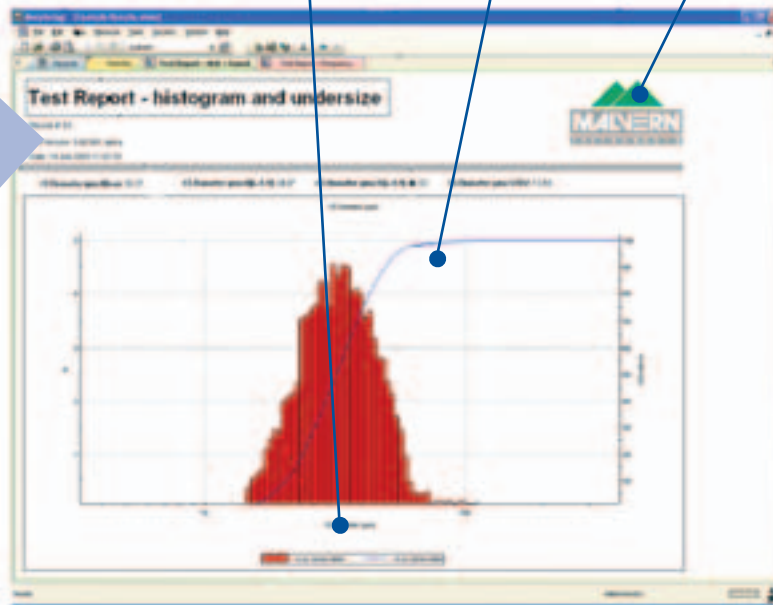
A range of reports is supplied to display distribution, tables and result statistics. The Report Designer can be used to customize the contents of these reports

Plot any morphological parameter on the x-axis

Choose frequency, undersize or oversize graph types

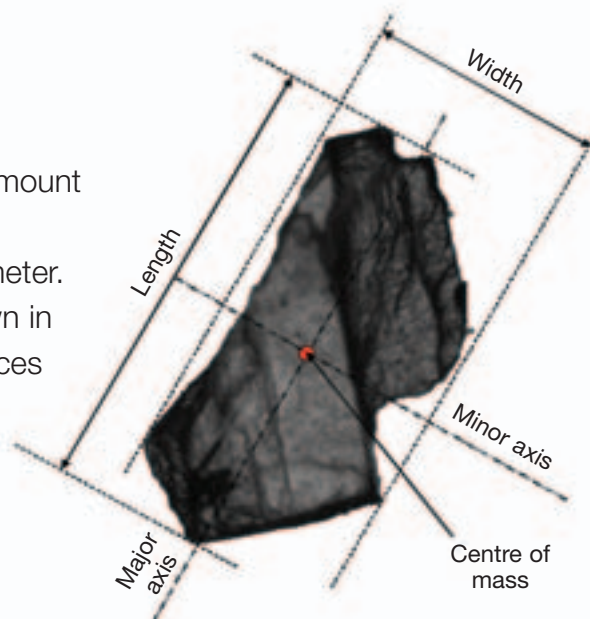
Add specific parameters or logos and other graphics

5 Report creation



Why is shape analysis important?

Manual microscopy and traditional particle sizing techniques are often not sufficiently sensitive to distinguish subtle differences in raw materials. Batches of samples may differ by such a small amount that this difference is lost during the translation to a circle-equivalent or spherical-equivalent diameter. Calculating shape parameters like the ones shown in the list below allow even the most subtle differences to be identified and quantified.









Parameter	Example value	Definition
ID	516	Unique ID of the particle – allocated in the order that the particles are detected
Magnification	2.50	Magnification used to make the measurement
CE diameter (µm)	904.14	The diameter of a circle with the same area as the particle
Length (µm)	1306.35	All possible lines from one point of the perimeter to another point on the perimeter are projected on the major axis (axis of minimum rotational energy). The maximum length of these projections is the length of the object.
Width (µm)	678.54	All possible lines from one point of the perimeter to another point on the perimeter are projected on the minor axis. The maximum length of these projections is the width of the object.
Max. Distance (µm)	1318.07	Largest distance between any two pixels in particle
Perimeter (µm)	3619.42	Actual perimeter of particle
Major axis°	105.52	Axis of minimum rotational energy
Area (µm²)	371550.78	Actual area of particle in sq. microns
Area (pixels)	215018	Number of pixels in particle
Circularity	0.785	Circumference of equivalent area circle divided by the actual perimeter of the particle $= 2\sqrt{(\pi \text{ Area})}/\text{Perimeter}$
HS Circularity	0.616	High sensitivity circularity (circularity squared) $= 4 \pi \text{ Area}/\text{perimeter}^2$
Convexity	0.919	Convex hull perimeter divided by actual particle perimeter
Solidity	0.905	Actual particle area divided by convex hull area
Aspect ratio	0.519	Width divided by length
Elongation	0.461	1 - aspect ratio
Intensity mean	61.310	Average of all the greyscale values of every pixel in the particle
Intensity standard deviation	29.841	Standard deviation of all the greyscale values of every pixel in the particle
Centre x position (µm)	6898271.5	x co-ordinate of centre of mass of particle
Centre y position (µm)	1797186.3	y co-ordinate of centre of mass of particle

Why is shape analysis important?

Shape parameters such as Circularity, Convexity and Elongation provide the user with a series of highly sensitive tools in order to identify and quantify subtle variations in particle shape and provide a “fingerprint” of each sample. Each parameter is usually normalized between 0 and 1 in order to provide quick and easy comparability. Traditional qualitative human descriptions such as “jagged”, “smooth” or “needlelike” can be accurately quantified and hence correlated against important process or end-product variables such as flowability, active area and grinding efficiency.



						
<p>Circularity is a measure of the closeness to a perfect circle. Circularity is sensitive to both changes in overall form and surface roughness.</p>	Circularity = 1	Circularity = 0.47	Circularity = 0.89	Circularity = 0.52	Circularity = 0.47	Circularity = 0.21
<p>Convexity is a measure of the surface roughness of a particle. Convexity is sensitive to changes in surface roughness but not overall form.</p>	Convexity = 1	Convexity = 1	Convexity = 1	Convexity = 1	Convexity = 0.70	Convexity = 0.73
<p>Elongation is a measure of the length-width relationship. Elongation is unaffected by surface roughness – a smooth ellipse has a similar elongation as a spiky ellipse of similar aspect ratio.</p>	Elongation = 0	Elongation = 0.82	Elongation = 0	Elongation = 0.79	Elongation = 0.24	Elongation = 0.83

High quality hardware means high quality images



High quality hardware means high quality images

The Morphologi G2 is built upon the acclaimed Nikon CFI 60 optical system which achieves both higher Numerical Apertures (NA) and longer working distances than ever before. A precision XY stage and calibration grating ensure that data is precise, secure and validated at all times.

In these revolutionary optics, both axial and lateral chromatic aberration have been corrected independently in the objective and the tube lens. This geometry produces images that are crisp and clear with high contrast and minimal flare.



The precision engineered XY stage uses high accuracy, ground ball-screws to provide smooth and maintenance free motion with zero-backlash. The quiet and precise stepper motors ensure accurate positioning of the stage while the use of micro-stepping provides smooth motion at low speeds.



Precision etched chrome-on-glass gratings are built into the XY stage for calibration purposes. The gratings are certified and traceable to the National Physical Laboratory. The system automatically calibrates before every measurement to guarantee validated, secure data.



What Morphologi G2 delivers

You asked for

We give you

Repeatability and automation

The tried and tested SOP (Standard Operating Procedure) methodology records all software and hardware variables in a single file. At the click of a mouse the system selects and calibrates the required magnification, the light intensity and focus before scanning a defined area.

Sensitivity to shape

Particles are fully characterized by morphological parameters including circle equivalent diameter, circularity and convexity. This high quality information can be used to distinguish between materials that appear identical to a conventional microscope or traditional particle sizer.

High quality optics

Nikon's acclaimed CFI60 optics offer longer working distances and high N.A.s and allow high contrast imaging with a minimum of flare.

Statistical significance

Large numbers of particles (typically 5,000 - 500,000) are captured and analyzed in minutes or even seconds.

Images you can see

All images are saved for future reference including the xy coordinates of each particle. If desired, you can precisely move the camera back to any position for a more detailed visual analysis.

Controlled orientation

To avoid errors due to random orientation, particles are dispersed onto a flat glass plate. This achieves consistency of orientation with the largest area facing the camera.

Regulatory compliance

The Morphologi G2 has a full validation documentation package available and provides technical compliance with the requirements of 21CFR part 11.

A product and company with a secure future

Recognizing that most of our customers have global operations Malvern Instruments is committed to providing a service and support structure which is present worldwide including comprehensive applications knowledge.

Applications and case-studies

At any point in your manufacturing process from early research and development, through process-analysis, manufacturing trouble-shooting and root-cause analysis to final product quality control, this instrument gives you an unprecedented level of product and process understanding.

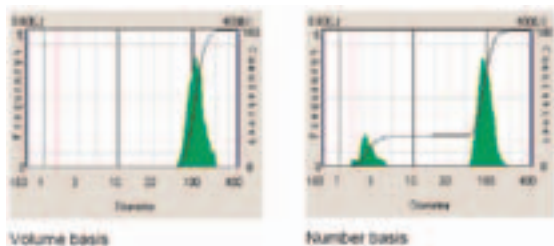


Pharmaceuticals

Even subtle differences in particle size or shape can significantly affect bioavailability, flowability, stability, blending and tableting efficiency. Manufacturing processing steps including crystallization, drying, milling, blending, filtering can all introduce variability into the product and have to be precisely controlled. The extra sensitivity and resolution available in the Morphologi G2 instrument provides users with the ability to identify, measure and monitor those process variables which are critical to product quality.

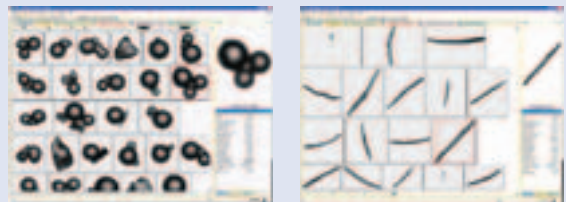
Sensitivity to fines

Image analysis proceeds on a 'number-basis' where the contribution each particle makes to the distribution is the same - a very small particle has exactly the same weighting as a very large particle. For diagnostic or trouble-shooting purposes the presence of fines could be critical to understand any given manufacturing process.



Foreign particle detection

Image analysis is an ideal technology for detecting the presence of very small numbers of foreign particles or confirming phenomena such as agglomeration. Using single parameters or combinations of parameters, foreign particles can be detected and quantified. For example – needles or fibres can be detected using the circularity shape descriptor.



Overview

Morphologi G2

Size, shape and count measurement of particulate samples

Size measurement

Size range

0.5µm - 1000µm (depending upon material properties and dispersion conditions)

Shape measurement

Multiple shape parameters calculated for each particle and distribution generated on each parameter. Parameters include: circle equivalent diameter, Length, Width, Perimeter, Area, Aspect ratio, Circularity, Convexity, Solidity, Elongation, Intensity.

Optical configurations

Optical system

Nikon CFI 60 Brightfield/Darkfield system

Magnification (at camera)

2.5X 5X 10X 20X 50X

Approximate total magnification (at 17" screen)

120X 240X 480X 960X 2400X

Min particle size (µm)

20 10 5 3 0.5

Max particle size (µm)

1000 430 210 100 40

Numerical aperture

0.075 0.15 0.30 0.40 0.55

Focal depth (total) (µm)

97.78 24.44 6.11 3.44 1.82

Working distance (mm)

8.80 18.00 15.00 13.00 9.80

Camera system

Camera type

1/1/8" Global shutter progressive scan CCD

Connection protocol type

IEEE 1394a (Firewire™)

Number of pixels

1624 x 1236 (2 MegaPixel)

Pixel size

4.4µm x 4.4µm

Sensor size

7.15mm x 5.44mm

Minimum PC specification

(Supplied with system)

DELL Mini Tower PC, Windows XP SP2, 3.0GHz Intel Pentium IV Processor, 1Gb RAM, 160Gb-HDD, DVD +/-R/RW, complete with mouse, keyboard and 2 x 17" Flat Panel Monitors (1 for software and 1 for live video feed)

Weight and dimensions

Weight (with stage fitted)

50kg

Overall dimensions (with stage fitted) mm

550(w) x 850(d) x 680(h)

Suggested deskspace (with PC and 2 screens)

850(d) x 2500(w)

Site requirements

Power requirements

AC 100-240V, 50-60Hz

Ambient operating temperature

10°C - 35°C

Humidity

10-90% non-condensing

Location

Normal laboratory conditions – out of direct sunlight

Malvern Instruments Limited

Enigma Business Park • Grovewood Road • Malvern • Worcestershire • UK • WR14 1XZ

Tel: +44 (0)1684 892456 • Fax: +44 (0)1684 892789

Malvern Instruments Worldwide

Sales and service centres in over 50 countries for details visit www.malvern.co.uk/contact

Morphologi
G2

Advanced technology made simple

distributor details

Malvern Instruments is part of Spectris plc, the Precision Instrumentation and Controls Company.

spectris

