Alicona Specifications

The Alicona optical profilometer works using focus variation.

Highest Specifications

Table 1: Highest specification for optical profilometer parameters.

Parameter	Specification
*Vertical Resolution	>10nm
**Lateral Resolution	>400nm
*Scan Height	<22mm
Scan Area	100mm x 100mm

* At the lens magnification to obtain the best for that parameter

** Restricted by the smallest wavelength of light

Objectives

Table 2: Specifications of Objectives.

Objective	X	2.5	5	10	20	50	100
Numerical Aperture		0.06	0.15	0.30	0.40	0.55	0.80
Lateral Sampling Distance	µm	3.52	1.76	0.88	0.44	0.18	0.09
Min Lateral Resolution	µm	58.71	23.48	11.74	8.80	6.40	4.40
Max Lateral Resolution	µm	6.92	3.49	1.75	0.881	0.64	0.44
Min Repeatability (vert.)	nm	800	120	30	15	8	3
Lowest Vertical resolution	µm	132.51	23.07	5.71	2.73	1.19	0.478
Highest Vertical resolution*	µm	2.3	0.410	0.100	0.05	0.02	0.01
Working distance	mm	8.8	23.5	17.3	13	10.1	3.5
Field of View X	µm	5716	2858	1429	715	286	143
Field of View Y	µm	4951	2175	1088	544	218	109

** Vertical resolution can be adjusted depending on the application, this also influences the scan speed*

Specimen

Table 3: Specifications of specimen.

Parameter	Limit
Surface Texture	Surface topography Ra >10-15nm with a Lc of 2µm, surface structure dependant
Maximum Height	100 – 240mm
Maximum Weight	35kg
Maximum Slope Angle	< 85°
Sample Preparation	None

Resolution & Application Limits

Table 4: Specifications of resolution and applications.

Objective	X	2.5	5	10	20	50	100
Min Measurable Height	nm	2300	410	100	50	20	10
Approx Max Measurable Height	mm	8	22	16	12	8	3.2
Max Measurable Area	mm^2	10000	10000	10000	4500	700	150
Step Height Accuracy (1mm height step)	%	-	0.05	0.05	0.05	0.05	0.05
Max Measurable Profile Length	mm	100	100	100	100	100	100
Min Repeatability	nm	800	120	30	15	8	3
Min Measurable Roughness (Ra)*	nm	7000	1200	300	150	60	30
Min Measurable Roughness (Sa)*	nm	3500	600	150	75	30	15
Min Measurable Radius	µm	20	10	8	5	2	1
Min Measurable Vertical Angle	*	20	20	20	20	20	20

**The minimum measurable values are dependent on the structure of the specimen.*

Data

There are two types of data that differ in the way the coordinates are arranged and saved;

1. Surface Dataset

- Information for every point in its x, y and z orientation
- Resolution is better than Real-3D

- Better for performing roughness measurements

2. Real-3D Dataset

- Required for 180 - 360˚ scans.
- Each point is plotted within a network of triangles.
- Coordinates are all relative to one another.

Data set information includes;

- Colour (RGB) – 2D measurement module. No polariser. For colour information the contrast must be set to 1.
- 3D position (x, y, z)
- Estimated repeatability – View → Viewer coordinates

Measurements

Profile form

- According to ISO 5436
- Radii
- Angles
- Height steps
- Normal distances
- Edge measurement by measuring edge shape, radius, ellipse, wedge angle and bevel lengths

Profile roughness

- According to ISO 4287 and/or ISO4288
- Statistical evaluations
- Bearing ratio curve
- Spectral analysis
- Can be measured on angles of inclination; up to 30° for 20X, up to 40° for 50X, up to 55° for 100X

Surface texture

- According to ISO 25178, ISO 12781-1 and ASME B46.
- Surface texture parameters
- Bearing area curve
- Fractal dimension
- Auto correlation
- Gradient distribution
- Spectral distribution

Volume

- Calculates the volume of a defined area or the whole object.
- Used to measure volumes of voids or protrusions in a comfortable and intuitive manner

3D-Form

- Measures regular geometries as plane, cylinder, sphere ore cone
- Evaluates the deviation of a 3D data set to a plane geometric shape

Difference

- Compares two data sets.
- Computes form deviations from a measured data set to a reference geometry

Contour

- Extraction of a profile on the basis of a cutting plane, a helix, and a polyline
- This profile can be measured at any position by the use of height step, circle, line, angle, edge or roundness measurements.

Real 3D-Fusion

- Combines two datasets into one.
- Different alignment methods; coarse, automatic, manual.

Parameters

Polarisation

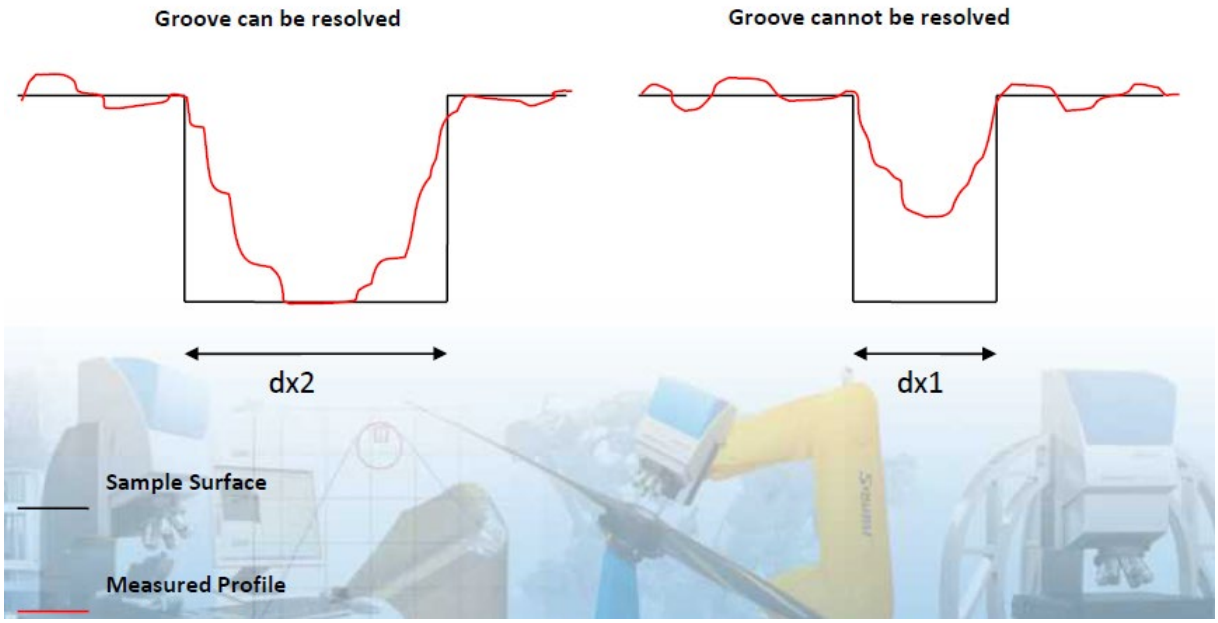
Is the property of waves (light, gravitational) that describes the orientation of its oscillations. Should be used on inclined surfaces which diffuse light. For more information about polarisation and when it is required click here (INSERT LINK).

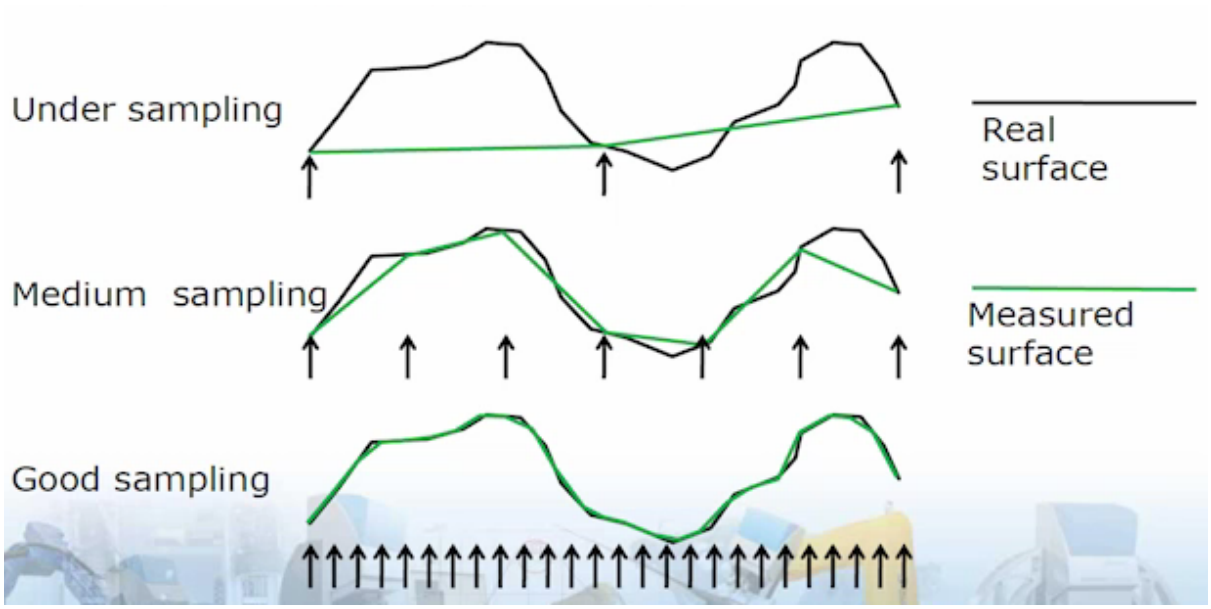
Resolution

There are three types of resolution;

1. *Lateral Resolution*

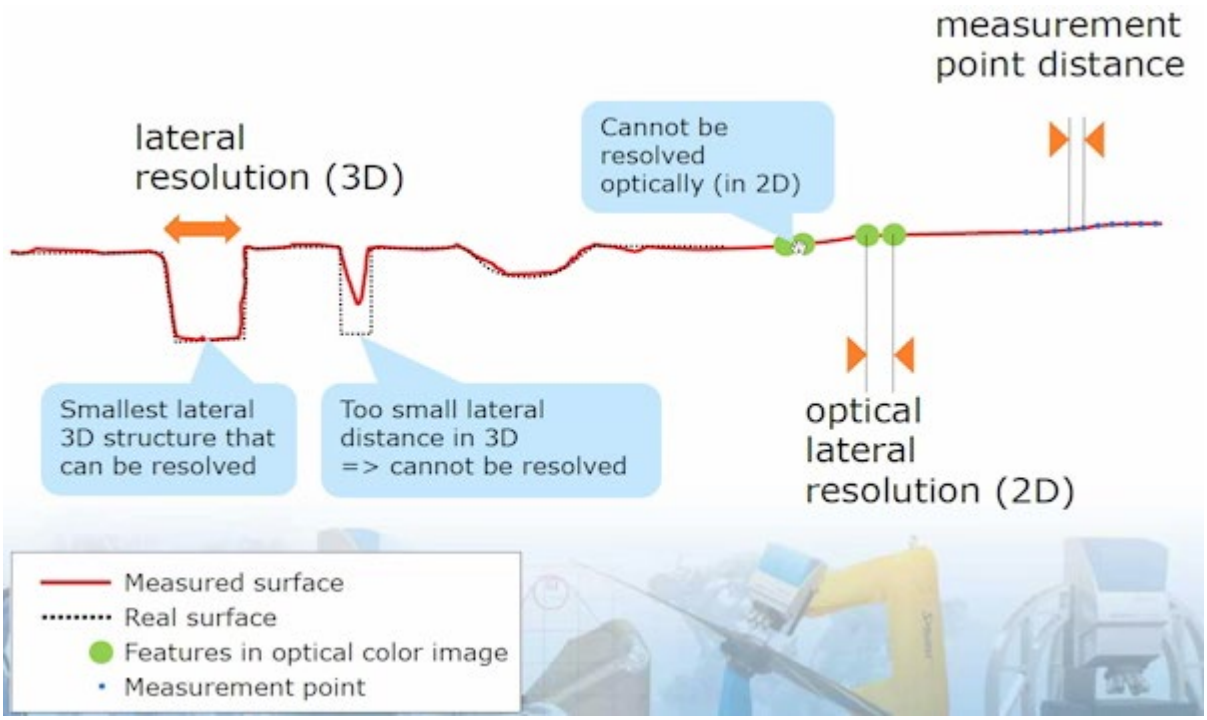
- Relevant when small details shall be visible in a 3D dataset (eg: roughness).
- Should be selected based on the structure of the surface.
- Make sure you do not under sample the surface.
- In general a lateral resolution of 1µm or better gives good results (required for roughness).
- $Rule = \frac{Lateral\ size\ of\ detail\ in\ live\ view}{a\ value\ between\ 10\ and\ 40\ inclusive}$





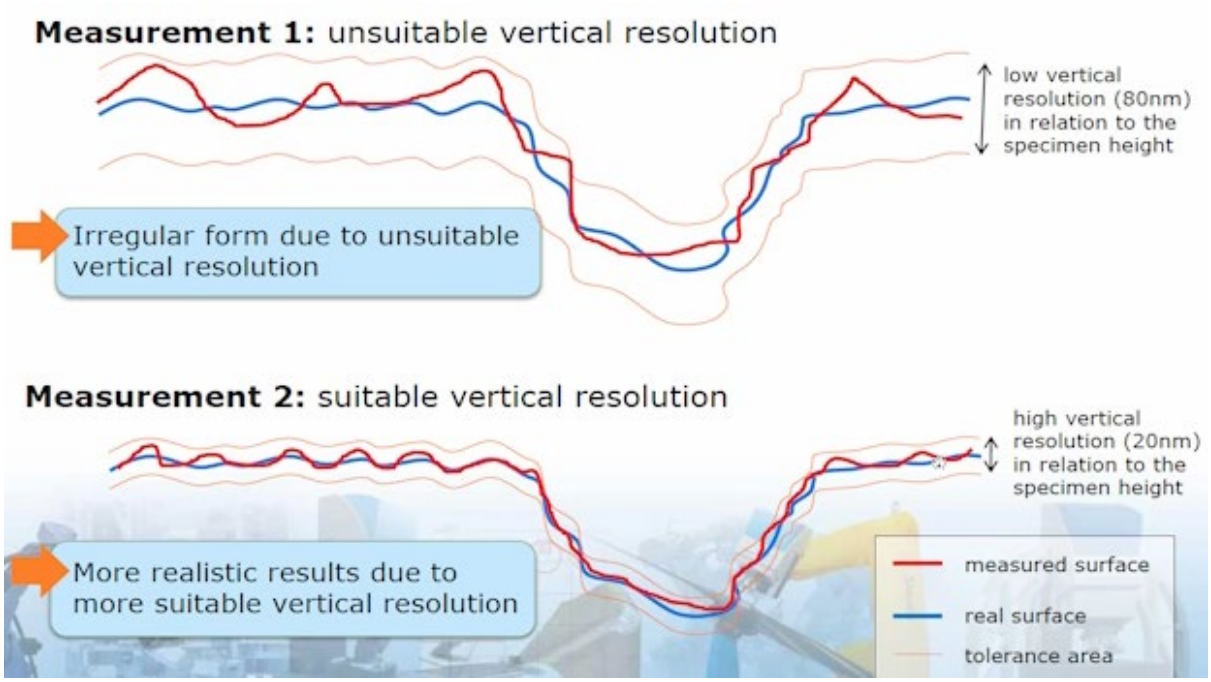
2. *Optical lateral resolution*

Relevant when small details shall be visible in an optical 2D image.

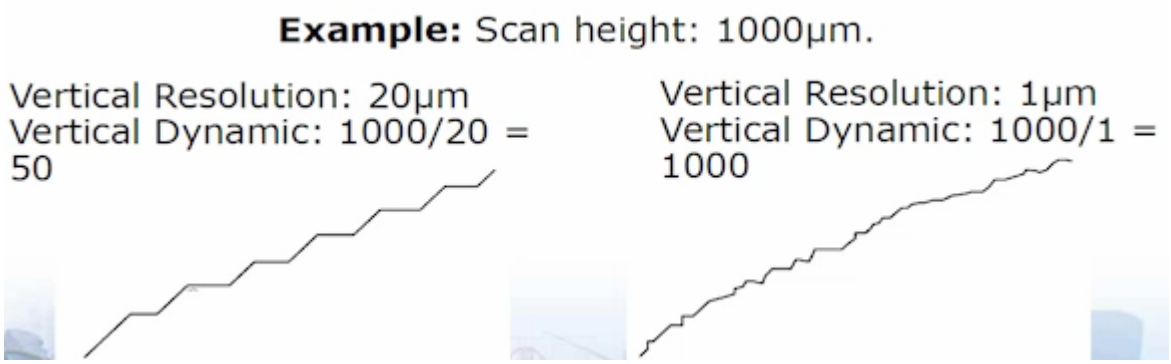


3. *Vertical Resolution*

Relevant when small height distances are to be measured.

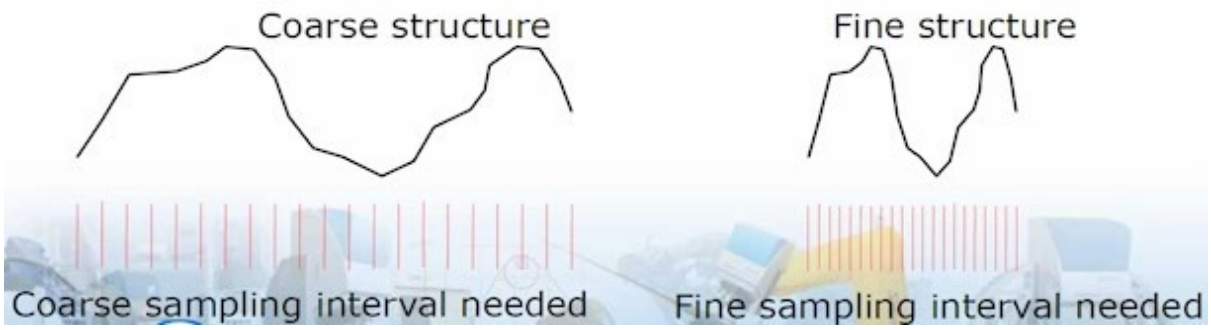


The vertical dynamic is the number of possible z values over the scan height ie: $\frac{\text{Scan height}}{\text{vertical resolution}}$. When you have a small vertical dynamic step artifacts are visible. However, with a high vertical dynamic small surface features can be measured.



Sampling distance

The distance between two measurement points.



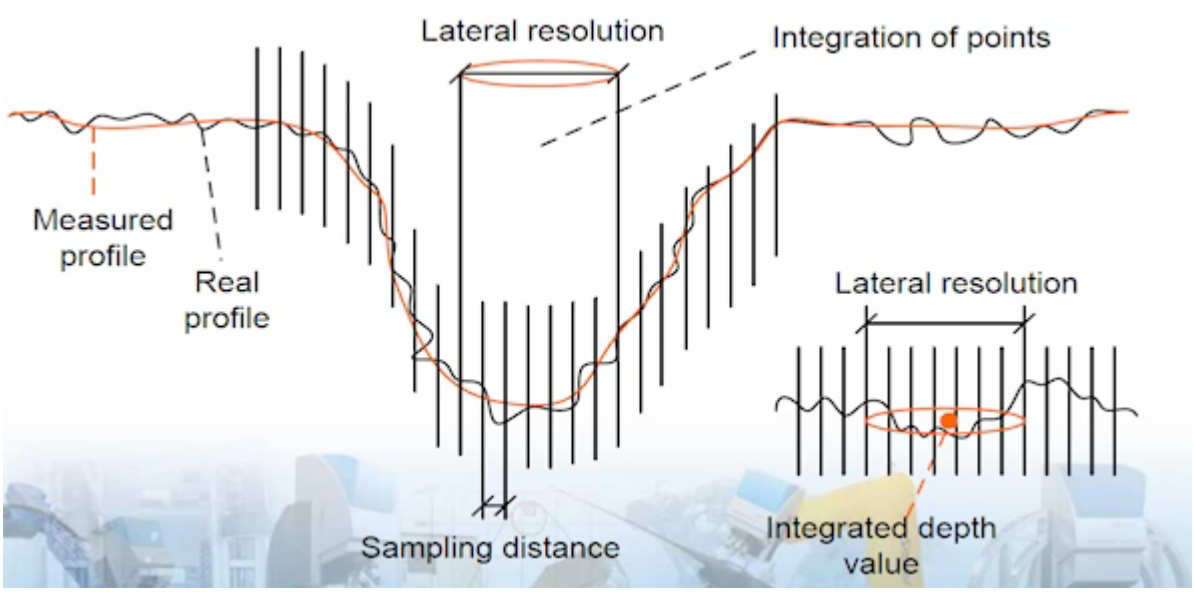


Table 5: Choosing the right resolution

Measurement	Vertical Resolution	Lateral Resolution
Height	= Height/(100-1000)	Not important
Lateral	Not important	= Length/(100 – 1000)
Cylinder	= Radius/(50-100)	= Radius/(50-100)
Flatness	= 50 – 500nm	Not important
Edge	= Radius/10	= Radius/5
Roundness	= Radius/(50-100)	= Radius/(50-100)
Roughness	~Rq/(2.5 – 5) ~Rz/(15 – 30) for random structures ~ Rz/(8 – 16) for sinusoidal structures	Default settings

Roughness Measurements

Choosing the objective

It is better to start with a higher magnification objective rather than a lower magnification objective.

Table 6: Objectives that can be used to measure specific Ra values

Ra	~Rz	Vertical Resolution	Objective
5µm	30µm	≤ 2µm	5x*, 10x, 20x, 50x, 100x
1µm	6µm	≤ 400nm	10x, 20x, 50x, 100x
0.5µm	3µm	≤ 200nm	10x*, 20x, 50x, 100x

Ra	~Rz	Vertical Resolution	Objective
0.1µm	0.6µm	≤ 40nm	20x*, 50x, 100x
0.05µm	0.3µm	≤ 20nm	50x*, 100x

**Please choose longer profiles lengths in these cases.*

Choosing Lc

1. If certificate is available – use the specified Lc.
2. If measurement instruction is available – use the specified Lc.
3. If technical drawing is available – use the specified Lc.
4. If no information is available
    a. If appropriate* for the sample – use the Lc according to ISO 4288.
    b. Otherwise choose Lc according to the following procedure.

**Measurement area has to be long enough for the required measurement length. The undesired waviness has to be removed by the filter value.*

You need to know the approximate result.

Table 7: Choose the Lc according to ISO 4288 – Random Profiles only

Ra min	Ra max	Lc	Profile length
-	0.02µm	80µm	0.4mm
0.02µm	0.1µm	250µm	1.25mm
0.1µm	2µm	800µm	4mm
2µm	10µm	2500µm	12.5mm
10µm	80µm	8000µm	40mm

Table 8: Choose Lc according to ISO 4388 – Periodical Profiles only

Rsm min	Rsm max	Lc	Profile length
0.013mm	0.04mm	80µm	0.4mm
0.04mm	0.13mm	250µm	1.25mm
0.13mm	0.4mm	800µm	4mm
0.4mm	1.3mm	2500µm	12.5mm
1.3mm	4.0mm	8000µm	40mm

Note: this is typically useful for turned surfaces.