Surface Roughness Measurement System Comparison

Stylus type

Non-contact type
Surface Roughness Measurement System Comparison

INDEX

01
Comparing Measurement Methods

02
Comparing Measurement Stability

03
Comparing Measurement Applications

04
Comparing Measurement Versatility

3D Laser Scanning Confocal Microscope
VK Series

Stylus type

Non-contact type
### Measurement data

#### Stylus type

**Measurements can only be performed line by line**

A stylus is used to trace along the surface of an object, producing a single line of data. In order to measure over an area, a motorized XY stage is required, but measurements take a long time.

#### Non-contact type

**Measurements can be performed over an area or by line**

Non-contact surface roughness systems, such as laser microscopes, can collect roughness data over an entire area with just the click of a button.

### Measuring range

#### Stylus type

**Measure over lengths of up to 100 mm 3.94”**

General detectors have measuring distances of 50 to 100 mm 1.97” to 3.94”.

#### Non-contact type

**3D measurement on up to a 50 mm 1.97” area**

Obtain nanometer resolution over a 50 mm 1.97” area with length measurements up to 60 mm 2.36”.

### Sample preparation

#### Stylus type

**Samples need to be secured or installed**

To enable highly accurate surface roughness measurements, it is necessary to process, secure, or adjust the tilt of the specimen in order to place the object’s surface within the measurement range of the system.

#### Non-contact type

**No sample preparation required**

Objects can be measured directly on the stage with no need to cut or process them. Even large objects can be accommodated with the use of a gantry system or custom stage.
## Comparing Measurement Stability

### Stylus type

**Roughness measurements**

**Dedicated to only one specific type of measurement**

There are a number of different tools that have varying stylus shapes and detector performance. Most are used to measure surface roughness while a few tools are capable of measuring shapes.

<table>
<thead>
<tr>
<th>Shape measurement system</th>
<th>Surface roughness measurement system</th>
</tr>
</thead>
</table>

**Sample placement**

**Aligning the stylus along small features is challenging**

The stylus is positioned visually by the operator, so it can be difficult to align the stylus at the center of shapes such as spheres and cylinders or if the feature of interest is small.

**Reproducibility of measured values**

**Measured values vary depending on adjustments or users**

A variety of adjustments need to be made before measuring, such as selecting the stylus type/size, measurement parameters, and tilt angle. These adjustments may cause differences in measured results due to varying levels of user experience.

### Non-contact type

**Performs surface roughness and 3D form and contour measurements**

Users can evaluate both roughness and overall shape of a part with a single system.

**Determining the measurement range is quick and visual**

The measurement cross section curve can be set while viewing the image of the desired location on the obtained 3D shape.

**No adjustments are necessary prior to measuring a surface**

The 3D information of the entire surface can be obtained with a single click. There is no need to make adjustments for each measurement, so the same measured results can be obtained even with different operators.
### Stylus type

**Soft samples**

**Stylus probe can scratch or damage surface**
Styluses are typically made of a hard material such as sapphire or diamond, which can scratch and damage the surface of the target.

### Non-contact type

**Non-contact system can measure soft materials with no damage**
Measurements can be performed without contact, which prevents the surface of the target from being scratched and enables accurate measurements. Targets in paste form such as resistive elements before firing can also be measured.

### Viscous samples

**Unable to measure non-solid or adhesive surfaces**
The stylus catches on viscous targets, so it is not possible to trace the correct surface shape.

### Transparent samples

**Transparent objects like glass can be measured**
Even transparent objects such as glass can be measured. However, these objects may be damaged due to the sapphire or diamond that is used at the tip of the stylus.

**Measure surface roughness and film thickness on transparent materials**
Non-contact systems are able to measure the surface of transparent materials, even if they are curved or complex, in addition to the thickness of any transparent layers.
### Stylus type

**Features smaller than the radius of the stylus tip cannot be measured**

The stylus tip is spherical. It is not possible to accurately capture the shapes of grooves (such as scratches) that are narrower than the stylus tip radius.

**Measurements are affected by stylus wear**

Because styluses wear down, they must be ground or replaced. The configuration of the stylus wear is not uniform; it varies depending on the material and shape of the measurement target. Consequently, the obtained shape waveform varies as the stylus shape changes.

**Consumables**

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### Non-contact type

**Surfaces with complex shapes or steep angles can be measured**

The laser spot diameter is much smaller than the stylus of a roughness gauge, which enables more accurate measurements of detailed shapes.

**Laser light, which is not subject to wear, is used**

A high-intensity laser light source is used for the measurements, so they are not affected by wear in the same way as measurements made using a stylus.

**Traceability**

Measurements are traceable to national standards

Measurements are based on a national standard traceability system.

**National Institute of Advanced Industrial Science and Technology (AIST)**

JCSS accredited organization

Gauge block/height difference gauge for calibration (reference standard for daily use)

Inspection/calibration equipment: gauge block/height difference gauge/ pin gauge

Shape measurement device

**National Institute of Standards and Technology (NIST)**

NVLAP accredited organization

Coordinate measurement equipment

Standard step

Reference scale

3D Laser Scanning Confocal Microscope VK-X Series

**Measurement accuracy**

**Stylus tip curvature radius**

Radius: 2 μm

**Laser spot diameter**

Radius: 0.2 μm

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Transforming 3D Surface Metrology
3D Laser Scanning Confocal Microscope

16-bit laser confocal
XYZ traceability

Quickly Visualize and Quantify Differences between Surfaces

Provides clear analysis of surface roughness
Up to 42 parameters for analyzing roughness are used to automatically compare multiple samples. Values such as Ra and Rz are automatically visualized in relation to each other. Instantly analyze previously undefined aspects used to quantify differences between targets, from judgment between good and bad products to analysis of samples made through different processing methods. With explanations attached to each parameter, any user is able to easily analyze surface texture.

Conventional Measurement Systems
Separate result files require longer analysis time and hinder understanding. Combining the data in Excel can be time consuming.

VK Series
You can arrange the samples you want to analyze and specify the item to compare for analysis.

Conventional Measurement Systems
Good sample: Ra = 1.8
Bad sample: Ra = 1.8
Even though these parts feel and appear different, it is difficult to judge which roughness parameter should be used in the evaluation. There are no differences when using Ra and Rz.

VK Series
Roughness parameter variations can be checked visually.
High-accuracy Measurement Regardless of the Material or Shape

Resolution: 0.5 nm + 16-bit PMT + AI-Scan

The high resolution and angular characteristics of the VK Series enable it to perform measurements that were not possible with interferometers and conventional laser microscopes. Additionally, KEYENCE’s proprietary laser technology and processing systems eliminate variations in measured results obtained by different operators.

High Magnification Color Imaging

16-bit laser color observation + magnification up to 28,800x

The VK Series is capable of SEM-equivalent high-resolution observation—which is not possible with optical microscopes. Image in true color at up to 28,800x with 120 nm lateral resolution.