

# Optical Metrology Application Note

Full Report available at:  
<https://bit.ly/3alzddq>

Application: Measurement of  
external and internal splines.



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Bruker Alicona is a leading global supplier of optical metrology solutions based on the principle of Focus Variation.

Focus Variation works on the basis of moving a focal plane over a surface and collecting robust 3D data which can then be used to measure geometric form and surface finish from a single optical sensor.

Measurement processes can be fully automated and provide GD&T measurement capabilities across all industrial & medical sectors.

The systems are in use in Industry, Industrial Research, Universities and production facilities globally.

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## Introduction

In this measurement report summary, we describe the use of Optical Metrology to measure profile and surface finish of mating outer and inner splines.

The metrology system used for this measurement task is the InfiniteFocusG5 system fitted with an Advanced Real3D RotationUnit to hold and rotate the sample, shown below in Figure 1.



Figure 1

Advanced Real3D  
RotationUnit with holding  
chuck

The parts to be measured, sample 6 & 7 are illustrated below in Figure 2 with the area to be measured identified.

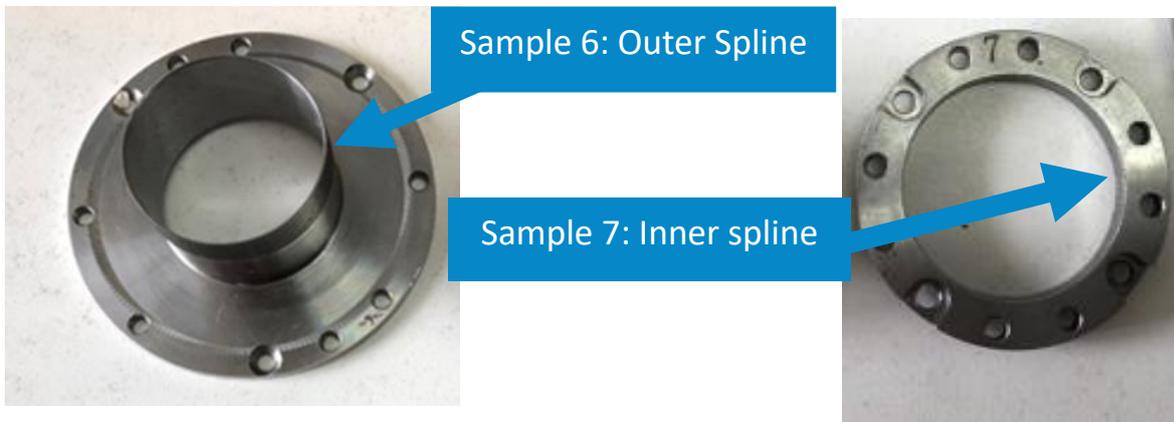


Figure 2

In use the parts to be measured are located in the 3-jaw mounting chuck.

The sample 6 is then scanned to produce a complete high-resolution data set which is then displayed in true colour or in pseudo colour related to height as displayed in Figure 3 below

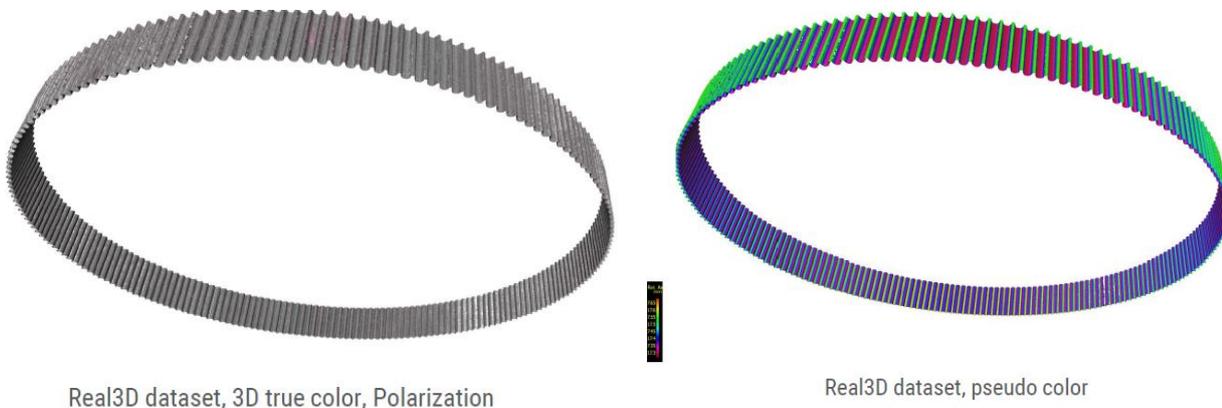


Figure 3

Using the Alicona Contour Measurement module it is now possible to measure the inner and outer diameter of the gear as displayed in Figure 4.

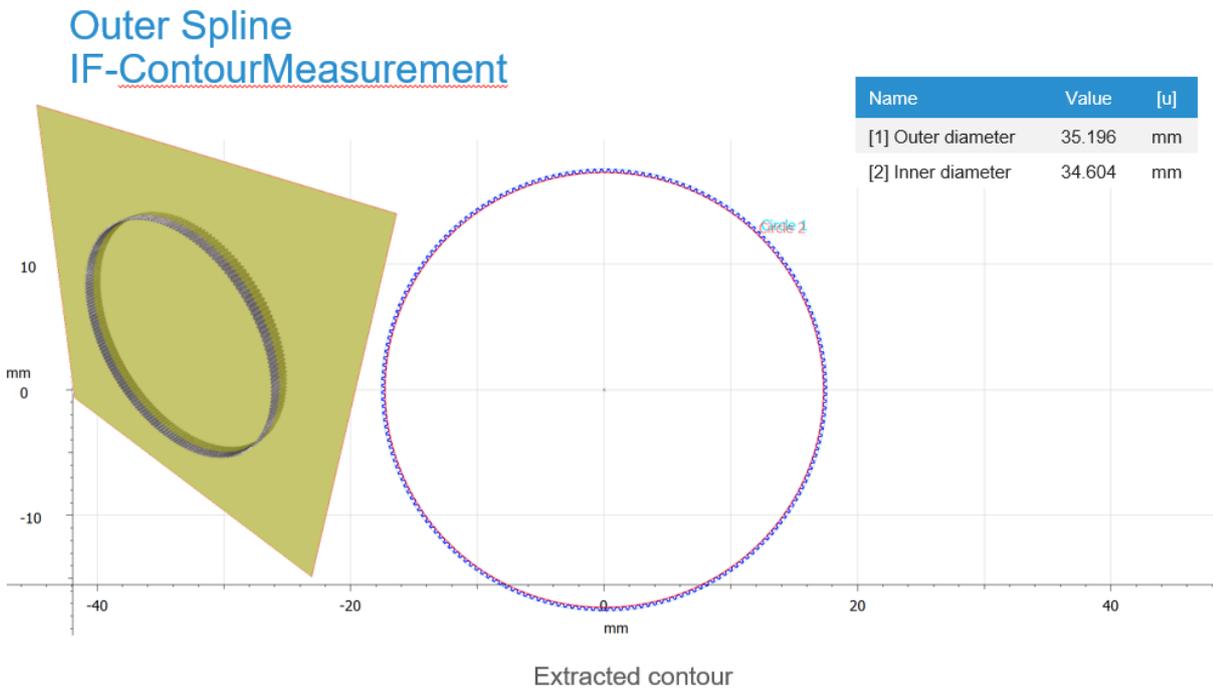


Figure 4

Using a section of the data set the spline tooth profile can be displayed in true colour and pseudo colour and measured, as shown below in figure 5 and figure 6.

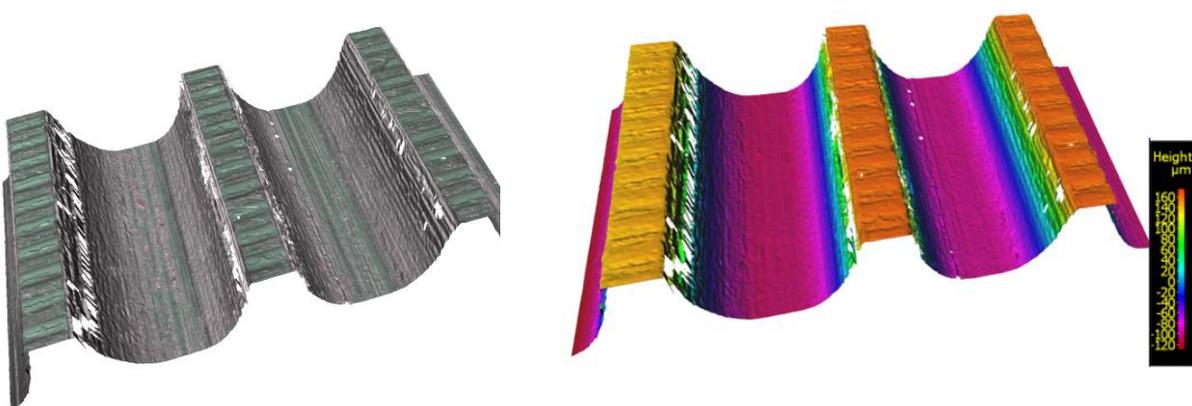
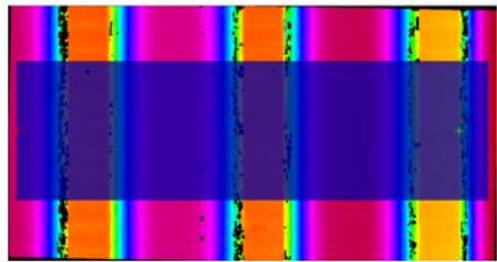


Figure 5



Profile path, profile width: 440µm

Name	Value	[u]
[1] Max. height	264.6	µm
[2] Max. height	264.4	µm
[3] Radius	122.5	µm
[4] Radius	134.9	µm
[5] Radius	114.6	µm
[6] Radius	115.2	µm
[7] Width	121.4	µm
[8] Width	122.9	µm

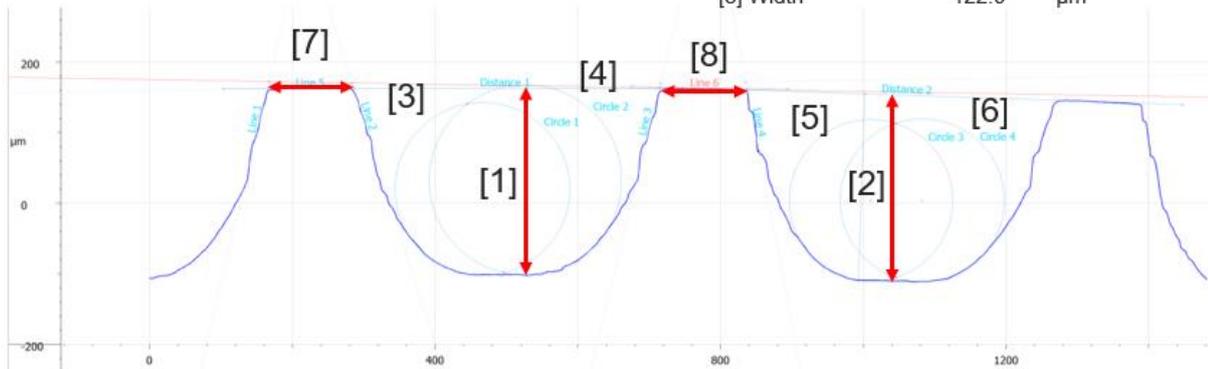
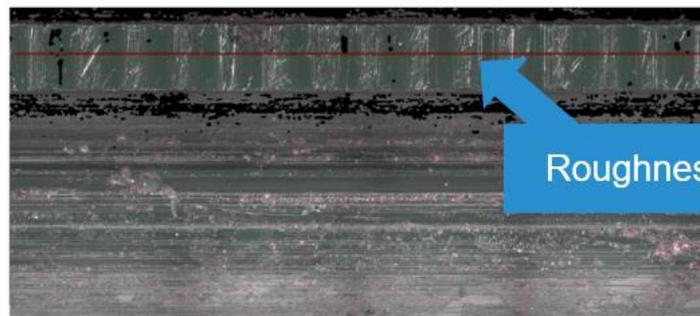
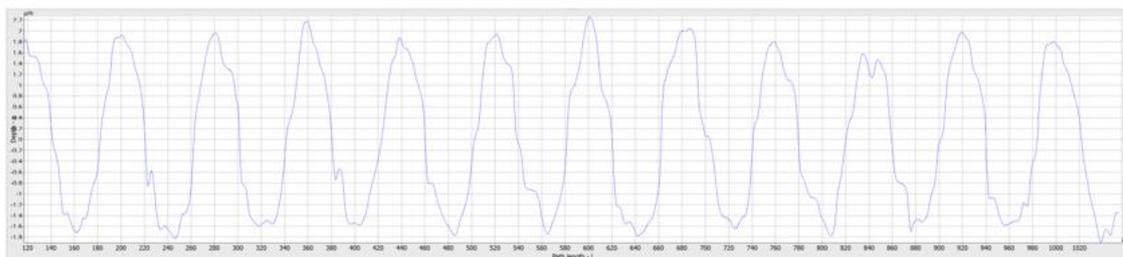


Figure 6

Using the same data set it is then an easy task to measure roughness profile across the teeth using the profile roughness module and to measure the profile of the tooth flank as shown in figure 7 & 8 below.



Profile path, profile width: 3.5µm



Extracted roughness profile (Lc=250µm)

<b>Ra:</b>	1.209 µm	<b>Rq:</b>	1.315 µm	<b>Rz:</b>	3.891 µm
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Figure 7

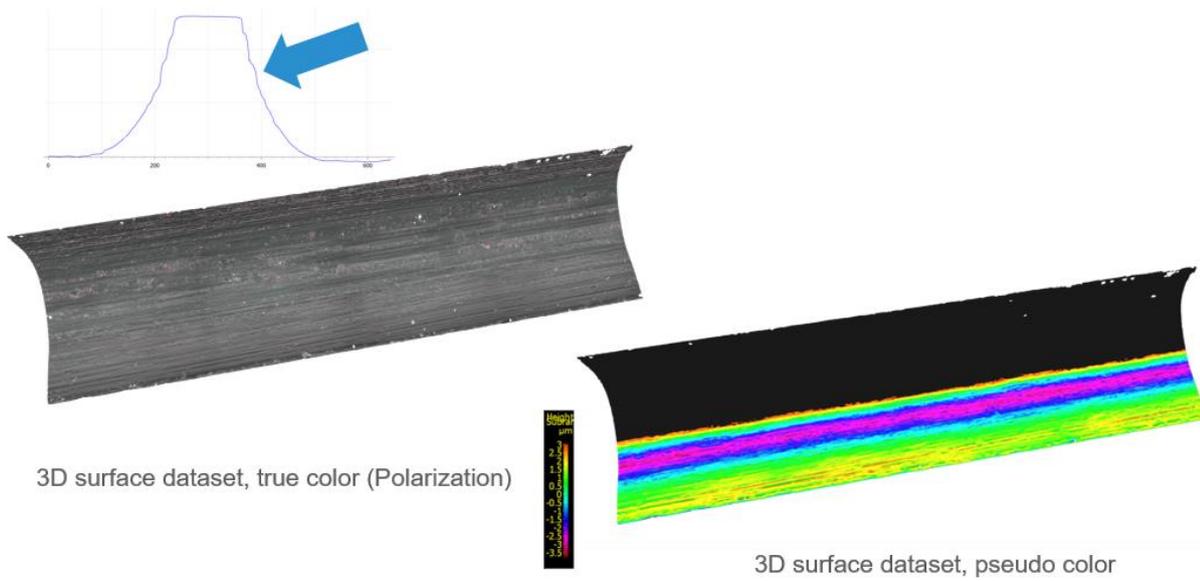


Figure 8

The measurement of the inner spline is achieved using the same rotation device with the sample tilted at 30° to the measurement axis, the data sets from the inside is displayed below in Figure 9 in true colour and pseudo colour.



Figure 9

Using this inner spline data, it is then possible to perform the same measurements as illustrated on the external spline form measurements displayed above. It is also possible to easily compare the data against CAD data for quality assurance.

## **Summary:**

It can be seen from this application note that using Optical Metrology provides a unique solution for the measurement inner and outer spline and gear forms.

The InfiniteFocusG5 used for this report is a highly accurate and flexible optical 3D measurement system based on the Focus Variation technology. Using only one sensor, users verify dimensional accuracy surface finish of their components. By means of Vertical Focus Probing, an extension of Focus Variation vertical surfaces can be probed laterally. Components in high accuracy, with a high vertical resolution and in high repeatability. The robust measurement principle of Focus Variation in combination with a vibration-isolating hardware allows the systems to be used in a manufacturing environment. With an automation interface, InfiniteFocus can also be used for fully automatic measurements in production.