

**Soft & Transparent Surface Measurement
Using 3D Profilometry**



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INTRODUCTION:

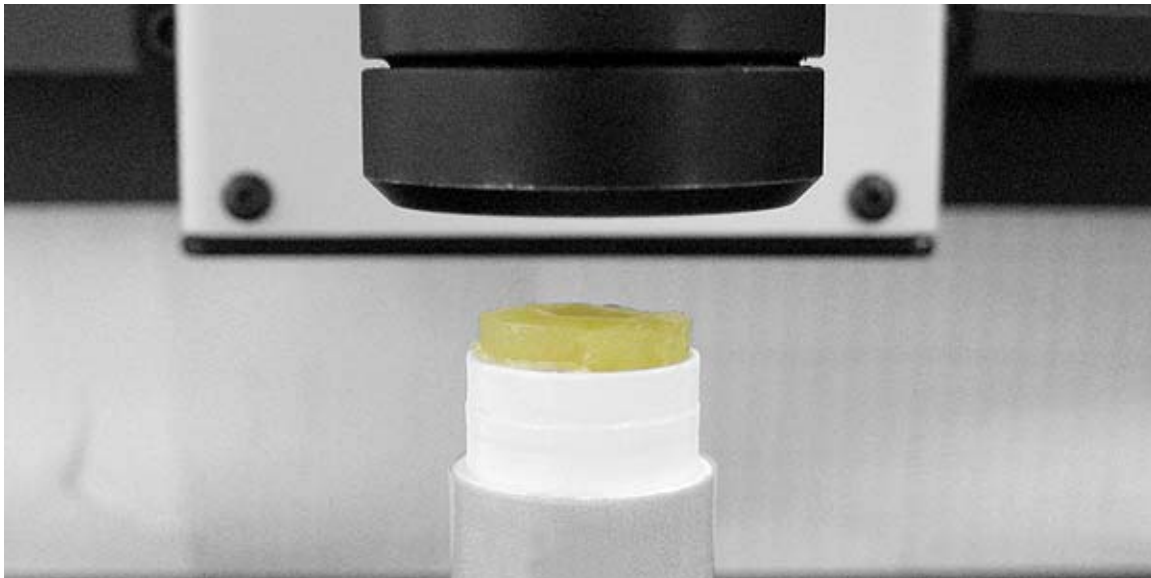
Non-contact surface measurement has the advantage that eliminates the possibility of surface alteration of a given application (deformed, scratched or moved). This may be critical, for example, when measuring soft surfaces of films, gels and many others. Additionally, many of these soft surfaces will have transparent or absorptive surfaces leading to measurement error with some optical techniques.

IMPORTANCE OF 3D NON CONTACT PROFILOMETER FOR WELD INSPECTION

Unlike other techniques such as touch probes or interferometry, the 3D Non Contact Profilometer, using axial chromatism, can measure nearly any surface, sample sizes can vary widely due to open staging and there is no sample preparation needed. Nano through macro range is obtained during surface profile measurement with zero influence from sample reflectivity or absorption, has advanced ability to measure high surface angles and there is no software manipulation of results. Easily measure any material: transparent, opaque, specular, diffusive, polished, rough etc. The technique of the Non Contact Profilometer provides an ideal, broad and user friendly capability to maximize weld surface studies with the benefits of combined 2D & 3D capability and portability for field studies.

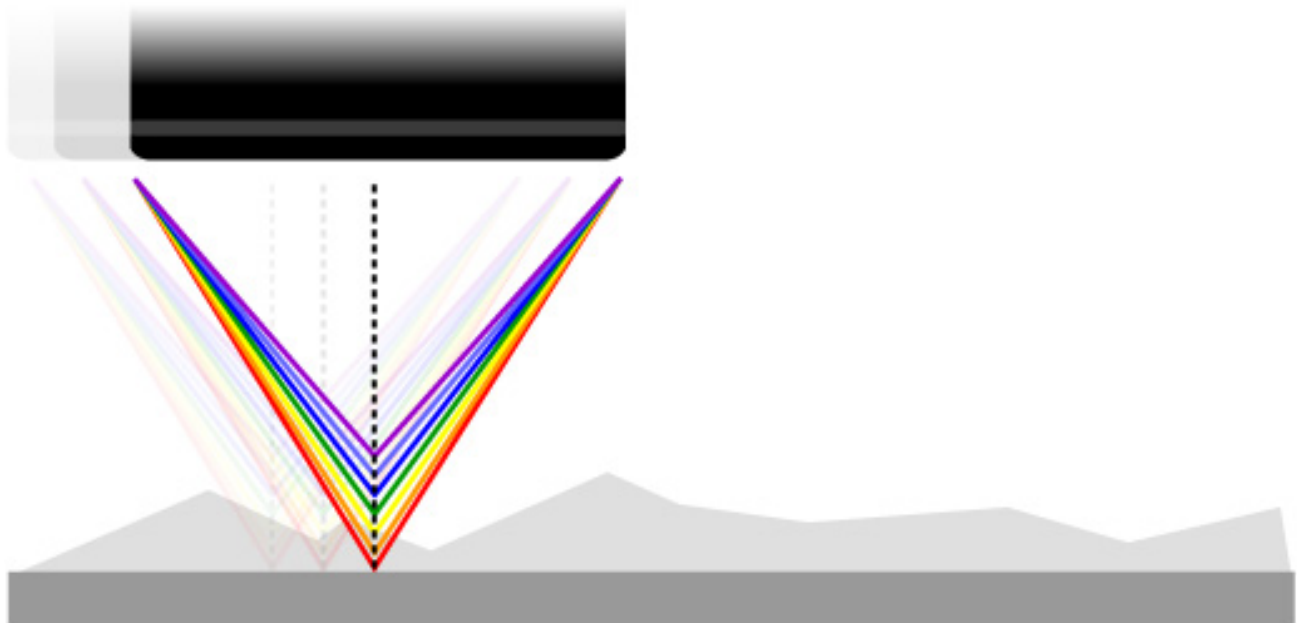
MEASUREMENT OBJECTIVE

In this application the Nanovea ST400 Profilometer is used to measure the extremely soft and transparent surface of lip balm made of a petroleum jelly.



MEASUREMENT PRINCIPLE:

The axial chromatism technique uses a white light source, where light passes through an objective lens with a high degree of chromatic aberration. The refractive index of the objective lens will vary in relation to the wavelength of the light. In effect, each separate wavelength of the incident white light will re-focus at a different distance from the lens (different height). When the measured sample is within the range of possible heights, a single monochromatic point will be focalized to form the image. Due to the confocal configuration of the system, only the focused wavelength will pass through the spatial filter with high efficiency, thus causing all other wavelengths to be out of focus. The spectral analysis is done using a diffraction grating. This technique deviates each wavelength at a different position, intercepting a line of CCD, which in turn indicates the position of the maximum intensity and allows direct correspondence to the Z height position.



Unlike the errors caused by probe contact or the manipulative Interferometry technique, White light Axial Chromatism technology measures height directly from the detection of the wavelength that hits the surface of the sample in focus. It is a direct measurement with no mathematical software manipulation. This provides unmatched accuracy on the surface measured because a data point is either measured accurately without software interpretation or not at all. The software completes the unmeasured point but the user is fully aware of it and can have confidence that there are no hidden artifacts created by software guessing. Nanovea optical pens have zero influence from sample reflectivity or absorption. Variations require no sample preparation and have advanced ability to measure high surface angles. Capable of large Z measurement ranges. Measure any material: transparent/opaque, specular/diffusive, polished/rough.

RESULTS:

Image below shows the full 3D view of petroleum jelly surface, along with different surface parameters corresponding to ISO 25178, 3D surface area calculations and surface flatness corresponding to ISO 12781. A 2D cross-section (below) is shown for more surface detail.

ISO 25178

Height Parameters

Sq	76.63	μm
Ssk	0.3746	
Sku	3.144	
Sp	238.5	μm
Sv	174.3	μm
Sz	412.8	μm
Sa	60.00	μm

Other 3D Parameters

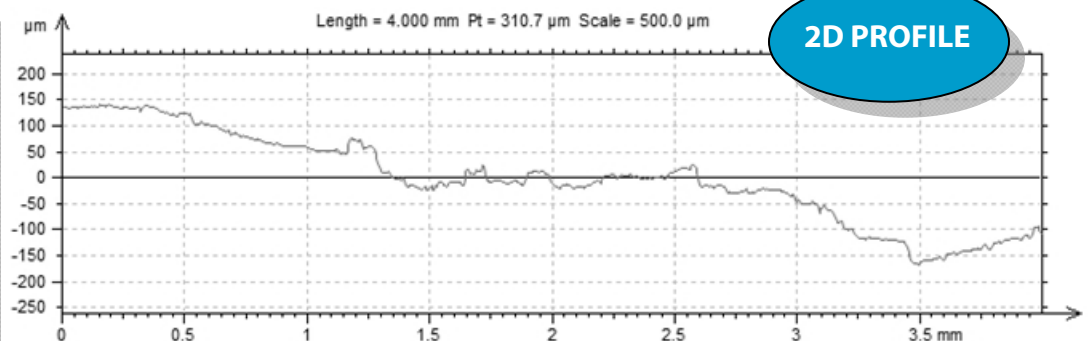
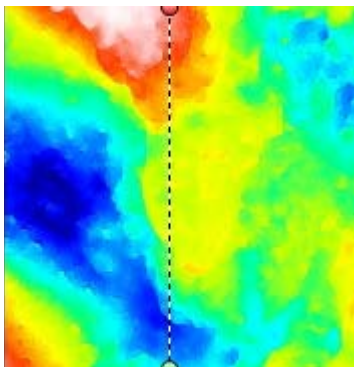
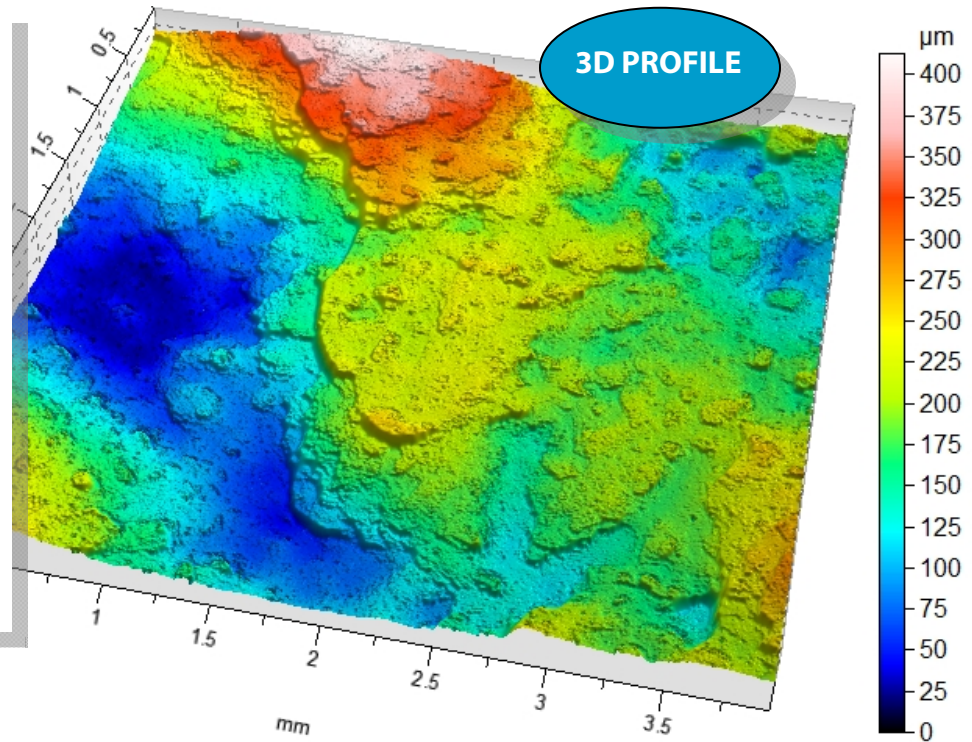
Miscellaneous

Sdar	20.66	mm^2
Spar	16.00	mm^2

ISO 12781

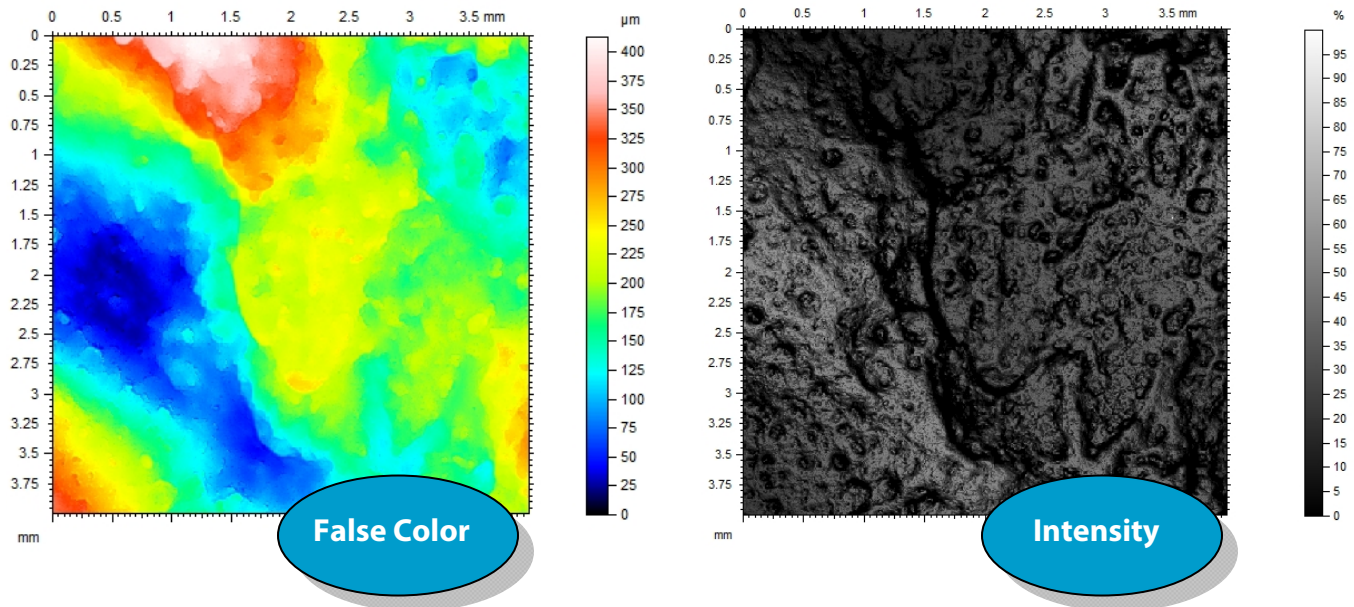
Flatness parameters

FLTt	326.9	μm
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RESULTS (cont):

Images below show a 3D surface of the petroluem jelly (left) alongside a contrast image (right), both acquired simulataneously in the measurement.



CONCLUSION:

In this application, we have shown how the Nanovea 3D Non Contact Profilometer can precisely characterize a very soft, transparent material that could have the potential for internal reflections. Surface roughness, surface flatness and 3D surface area were used here to characterize the surface. If applicable the 3D data or the Intensity data could be used to determine particle or pit size distributions. Soft materials, such as the petroleum jelly example in this note, can easily be analyzed with the standard table top Nanovea Profilometer or a portable option is available for immovable and or field application study.

Learn more about the: [Nanovea Profilometer](#)