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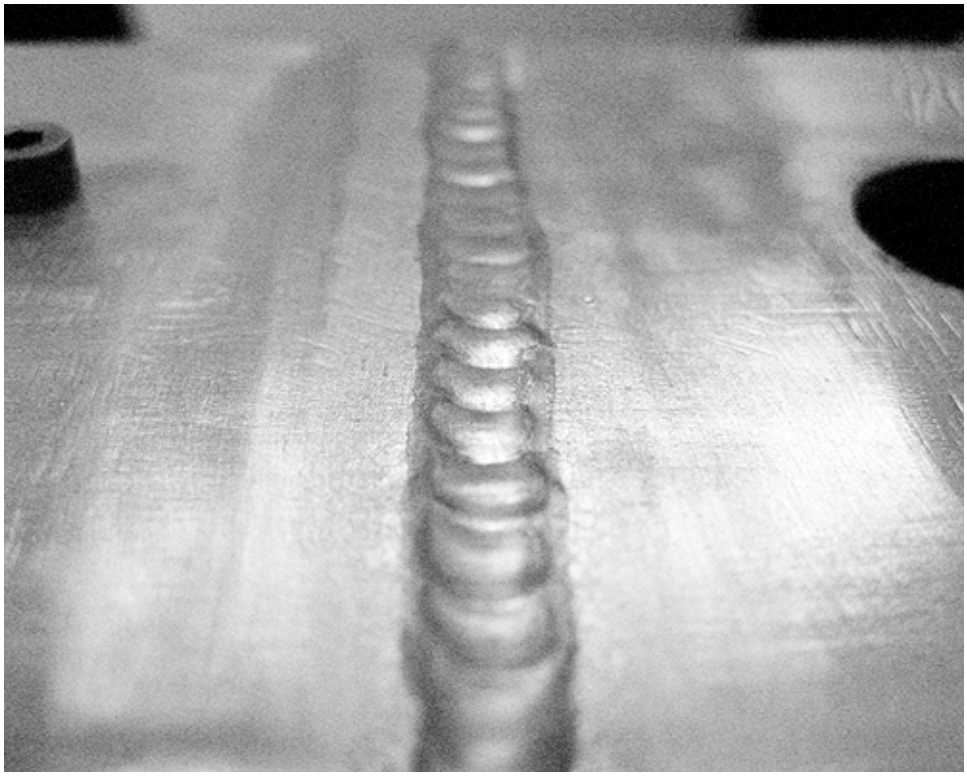
A Better Measure.

WELD SURFACE INSPECTION
USING 3D PROFILOMETRY



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INTRODUCTION:

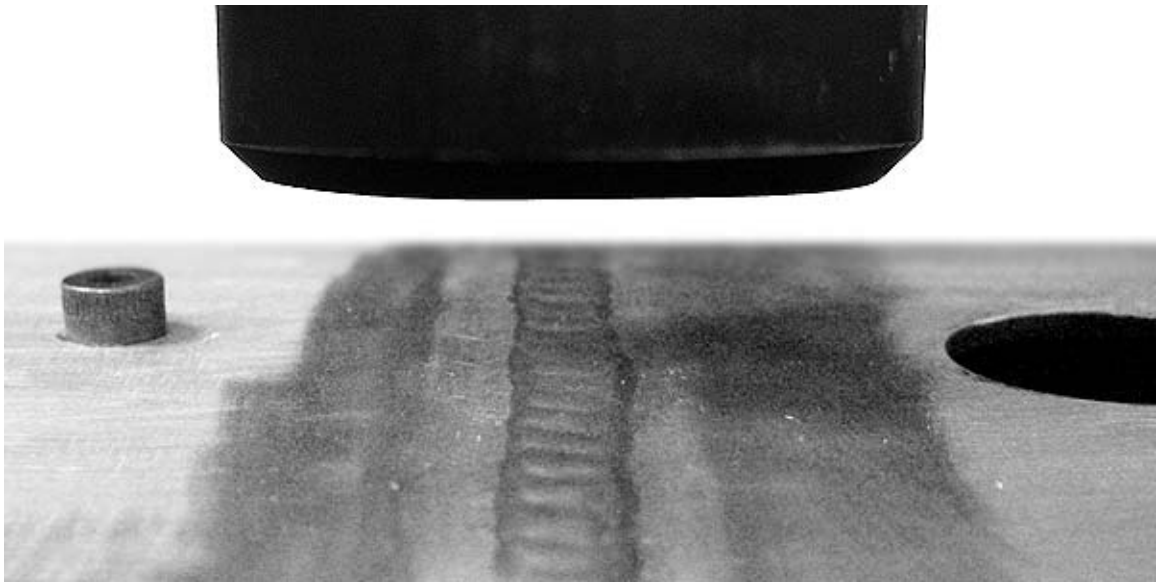
It may become critical for a particular weld, typically done by visual inspection, to be investigated with an extreme level of precision. Specific areas of interest for precise analysis include surface cracks, porosity and unfilled craters, regardless of subsequent inspection procedures. Weld characteristics such as dimension/shape, volume, roughness, size etc. can all be measured for critical evaluation.

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.

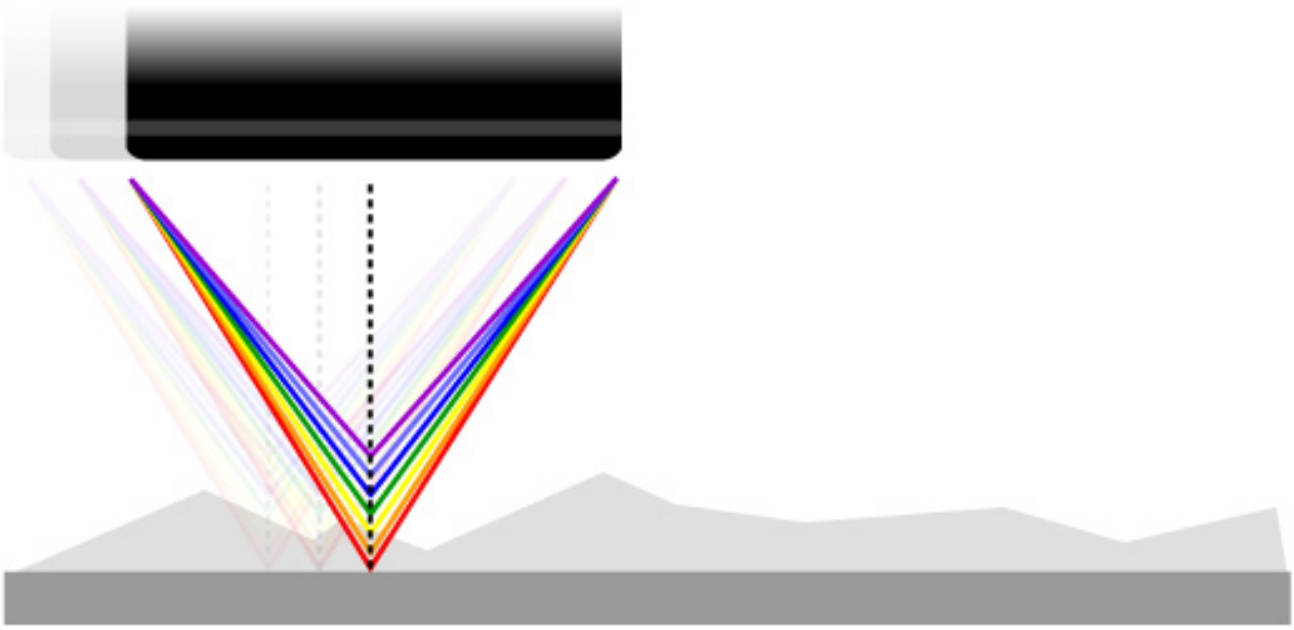
MEASUREMENT OBJECTIVE

In this application the Nanovea ST400 Profilometer is used to measure the surface roughness, shape and volume of a weld as well as the surrounding area. This information can provide critical information to properly investigating the quality of the weld and weld process.



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.

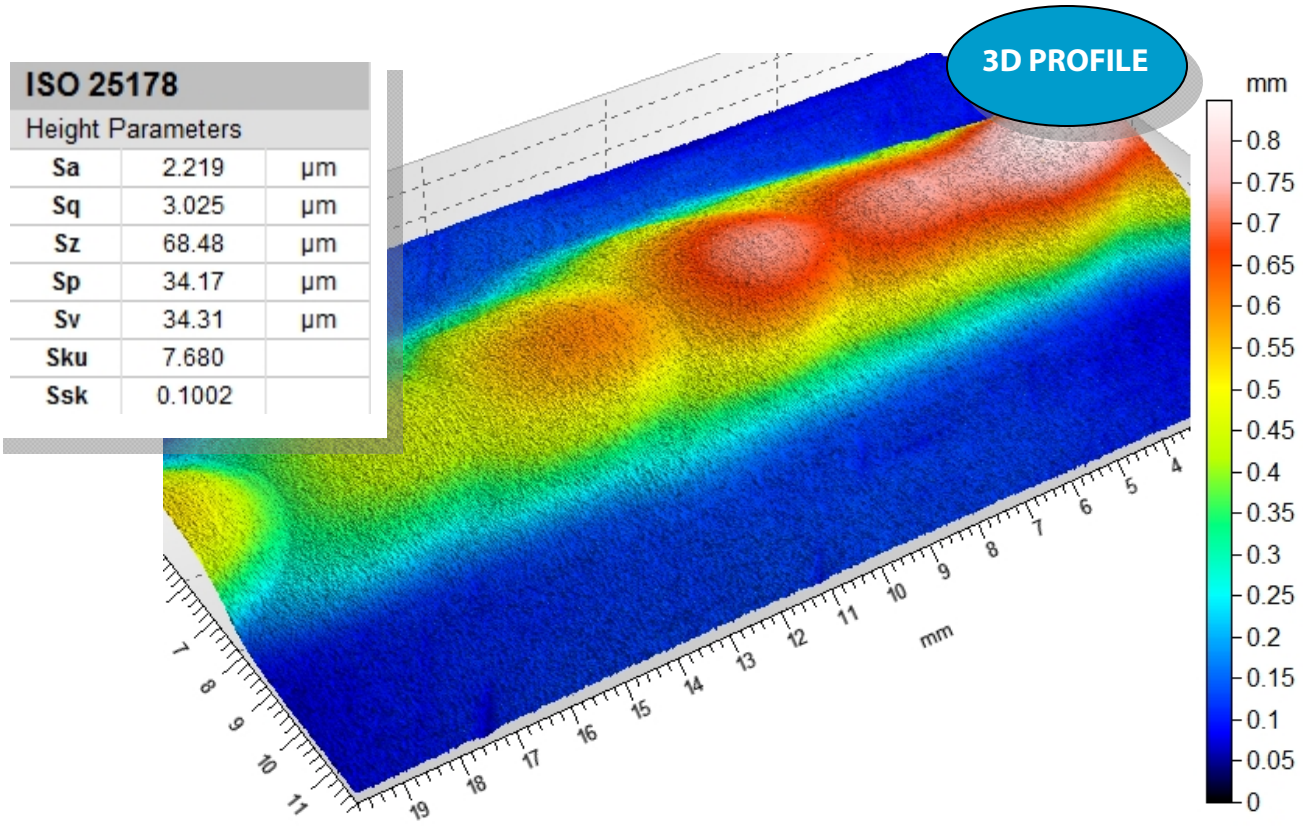


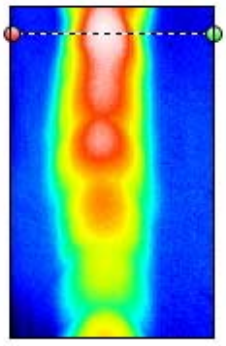
Unlike the errors caused by probe contact or the manipulative Interferometry technique, White light Axial Chromatism technology measures height directly from the detection of the wavelength that hits the surface of the sample in focus. It is a direct measurement with no mathematical software manipulation. 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:

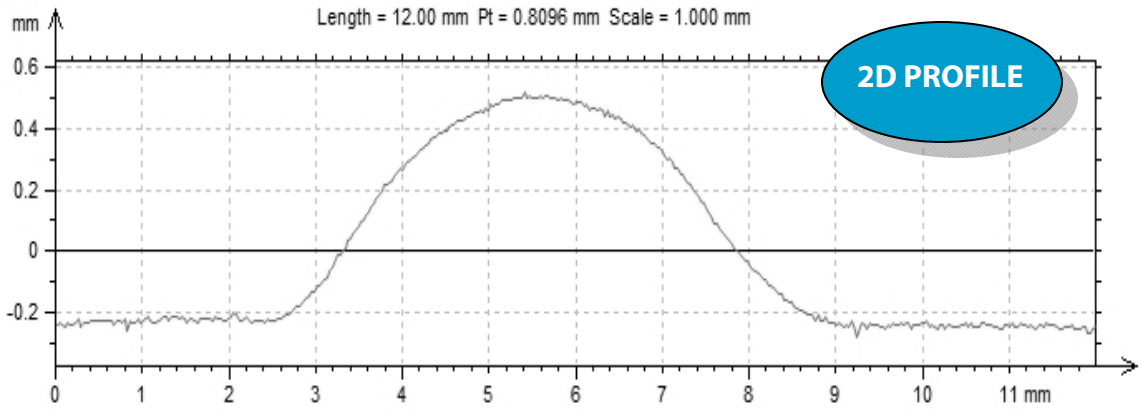
Image below shows the full 3D view of the weld and the surounding area along with the surface parameters of the weld only. And a 2D cross section profile is also show below.

ISO 25178		
Height Parameters		
Sa	2.219	µm
Sq	3.025	µm
Sz	68.48	µm
Sp	34.17	µm
Sv	34.31	µm
Sku	7.680	
Ssk	0.1002	



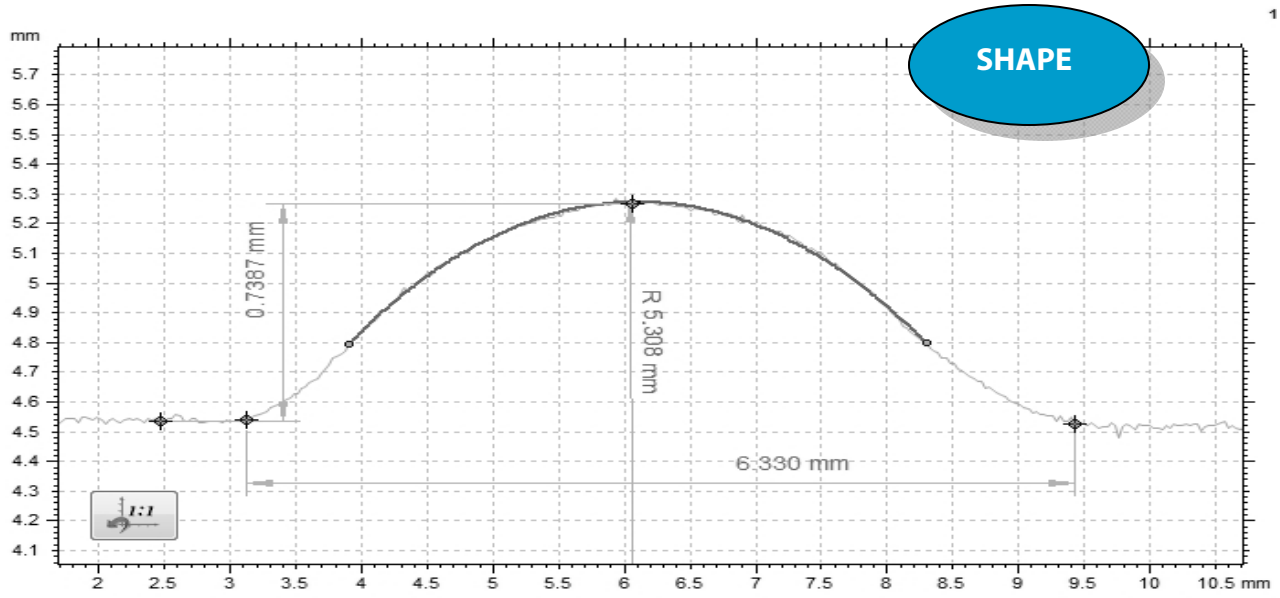


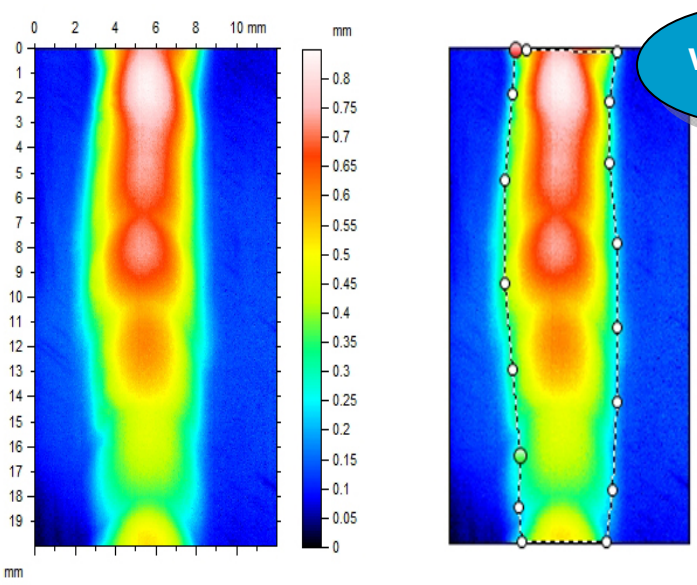
Extracted profile



RESULTS (cont):

With above cross-section removed from the 3D, dimensional information of the weld is calcualted below. And surface area and volume of material calcualted for the weld only also below.





	Hole	Peak
Surface (mm²)	0.02187	101.3
Volume (mm³)	8.799e-005	23.27
Max. depth/height (mm)	0.0276	0.6195
Mean depth/height (mm)	0.004024	0.2298

CONCLUSION:

In this application, we have shown how the Nanovea 3D Non Contact Profilometer can precisely characterize critical characteristics of a weld and the surrounding surface area. From the roughness, dimensions and volume, a quantitative method for quality and repeatability can be determined and or further investigated. Sample welds, such as the example in this note, can easily be analyzed, along with AFM, 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