Application Note

VSC-OSP: Determination of Scaling Factor

Application Note: 2025/03

Optical Surface Profiling (OSP) is a laser-based technique utilized for evaluating the topography of a sample surface, specifically measuring height variations along the Z-axis. While typically conducted in air, OSP can also be employed under specific conditions in a liquid electrolyte.

In OSP, a laser beam is directed onto the sample surface, and the reflected light is analyzed to generate a detailed topographic map. This method offers insights into surface morphology, including details like roughness, feature heights, and other surface characteristics.

The "Scaling Factor" setting in OSP allows users to adjust for experimental or system limitations during measurements. This adjustment is particularly crucial when OSP is performed in a liquid medium, such as a liquid electrolyte. Liquids like water have a significantly higher refractive index (approximately 1.3330) compared to air (close to 1.000277). These differing refractive indices can impact the accuracy of OSP measurements in liquid environments. Therefore, precise adjustment using the Scaling Factor is essential to ensure reliable and accurate data acquisition under such conditions.

Determination of Scaling Factor

1. Power on the System Control Box. You should observe the light on top of the OSP Head is illuminated, indicating power.
2. Navigate to the System Tab to verify Ethernet communication with the Laser Controller.
3. Create a new Project titled “VSC-OSP Scaling Factor determination and verification.” Configure the parameters as depicted in Fig. 1(a), setting the “Scaling Factor” to 1.000.
4. Position a slip-gauge test samples (e.g., the 10mm slip gauge) on the base below the OSP Laser Head.
5. Ensure the laser head is powered and select OSP Step in the software. A red laser spot emitted from the VSC-OSP Laser Head should now be visible on the base, as illustrated in Fig. 1(b).
6. Adjust the position of the VSC-OSP Laser Head in the Z direction until the sensor on top of the head displays a Green Light. Note the sequence: Blinking Amber > Solid Amber > Green > Solid Amber > Blinking Amber, as shown in Fig. 1(c).
7. Record the Measured Value from the Optical Sensor Setup.
8. Move the Laser Head upward or downward in the Z direction by a known distance.
9. Utilize the Known Distance Movement and observe the change in measurement response to determine the scaling factor. Input this factor into the Scaling Factor parameter. Optionally, adjust

©Copyright 2025 AMETEK, Inc. All Rights Reserved

the Laser Head in Z until the measurement reads 0 microns to establish a baseline for subsequent scans, though this step is not mandatory.



Figure 1. (a) Default settings for OSP measurement and (b) the laser spot and (c) status light of OSP scan head.Run the experiment and use Line fit to determine the slip-gauge height measured by the VSC-OSP. As shown in Fig. 2, the height was 9,760 µm.

10. Conduct the experiment and employ Line fitting to ascertain the slip-gauge height measured by the VSC-OSP, which is $H_{measured}$.
11. The Scaling Factor is calculated as $H_{measured}/H_{standard}$, where $H_{measured}$ = 9760 µm and $H_{standard}$ = 10000 µm; Therefore, the Scaling Factor is calculated as 0.976.

Verification of Scaling Factor

The Scaling Factor can be additionally validated by measuring two slip gauges: one measuring 1mm and the other 5mm. The measured values should align with the specified dimensions of the slip gauges. The

©Copyright 2025 AMETEK, Inc. All Rights Reserved

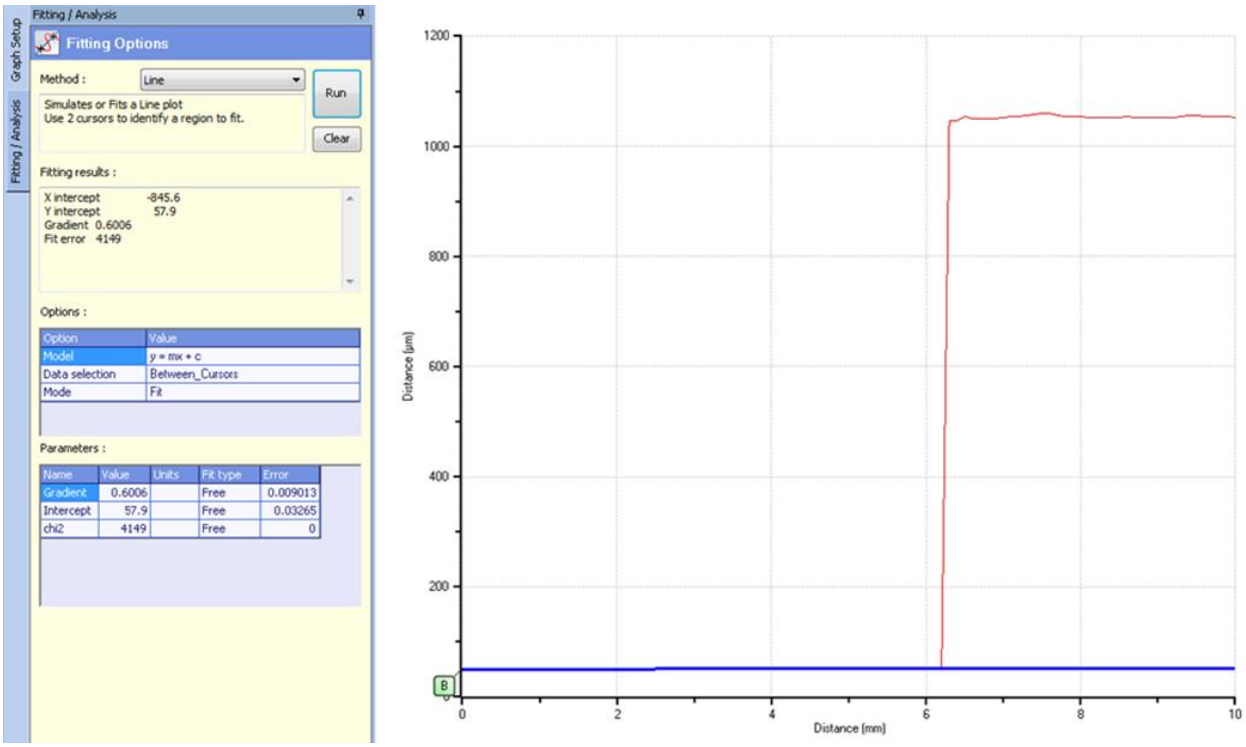


Figure 2. Verification measurement result with the 1mm slip gauge sample.

errors for the 1mm and 5mm slip gauge samples are ±5 µm and ±25 µm, respectively. As depicted in Fig. 2, the measured height of the 1mm slip gauge is 1002.3 µm.

Summary

The scaling factor can be established and validated using a standard sample. It is advisable to maintain a shallow liquid level, a relatively small area, and a vibration-free environment when determining the scaling factor in liquids to prevent artifacts from rippling.

One significant application of OSP includes utilizing topographic data as a reference file. In this scenario, the probe of an electrochemical technique is adjusted incrementally along the Z-axis to maintain a Constant Probe-to-Sample Distance during Area Scan data mapping. This experimental setup aims to eliminate convolution effects between topographic alterations and electrochemical data, thereby ensuring that changes in the measured signals remain unaffected by variations in the sample-to-probe distance.

Summary – This application note showed how to determine and verify the scaling factor to utilize the VSC-OSP technique, which is the foundation of Constant Distance measurements with other VersaSCAN techniques.
Please contact us for more information at **www.ameteksi.com**

©Copyright 2025 AMETEK, Inc. All Rights Reserved