Surface Profile

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Testing & Measuring Everything

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The Measure of Quality

Why Measure Surface Profile?

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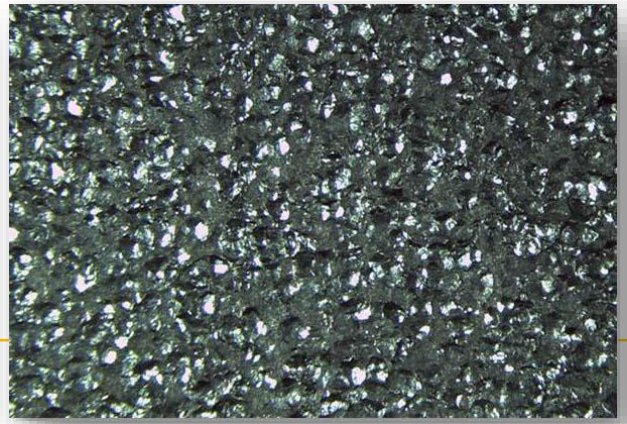
Abrasive blasting removes previous coatings and roughens the surface to improve coating adhesion.

Results in a surface profile (anchor pattern) comprised of a complex pattern of peaks and valleys.



Why Measure Surface Profile?

Surface profile must be accurately assessed to ensure compliance with job or contract specifications.

- If the profile is too smooth, adhesion strength may be reduced
- If the profile is too rough, paint may not fill all the valleys, creating foci for corrosion - and wasting paint!

There are three common methods to measure surface profile on blasted steel

- Surface Profile Depth Micrometer- PosiTector SPG
  ASTM D4417 Method B
- Replica Tape- PosiTector RTR
  ASTM D4417 Method C
- Portable Stylus Roughness Instrument (Not commonly used)
  ASTM D7127

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Surface Profile – Comparison

Advantages of PosiTector RTR

- Widely used method
- Works on curved surfaces
- Option of retaining a physical replica of the surface

Advantages of PosiTector SPG

- Faster
- Zero per-test cost
- Digital record of each measurement
- Accurate over the entire range of profile height
- Less operator dependent- no burnishing

PosiTector SPG

Surface Profile Gage

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PosiTector® SPG – Principle of Operation

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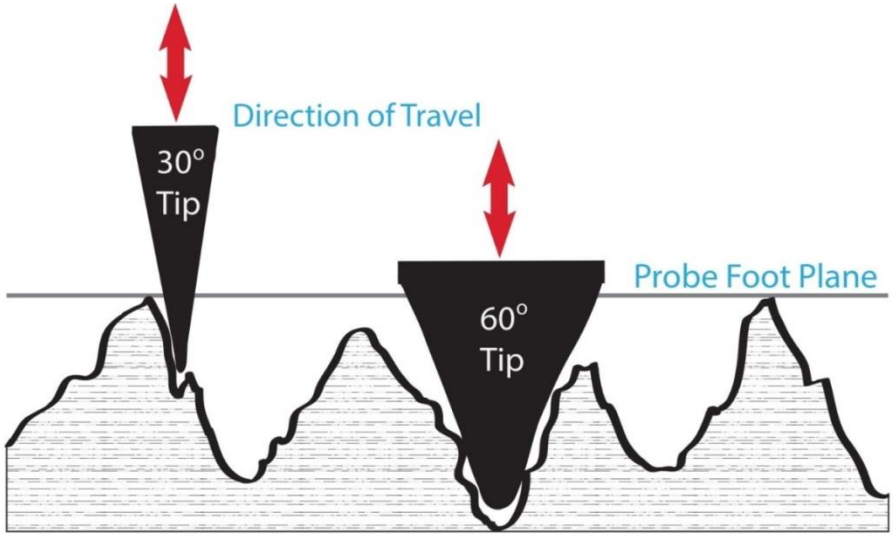
A flat base (probe foot) rests on the highest peaks and a spring-loaded tip drops into the valleys.



PosiTector® SPG – Overview

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Four SPG probes are available, featuring full PosiTector interchangeability

Standard model with 0-500 µm range for blasted steel

SPG

Tip Diameter: 100 µm (4 mils)
Range: 0 – 500 µm, 0 – 20 mils

Cabled model with 0-500 µm range for blasted steel

SPG S

Tip Diameter: 100 µm (4 mils)
Range: 0 – 500 µm, 0 – 20 mils

SPG CS & SPG TS

Cabled models with 0-1500 µm range for textured coatings (CS) and a range of 0 – 6 mm for concrete coatings (TS)

Tip Diameter: 1000 µm (40 mils)
Range: 0 – 1500 µm, 0 – 60 mils

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PosiTector® SPG – Overview

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PosiTector *SPG OS*

Surface profile probe for convex surfaces

Accuracy: ± (5 µm + 5%), ± (0.2mil + 5%)
Tip Diameter: 100 µm (4 mils)
Range: 0 – 500 µm, 0 – 20 mils

NEW

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PosiTector® SPG – Key Feature: SmartBatch™

To properly measure peak to valley height, a measurement is needed when the tip is in the deepest valley, but sometimes the tip will rest on a peak

The solution is to take the **maximum** of several readings

ASTM: At each location, make ten readings and record the maximum value. Then determine the mean for all the location maximum values and report it as the profile height of the surface. Discard any unusually high instrument readings that cannot be repeated in an area

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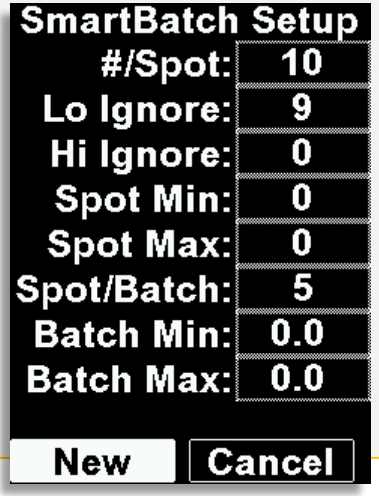
PosiTector® SPG – Key Feature: SmartBatch™

On competitive instruments, this process is complicated, and requires writing down many readings.

The PosiTector SPG makes the process easy, automatically keeping only the highest reading in each spot, and averaging several spots together (Advanced models only)



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PosiTector® SPG – Competitive Advantages

On competitive instruments, the probe foot can wear over time, causing incorrect readings. **Unlike the probe tip, the probe foot cannot be replaced!**

The PosiTector SPG features a ceramic probe foot, for superior wear resistance

PosiTector® SPG – Competitive Advantages

- Fast- over 50 readings/ minute
- SmartBatch mode makes following standards easy, and provides measurements comparable to Replica Tape
- Precision, replaceable carbide steel tip
- Long-lasting alumina probe foot

PosiTector platform	Included Certificate of Calibration Traceable to NIST	Full two year warranty on body and probe	DeFelsko service- quick shipping, recalibration, and repair
• Fully interchangeable probes • Often, competitive 'interchangeable' probes require specific body models • Free software, and USB, WiFi, and Bluetooth	• More than a 'Certificate of Accuracy'- contains measurements from the probe on traceable standards • An extra charge (and delay) from most competitors	• Many competitors offer a much shorter warranty on the probe- the most important part	

PosiTector® SPG – Standards

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Ideal for use in calibration labs

- Standards consist of 4 sapphire test plates mounted in a precision ground steel base and supplied in a hard shell case
- Sapphire test plates are individually serialized for traceability to PTB. Includes a Certificate of Calibration.
- Certified and labeled in both Metric and Imperial units
- Comes with a Sample Certificate of Accuracy

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PosiTector RTR-H

Replica Tape Reader

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PosiTector® RTR – Background

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- Replica tape is the most popular field method for measuring surface profile
- Simple, relatively inexpensive and shows good correlation with results from other methods
- Described in a number of international standards including:

  ASTM D4417

  ISO 8503-5

  NACE RP0287

  AS 3894.5

PosiTector® *RTR* – Principle of Operation

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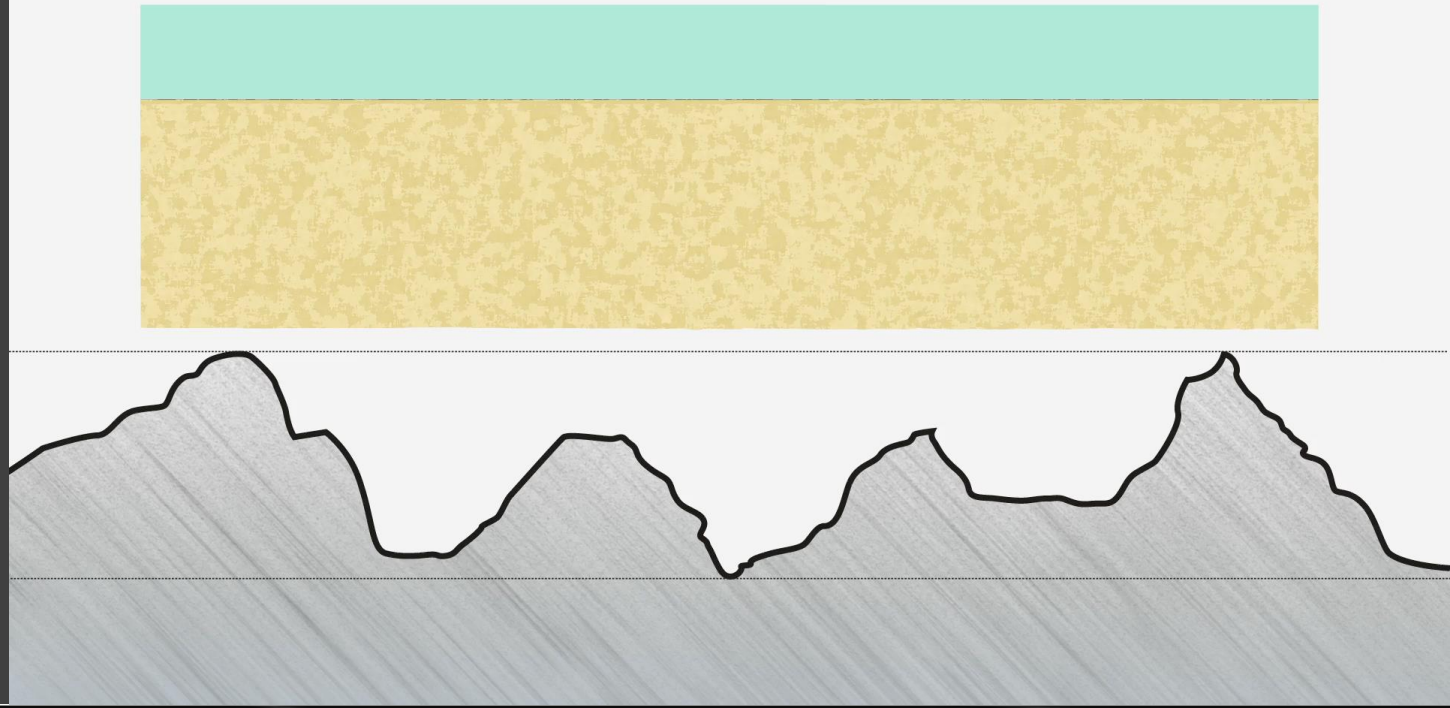
When pressed against a roughened surface, the foam forms an impression of the surface.

Placing the compressed tape between the anvils of a spring micrometer gives a measure of the surface profile.

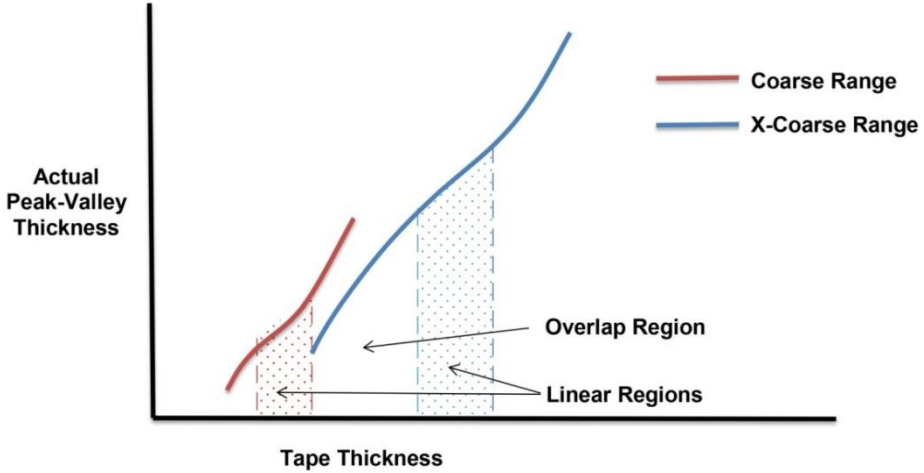
ASTM: The average of two “readings” is a “profile measurement.”

Replica Tape



PosiTector® RTR – Technical Note - Non-Linearity

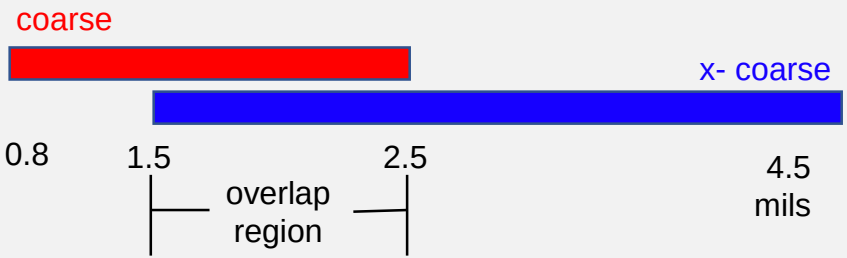
- Replica tape is most accurate in the middle of its measurement range, but errors are introduced towards the high and low ends of the measurement range
- When measuring deep surface profiles, the foam remains uncompressed in the valleys, and is subject to compression by the depth micrometer
- When measuring shallow surface profiles, the foam becomes highly compressed and ‘relaxes’

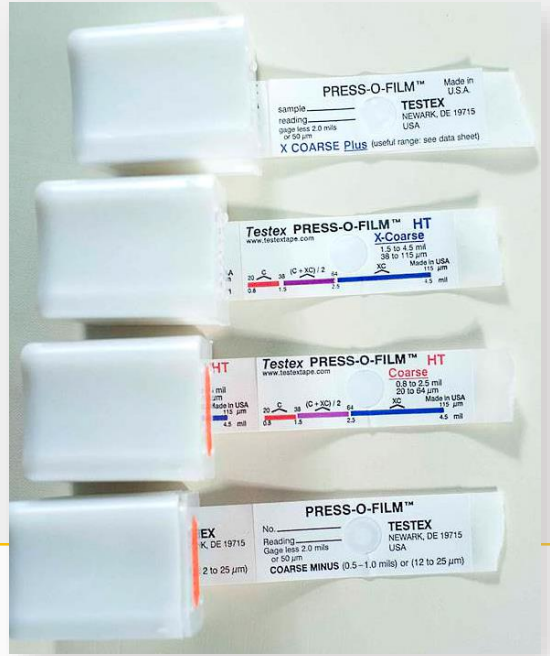


PosiTector® *RTR* – Technical Note - Non-Linearity

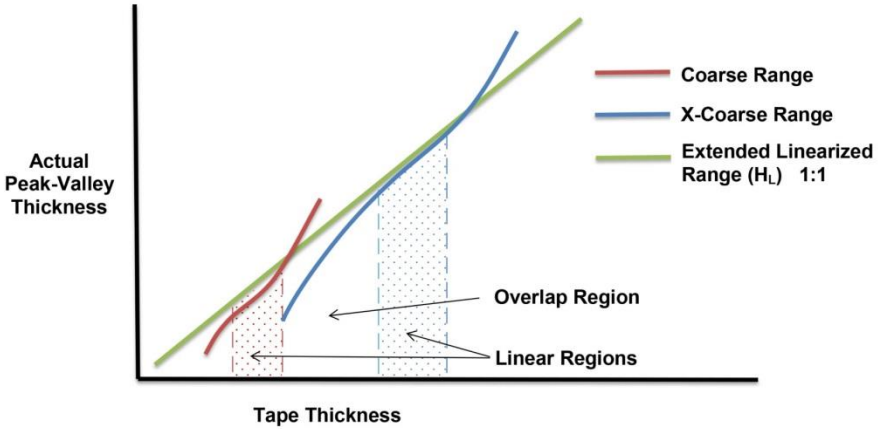
To correct for these errors, measurements with two different grades of tape are required in the 40- 60 µm range

- **The two errors ‘cancel out’.**
- **Requires two measurements instead of one- labor intensive!**





PosiTector® RTR – Technical Note - Non-Linearity



- These errors can also be corrected using experimentally- derived correction factors
- These corrections are built-in to the PosiTector RTR- just enable Linearization Mode (H_L)

PosiTector® RTR – Competitive Advantages

The PosiTector RTR is the only instrument of its kind- compare with analog micrometers!

- Reduces user influence
- Digital result is easier to read than an analog pointer
- Measurements and statistics can be stored in memory

Linearization feature- no need to use two grades of replica tape

PosiTector Platform	Included Certificate of Calibration Traceable to NIST	Full two year warranty on body and probe	DeFelsko Service – quick shipping, recalibration, and repair
• Fully interchangeable probes • Often, competitive 'interchangeable' probes require specific body models • Free software, and USB, WiFi, and Bluetooth	• More than a 'Certificate of Accuracy' – contains measurements from the probe on traceable standards • An extra charge (and delay) from competitors	• Many competitors offer a much shorter warranty on the probe – the most important part	

PosiTector RTR-3D

Replica Tape Reader

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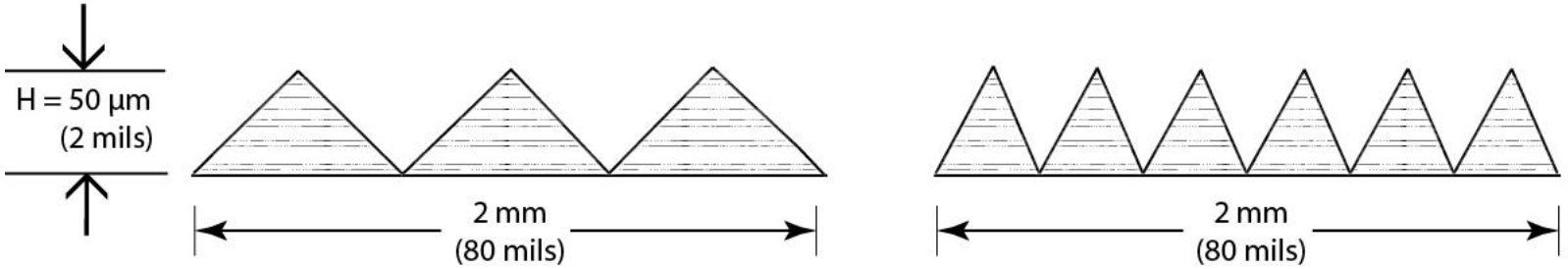
PosiTector® *RTR 3D* - Overview

Replica tape, when measured with a micrometer, provides a measurement of **peak height**



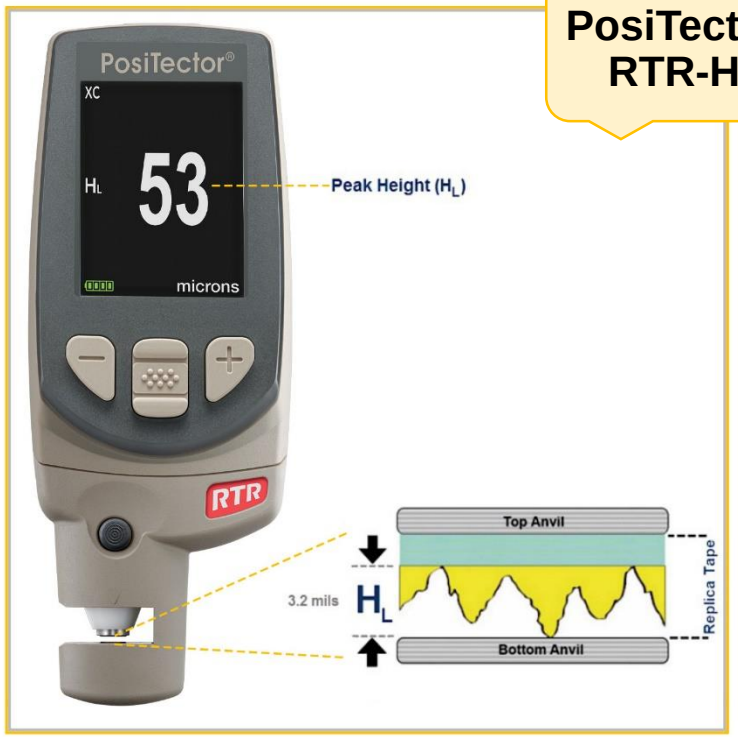
1.5 peaks per mm

3 peaks per mm

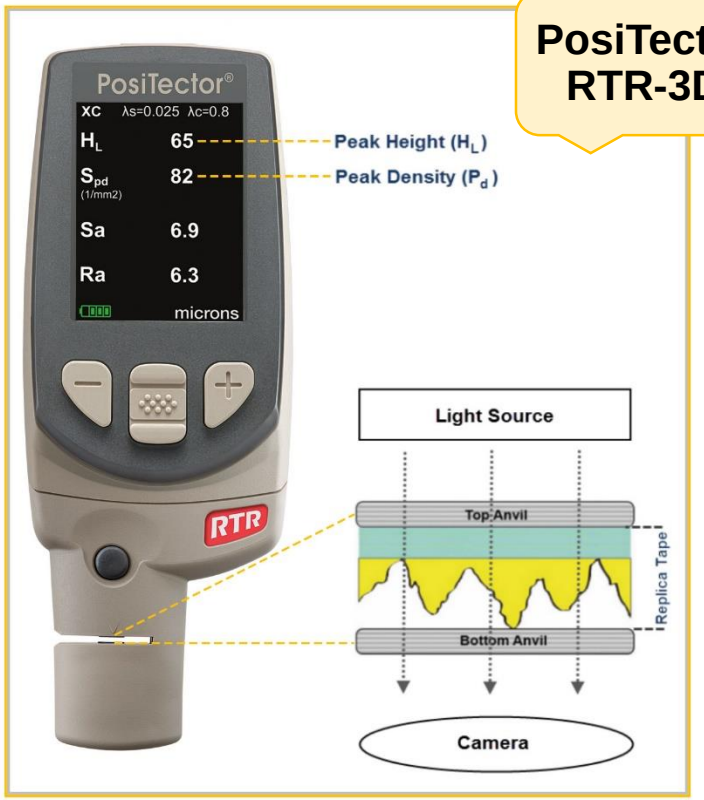
- In the above example, both surfaces have the same measured peak height
- A second important measurable parameter, **peak density**, helps explain why coatings bond differently to each surface

PosiTector® *RTR 3D* – Principle of Operation

PosiTector RTR-H



PosiTector RTR-3D



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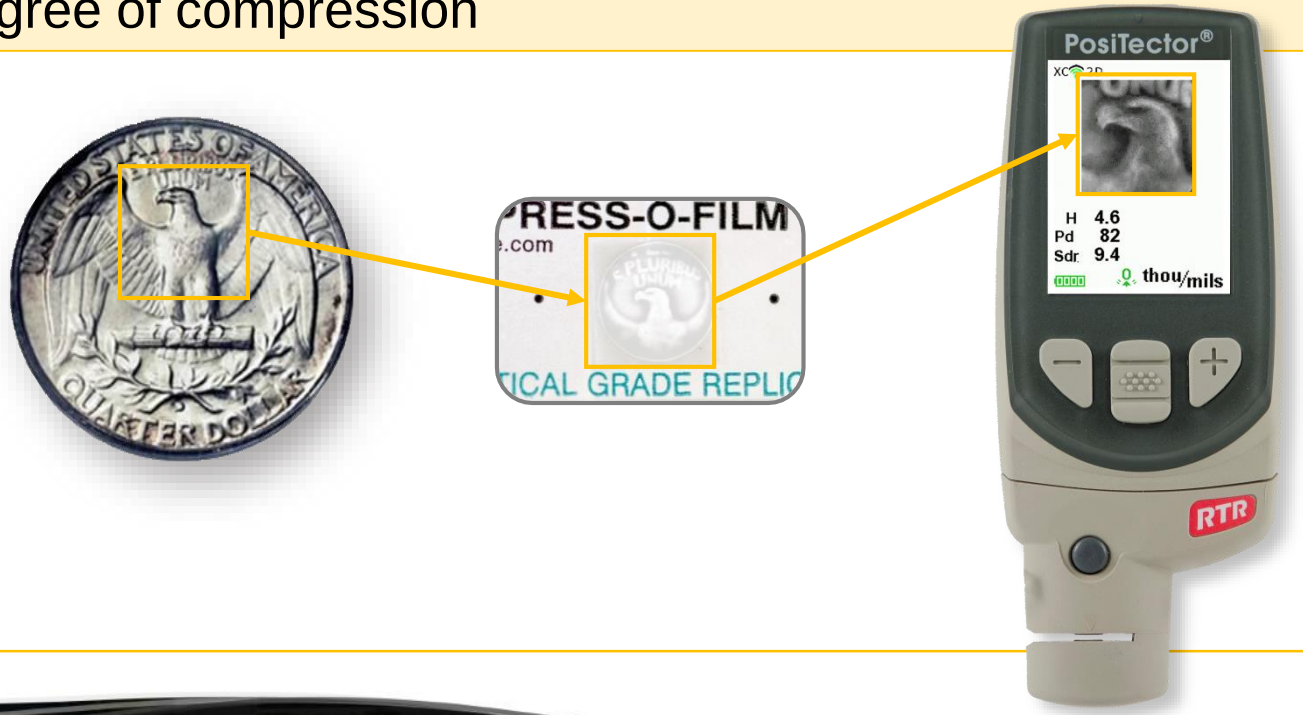
PosiTector® *RTR 3D* – Principle of Operation

Transmission of light through replica tape is proportional to the degree of compression



PosiTector® *RTR 3D* – Roughness Parameters

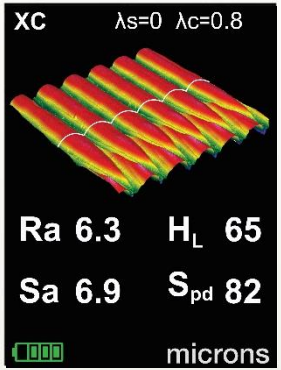
The enhanced imaging system in the RTR 3D allows 2D and 3D roughness parameters to be calculated.

2D Parameters – 'R' – Profile Parameters

R_a	Roughness Average
R_q	Root mean square roughness
R_p	Maximum Profile Peak Height
R_v	Maximum Profile Valley Depth
R_t	Total Profile Height
R_z	Average Maximum Height of the Profile
R_{pc}	Peak Count per unit length

3D Parameters – 'S' – Height/Amplitude

H	Average maximum peak-to-valley height
S_a	Average roughness
S_q	Root mean square roughness
S_z	Maximum area peak-to-valley height
S_p	Maximum area peak height
S_v	Maximum valley depth
S_{pd}	Areal peak density



Typical display of the Advanced model

Optical Grade Tape is required for measuring 2D/3D parameters

PosiTector® *RTR 3D* – Specifications & Limitations

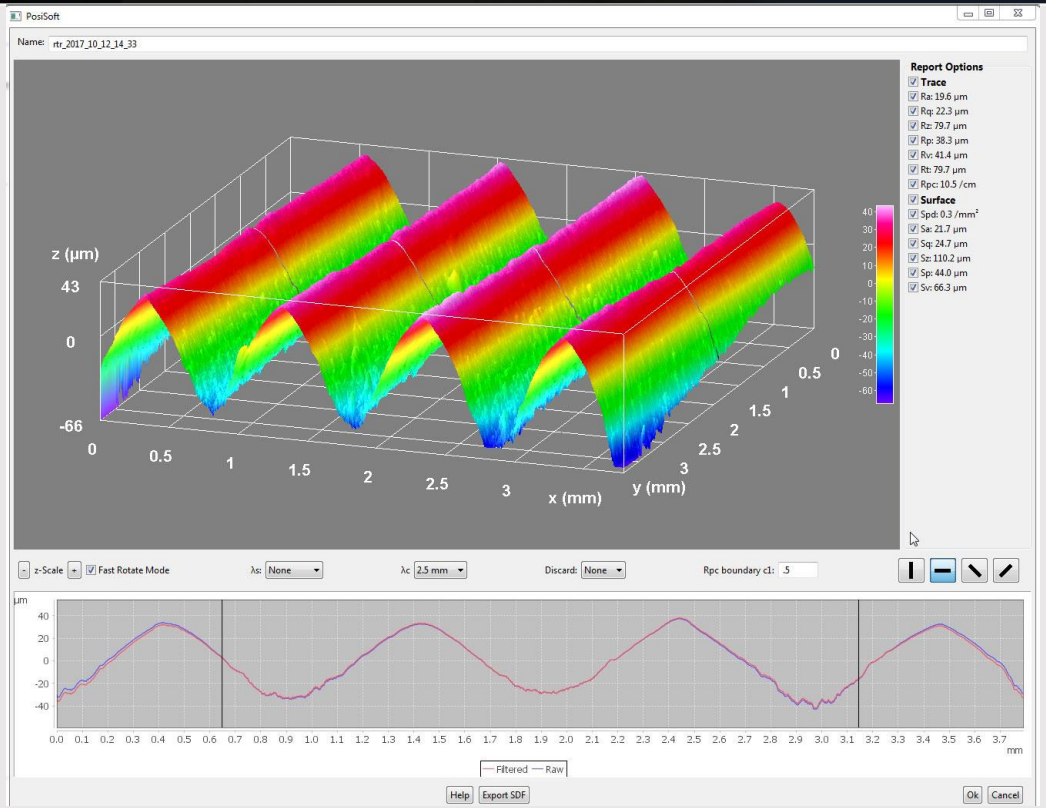
The RTR 3D can compete with more expensive technologies such as stylus micrometers or optical methods. However, it is not ideal for very smooth profiles with a peak-to-value roughness of < 10 µm

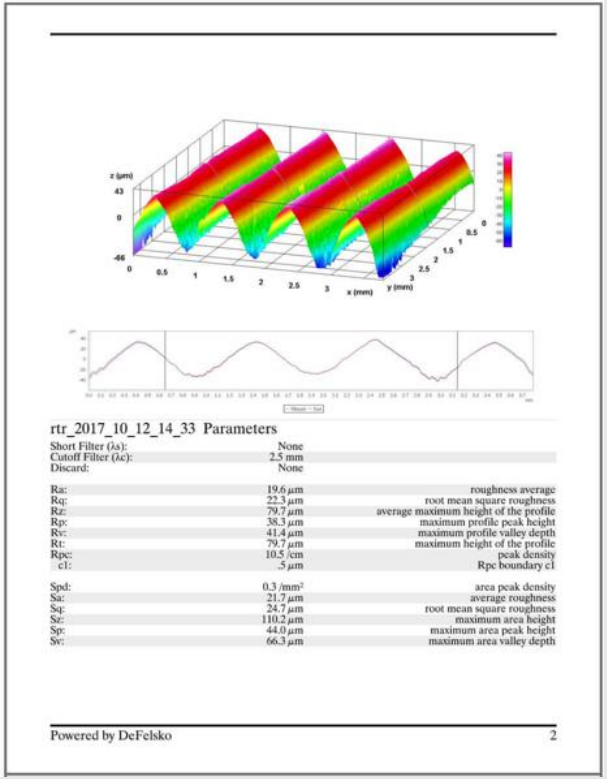
General Rule: The profile should be large enough to feel with a fingernail.

Measuring Range (H)	20 – 115 µm	0.8 – 4.5 mils
Measuring Range (Rt)	10 – 115 µm	0.4 – 4.5 mils
Minimum Roughness (Ra)	2 µm	0.08 mil
Accuracy (H)	± 5 µm	± 0.2 mil
Accuracy (Rt)*	± (5 µm + 5%)	± (0.2 mil+ 5%)
Accuracy (Ra)*	± (0.25 µm + 5%)	± (0.01 mil + 5%)
Anvil Pressure	1.1 Newtons	110 grams-force
Anvil Size	Ø6.25 mm	Ø0.25 inch
Field of View	3.8 x 3.8 mm	0.149 x 0.149 inch
Lateral Sampling	3.7 µm	0.145 mil
Vertical Resolution	100 nm - 2D/3D 10 nm - SDF	3.93 µin - 2D/3D 0.393 µin - SDF
Resolution	0.1 µm	0.01 mil

* *When measured using Optical Grade X-Coarse Replica Tape*

PosiTector® *RTR 3D* – PosiSoft Desktop Integration



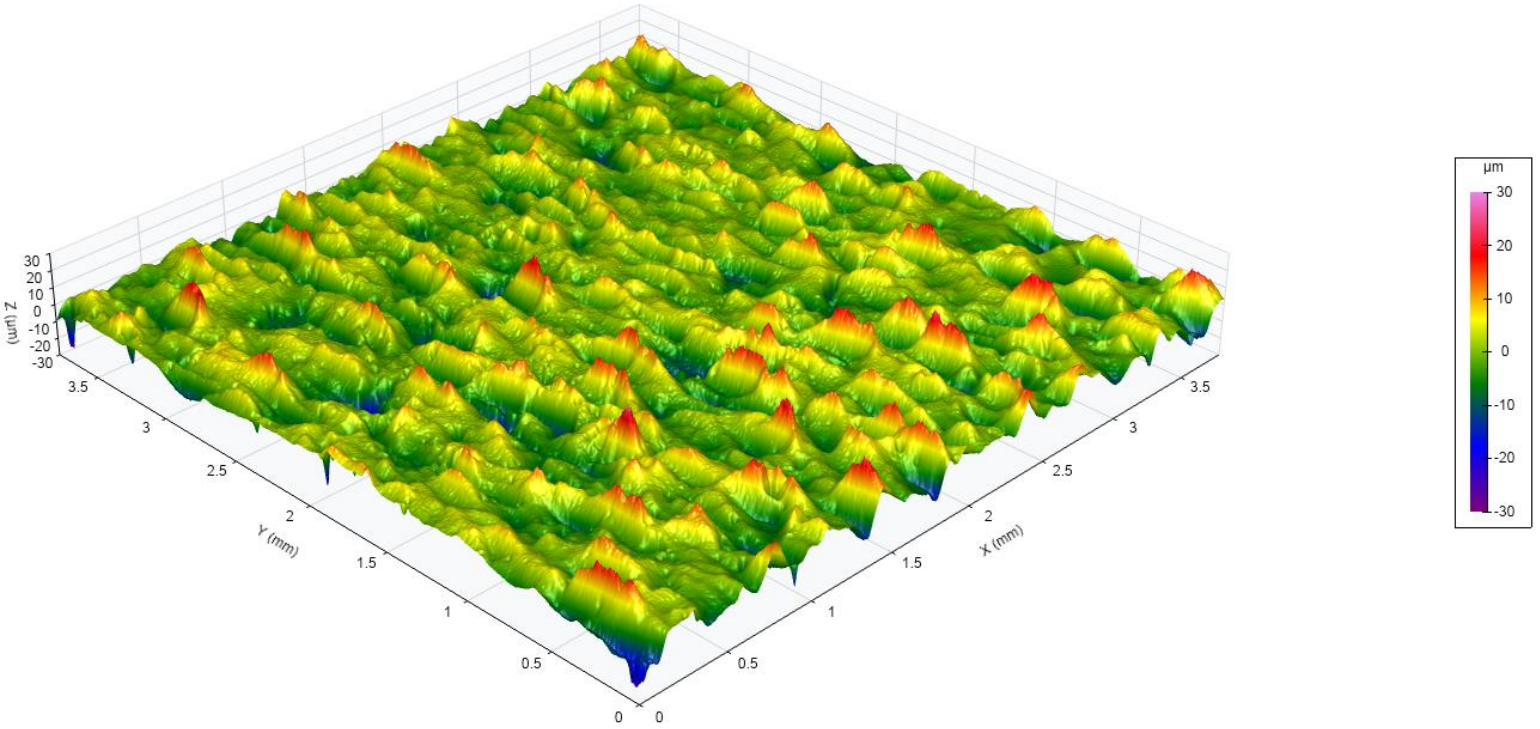


rtr_2017_10_12_14_33 Parameters

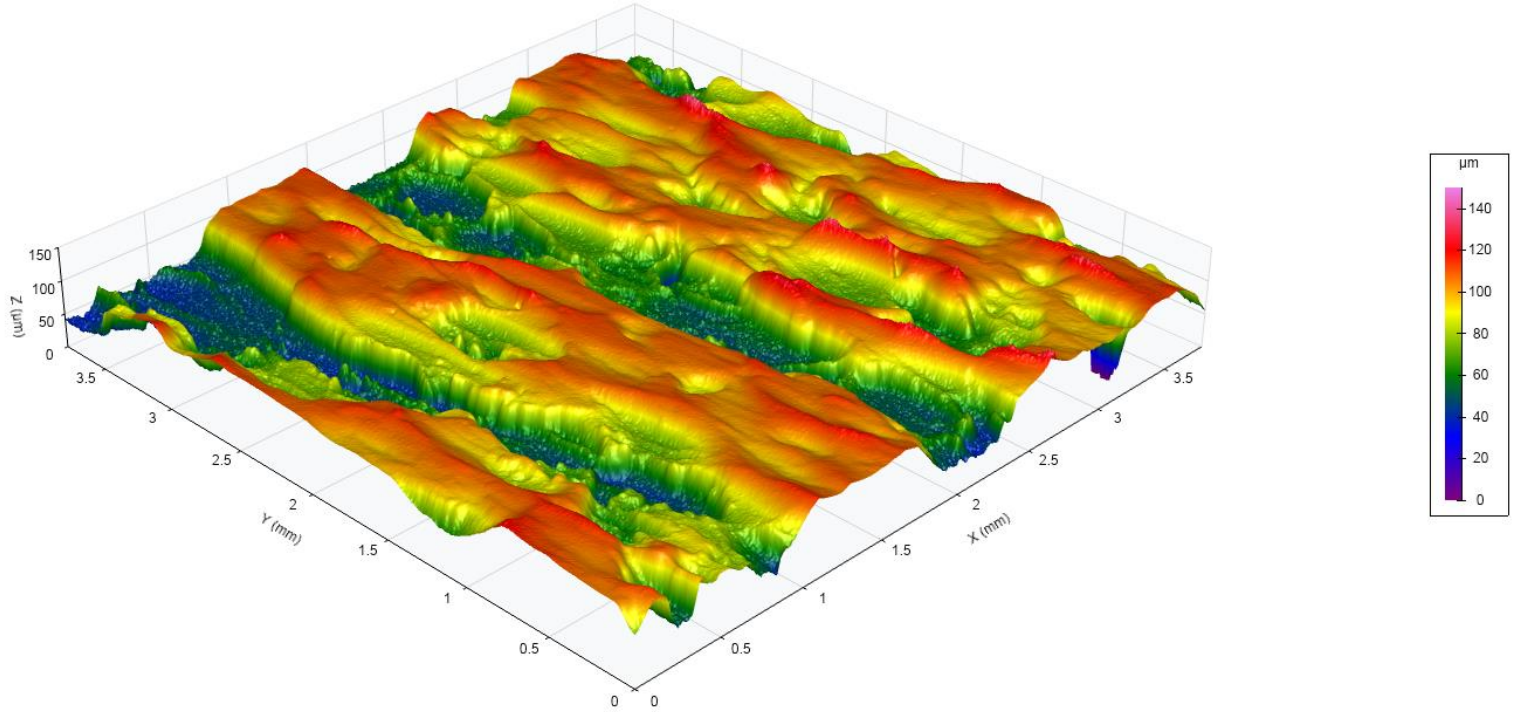
Short Filter (λs):	None	
Cutoff Filter (λc):	2.5 mm	
Discard:	None	
Ra:	19.6 µm	roughness average
Rq:	22.3 µm	root mean square roughness
Rz:	79.7 µm	average maximum height of the profile
Rp:	38.3 µm	maximum profile peak height
Rv:	41.4 µm	maximum profile valley depth
Rt:	79.7 µm	maximum height of the profile
Rpc:	10.5 /cm	peak density
c1:	.5 µm	Rpc boundary c1
Spd:	0.3 /mm²	area peak density
Sa:	21.7 µm	average roughness
Sq:	24.7 µm	root mean square roughness
Sz:	110.2 µm	maximum area height
Sp:	44.0 µm	maximum area peak height
Sv:	66.3 µm	maximum area valley depth

Powered by DeFelsko 2

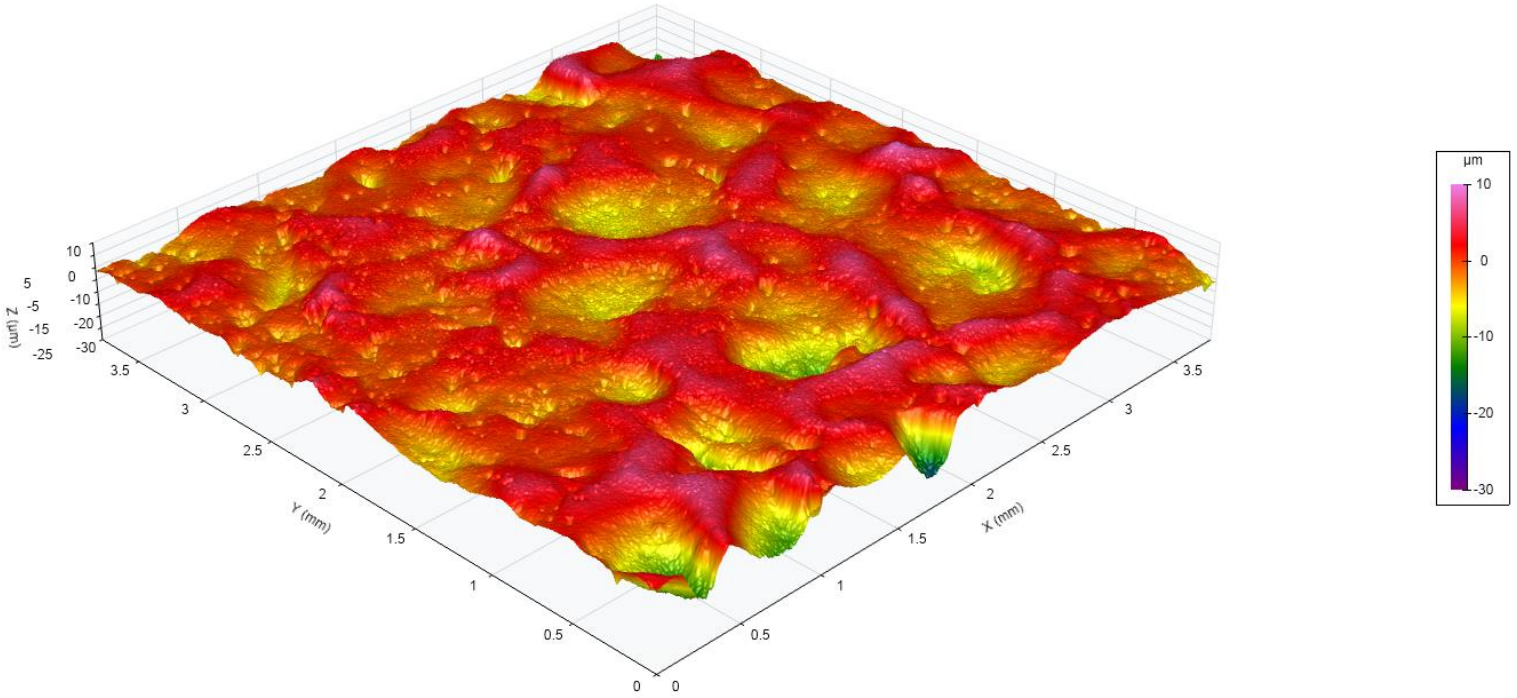
PosiTector RTR 3D Surface Imaging
Bristle Blaster Cleaned Surface



PosiTector RTR 3D Surface Imaging
Roto Peen Scaler Cleaned Surface



PosiTector RTR 3D Surface Imaging
Air Needle Scaler Cleaned Surface



PosiTector® *RTR 3D* – Technical Note

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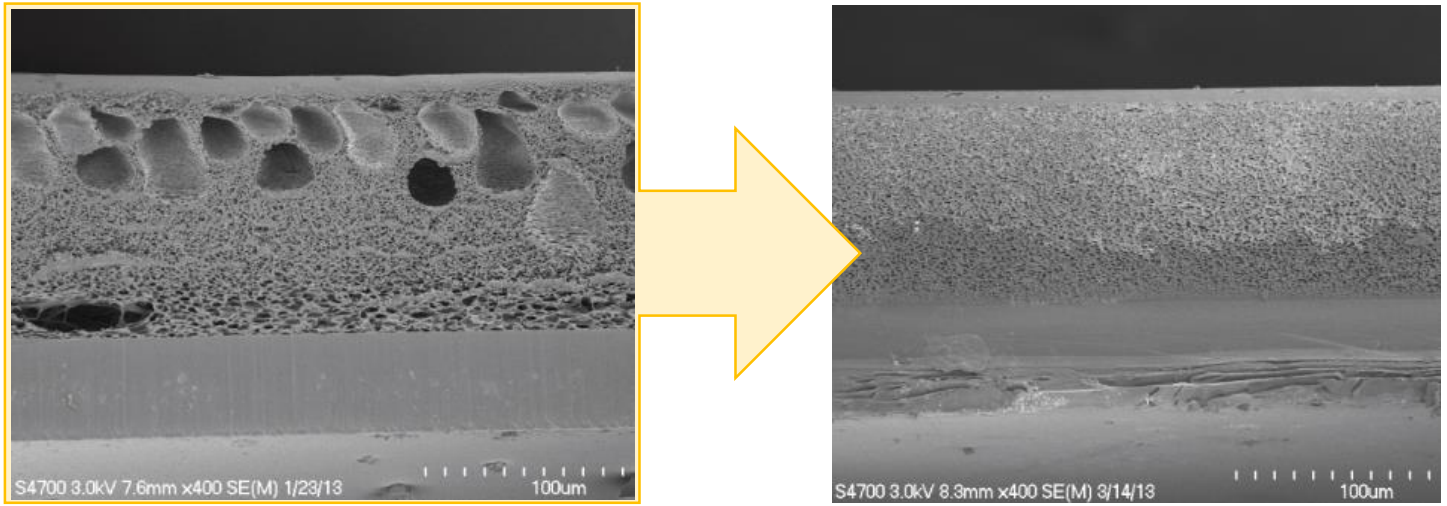
Optical grade replica tape has been developed for improved resolution.



Existing (left) and new optical grade replica tape for improved resolution (right)