DeFelsko®

Management Procedure 2565
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Calibration Procedure

DeFelsko Corporation

PosiTector RTR-3D

Replica Tape Reader Probe

Table of Contents

1 Introduction and UUC Performance Requirements

1.1 This procedure describes the calibration of the DeFelsko Corporation PosiTector RTR-3D tape reader probe with the following specification:

Table 1-1 Measurement Ranges

Unit	Measurement Range
H & H_L*	20 - 115 microns (0.8 – 4.5 mils)
R_t	10 - 115 microns
R_a	2 microns minimum

* Note the PosiTector RTR-3D measures the average maximum peak-to-valley profile height of Press-O-Film™ replica tape. Values are reported as either H or H_L. H readings represent the average maximum peak-to-valley profile height. H_L readings represent the linearized peak-to-valley profile height measurement that has been adjusted for the non-linearity of replica tape.

1.2 Peak density of the DeFelsko Corporation PosiTector RTR-3D replica tape reader is not calibrated.

1.3 The unit being calibrated will be referred to as the UUC (Unit-Under-Calibration).

2 Measurement Standards and Support Equipment Performance Requirements

2.1 The UUC accuracy requirements are based upon the published UUC performance specifications.

2.2 The test uncertainty ratio applied in this Calibration Procedure is 4:1 unless otherwise stated.

2.3 The Minimum-Use-Specifications are the minimum test equipment specifications required to meet all the UUC accuracy requirements and the test uncertainty ratio applied.

Table 2-1 UUC Accuracy Requirements and Description

Parameter	Performance Specifications		Test Method
H	20 – 115 um (0.8 – 4.5 mils)	± 5 um (± 0.2 mils)	Certified Shims
H_L	20 – 115 um (0.8 – 4.5 mils)	± 10 um (± 0.4 mils)	Derived, see section 3
R_t	10 – 115 um	± (5 um + 5% of reading)	Reference Standards
R_a	2 um min.	± (0.25 um + 5% of reading)	Reference Standards

Table 2-2 Minimum use specification

Parameter	Range	Accuracy
H	20 – 115 um (0.8 – 4.5 mils)	± 1.25 um (± 0.05 mils)
R_t	10 – 115 um (0.4 – 4.5 mils)	± 1.37 um (± 0.05 mils)
R_a	2 um minimum (0.08 mils min.)	± 0.09 um (± 0.004 mils)

Table 2-3 Actual Equipment Specification

Parameter	Equipment Generic Name	Range	Accuracy	Manufacturer / Model #'s Applicable
H	Certified Shims	75 – 125 um (3 – 5 mils)	± 1.25 um (± 0.05 mils)	DeFelsko CSSRTR
R_t	Roughness Specimen	9.9 – 20.08 um (0.4 – 0.8 mils)	± 0.32 um (± 0.01 mils)	Rubert + Co. type 525X & 526X
R_a	Roughness Specimen	3.139 – 6.36 um (0.1 – 0.3 mils)	± 0.067 um (± 0.002 mils)	Rubert + Co. type 525X & 526X

***Caution*:** The instructions in this Calibration Procedure relate specifically to the equipment and conditions listed in Section 2. If other equipment is substituted, the information and instructions must be interpreted accordingly.

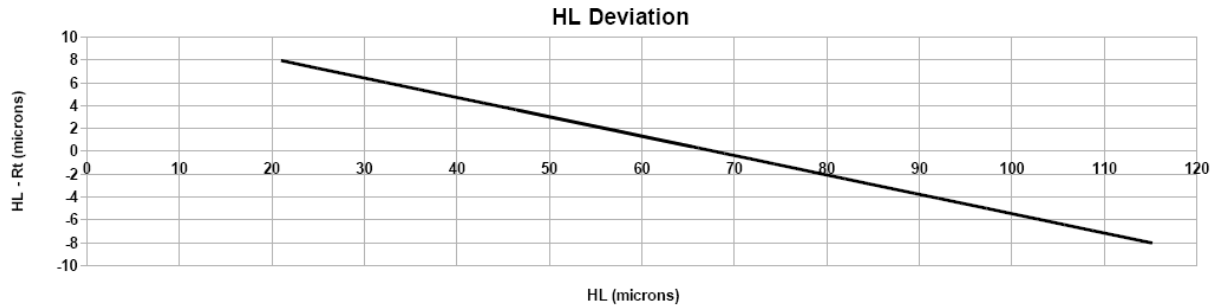
Table 2-4 Calibration Environmental and Warm-Up Requirements

Measurement Standards & Support Equipment Environmental Requirements:	Temperature: 23 ± 5° C. Relative Humidity: Less than 95%
Measurement Standards & Support Equipment Warm-up and Stabilization Requirements:	Not Required

3 Discussion on the Linearization of Profile Height Readings

H_L readings are determined in the following manner. Replica tape determinations of profiles using a Testex analog spring micrometer are plotted against profiles obtained with a Mitutoyo SJ-201 electronic stylus roughness instruments and a separate response curve is then determined for each grade, or thickness, of replica tape. The curves are represented by the mathematical functions, F_c for Coarse grade and F_{xc} for X-Coarse grade. These functions relate replica thickness (H) to electronic stylus roughness R_t (not the Rt reported by the RTR) as: $R_t = F_C$ (H) and $R_t = F_{XC}$ (H). The computed R_t is mapped to a least squares straight line fit of the combined F_c and F_{xc} curves, the result of which is what the gage reports as H_L.

The deviations associated with this linearization are illustrated below. Note that the areas of greatest deviation occur where the tape is least linear, at the upper and lower ends of the range.



The accuracy of the H_L reading versus R_t is determined by performing a sum of squares on the deviations of the system. There are three sources of significant deviations in the system. The first source is the equipment used in collecting the data used for generating the functions F_c and $F_{xc.}$ The second source is the deviations of the least squares straight line fit. The final source is the accuracy of the gage H reading.

The accuracies of the equipment used in collecting the data are ± 5 microns for the spring micrometer and ± 0.27 microns for the drag stylus. The maximum deviation between H_L and R_t is ± 8 microns as shown in the H_L deviation chart. The H reading as determined by the RTR has an accuracy of ± 5 microns that when applied to the equation of the line shown in the H_L Deviation chart results in deviations of ± 0.85 microns.

Performing a sum of squares on the system deviations yields:

$= ((5)^2 + (0.27)^2 + (8)^2 + (0.85)^2)^{0.5}$

$= (25 + 0.07 + 64 + 0.72)^{0.5}$

= 9.47 microns

4 Preliminary Operations

Note: Review the entire document before starting the calibration process.

4.1 Visual Inspection

4.1.1 Visually inspect the UUC for:

- Contamination on the measuring surfaces
- Damage to the buttons or probe housing
- Misalignment of the measuring surfaces
- Proper identification
- For body/probe combinations review the body for damage

4.1.2 Damage or excess wear shall be repaired prior to beginning the calibration process.

4.2 Probe Cleaning

4.2.1 Ensure the UUC is powered off.

4.2.2 Place a card reader cleaning card between the measuring surfaces.

4.2.3 Squeeze both buttons of the probe simultaneously to close the measuring head.

4.2.4 While keeping the buttons depressed, move the provided cleaning card back and forth several times.
Note: The cleaning card can be used multiple times. Do not use isopropyl alcohol to clean the RTR-3D.

4.2.5 Repeat steps 4.2.2 to 4.2.4 using the provided microfiber cloth.

4.2.6 Inspect the measuring surfaces. If there is any contamination, repeat the cleaning process.

4.3 Gage Reset:

4.3.1 When the UUC is powered down, simultaneously hold the "+" and middle buttons until the reset symbol appears.

4.3.2 When the UUC prompts you, depress both probe buttons simultaneously to perform a probe zero. Make sure to hold the buttons until you hear the UUC beep.

5 Height Calibration Process

Note: Whenever the test requirement is not met, verify the results of each test and take corrective action before proceeding.

5.1 Review the Performance Requirements Table 7-1.

5.2 Select Cal Settings, then Tape Grade to select the proper tape grade. For the 75 micron (3 mil) shim select C, for the 125 micron (5 mil) shim select XC.

5.3 Depress both probe buttons simultaneously without a shim in the probe to zero the probe. This must be done before <u>every</u> measurement.

5.4 Insert the 75 micron (3 mil) shim between the measurement surfaces and depress both probe buttons simultaneously. Any movement of the shim during the measurement process will impact the measurement, so let go of the shim once the probe is holding the shim.

5.5 After the measurement is complete, hold the shim, release the probe buttons and remove the shim. Record the measurement value (H_L or H).

Note: The PosiTector RTR measures the average maximum peak-to-valley profile height of Press-O-Film™ replica tape. The gage subtracts 50.8 microns (2 mils) from measurements to compensate for the thickness of the polyester film on the Press-O-Film™. When measuring shims all readings will be 50.8 microns (2 mils) lower than actual.

5.6 Select the "Cal Settings" menu and change the "Linearize" setting.

5.7 Record the new displayed value (H or H_L)

5.8 Repeat steps 5.2 – 5.7 with the 125 micron (5 mil) shim.

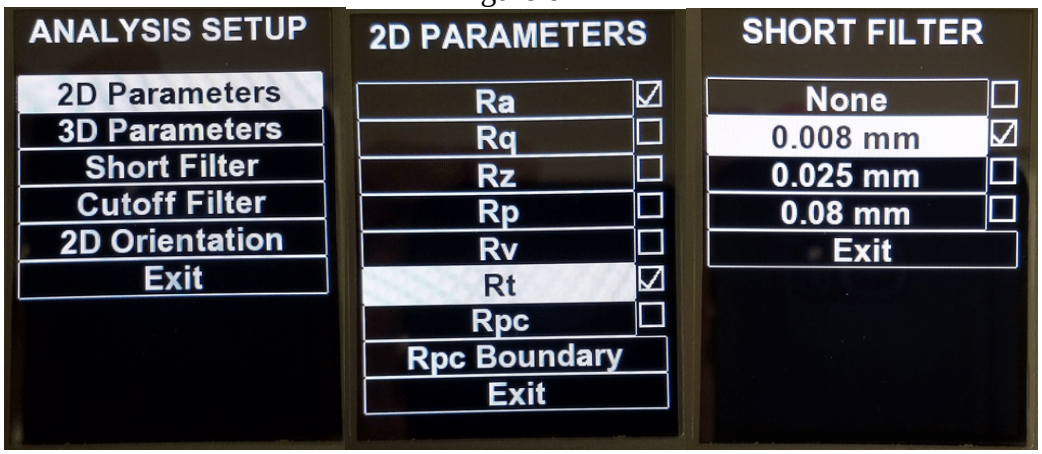
6 Profile Calibration R_a & R_t

6.1 Use the 1.5” (38mm) diameter ball to burnish two XC optical grade replica tape samples, one each on the two surface roughness standards 525X and 526X. Align the tape as shown below.

Figure 6-1

6.2 From the main menu select “ANALYSIS SETUP” then “2D Parameters”. Select R_t and confirm that R_a is also selected.

Figure 6-2

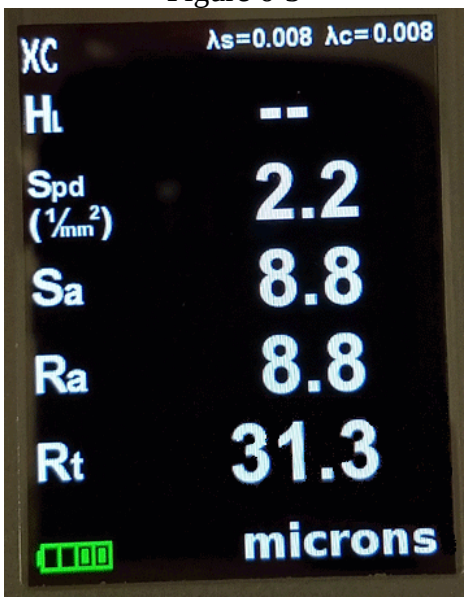


6.3 Press the minus button to return to the ANALYSIS SETUP menu and select “Short Filter”. Select the “0.008 mm” setting then “Exit”.

6.4 Clean and zero the probe and verify the tape is clean of debris and adhesive residue.

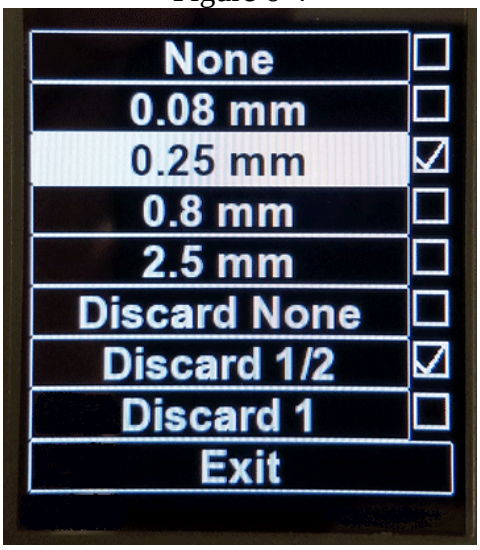
6.5 Measure the 525X sample, S/N PA6, and record the R_a & R_t readings in table 7-1.

Figure 6-3



6.6 From the main menu select “ANALYSIS SETUP” then “Cutoff Filter”. Select the “0.25 mm” setting then “Exit”.

Figure 6-4



6.7 Clean and zero the probe and verify the tape is clean of debris and adhesive residue.

6.8 Measure the 526X sample, S/N P51X, and record the R_a & R_t readings in table 7-1.

7 Performance Requirements

Table 7-1 Performance Requirements and Calibration Data for PosiTector RTR-3D

Standard Reading (microns)	Adjusted Shim Reading❶ (microns)	Min. Reading Allowed❷ (microns)	UUC Reading (microns)	Max. Reading Allowed❸ (microns)
A	B			
			H =	
			H_L =	
			H =	
			H_L =	
	N/A		R_a =	
	N/A		R_t =	
	N/A		R_a =	
	N/A		R_t =	

❶Calculation H & H_L: (A – 50.8)
❷Calculation H: (B – 5). Round up to the nearest micron.
H_L: (B – 10). Round up to the nearest micron.
R_a: (A*0.95) - 0.25. Round up to the nearest 0.1 micron
R_t: (A* 0.95) – 5. Round up to the nearest 0.1 micron
❸ Calculation H: (B + 5). Round down to the nearest micron.
H_L: (B + 10). Round down to the nearest micron.
R_a: (A*1.05) + 0.25. Round down to the nearest 0.1 micron
R_t: (A* 1.05) + 5. Round down to the nearest 0.1 micron

To convert from microns to mils divide by 25.4

Management Procedure Change Notice

Procedure Number: MP 2565
Revision Level: B
Date of Change: April 18, 2019
Title: Calibration Procedure for PosiTector RTR-3D

Reason for Change: • New product
Description of Change: • New procedure

I confirm I have read and understand the procedure and the change described above.

Printed Name	Signature	Date

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