



® Management Procedure 2550  
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## Calibration Procedure

DeFelsko Corporation

PosiTector RTRH and RTRP

Replica Tape Reader Probes

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# 1 Introduction and UUC Performance Requirements

1.1 This procedure describes the calibration of the profile height of the DeFelsko Corporation PosiTector RTRH and RTRP replica tape reader probes with the following specification:

Table 1-1 Measurement Ranges

Unit	Measurement Range*
PosiTector RTRH & RTRP	20 - 115 microns (0.8 – 4.5 mils)

\* Note the PosiTector RTR measures the average maximum peak-to-valley profile height of Press-O-Film™ replica tape. Values are reported as either H or H<sub>L</sub>. H readings represent the average maximum peak-to-valley profile height. H<sub>L</sub> 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 RTRP 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

UUC	Parameter	Performance Specifications		Test Method
RTRH & RTRP	H	20 – 115 microns (0.8 – 4.5 mils)	± 5 microns (± 0.2 mils)	Height Gage
	H <sub>L</sub>	20 – 115 microns (0.8 – 4.5 mils)	± 10 microns (± 0.4 mils)	Derived, see section 3

Table 2-2 Minimum use specification

Parameter	Range	Accuracy
H	20 – 115 microns (0.8 – 4.5 mils)	± 1.25 microns (± 0.05 mils)

Table 2-3 Actual Equipment Specification

Parameter	Equipment Generic Name	Range	Accuracy	Manufacturer / Model #’s Applicable
H	Height Gage	25 mm (0.984 inches)	$\pm 0.10$ microns* ( $\pm 0.004$ mils)	Heidenhain CT2501 with ND287 display
H <sub>L</sub>	Drag Stylus	350 $\mu$ m (0.013 inches)	$\pm 0.27$ microns ( $\pm 0.01$ mils)	Mitutoyo SJ-201
	Spring Micrometer	1 mm (0.393 inches)	$\pm 5$ microns ( $\pm 0.2$ mils)	Testex metric analog micrometer

\* ( $\pm 0.034$  microns with linear error compensation by the ND287)

**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.

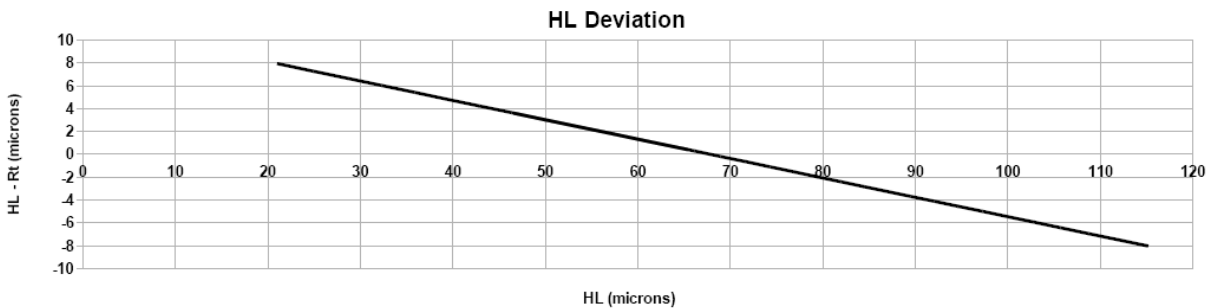
Table 2-4 Calibration Environmental and Warm-Up Requirements

Measurement Standards & Support Equipment Environmental Requirements:	Temperature: $23 \pm 5^\circ$ 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<sub>L</sub> readings are determined in the following manner. Replica tape determinations of profiles using a spring micrometer are plotted against profiles obtained with 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<sub>c</sub> for Coarse grade and F<sub>xc</sub> for X-Coarse grade. These functions relate replica thickness (H) to electronic stylus roughness R<sub>t</sub> as: R<sub>t</sub> = F<sub>c</sub> (H) and R<sub>t</sub> = F<sub>xc</sub> (H). The computed R<sub>t</sub> is mapped to a least squares straight line fit of the combined F<sub>c</sub> and F<sub>xc</sub> curves, the result of which is what the gage reports as H<sub>L</sub>.

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<sub>L</sub> reading versus R<sub>t</sub> 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 Management Procedure 2550 Rev. C

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

Performing a sum of squares on the system deviations yields:

$$\begin{aligned} &= ((5)^2 + (0.27)^2 + (8)^2 + (0.85)^2)^{0.5} \\ &= (25 + 0.07 + 64 + 0.72)^{0.5} \\ &= 9.47 \text{ microns} \end{aligned}$$

## 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 cleaning card back and forth several times.

**Note:** The cleaning card can be used multiple times but it may need to be moistened with isopropyl alcohol after the package has been open for several minutes.

#### 4.2.5 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 (2 arrows) 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 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 6-1.
- 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 every 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 and release the probe buttons. 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 Performance Requirements

Table 6-1 Performance Requirements and Calibration Data for PosiTector RTRH & RTRP

Shim Reading (microns)	Adjusted Shim Reading <sup>❶</sup> (microns)	Min. Reading Allowed <sup>❷</sup> (microns)	UUC Reading (microns)	Max. Reading Allowed <sup>❸</sup> (microns)
A	B			
			H =	
			H <sub>L</sub> =	
			H =	
			H <sub>L</sub> =	

❶ Calculation H & H<sub>L</sub>: (A – 50.8)

❷ Calculation H: (B – 5). Round up to the nearest micron.

H<sub>L</sub>: (B – 10) Round up to the nearest micron.

❸ Calculation H: (B + 5). Round down to the nearest micron.

H<sub>L</sub>: (B + 10) Round down to the nearest micron.

To convert from microns to mils divide by 25.4