DeFelsko® CORPORATION

Management Procedure 2592
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Calibration Procedure

Coated Metal Thickness Standards

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1 Introduction and UUC Performance Requirements

1.1 This procedure describes the calibration of the Coated Metal Thickness Standards with the following ranges:

Table 1-1 Measurement Ranges

Type	Measurement Range
Epoxy Coated Steel	15 – 1500 microns (0.6 – 60 mils)
Epoxy Coated Aluminum	75 – 1500 microns (3 – 60 mils)

1.2 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 specification of the most accurate DeFelsko product that the UUC is recommended for use on and the test uncertainty ratio applied.

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

2.3 Minimum-Use-Specifications are the minimum test equipment specifications required to meet all the UUC accuracy requirements.

Table 2-1 UUC Accuracy Requirements and Description

UUC Function	Range	Accuracy	Test Method
Epoxy Coated Steel	15 – 75 microns (0.6 – 3 mils) >75 – 250 microns (>3 – 10 mils) >250 microns (>10 mils)	± 0.25 microns (± 0.010 mils) ± 1.13 microns (± 0.044 mils) ± 4.25 microns (± 0.167 mils)	Height Gage
Epoxy Coated Aluminum	75 – 100 microns (3 – 4 mils) >100 – 250 microns (> 4 – 10 mils) >250 microns (>10 mils)	± 0.31 microns (± 0.012 mils) ± 1.10 microns (± 0.044 mils) ± 4.25 microns (± 0.167 mils)	Height Gage

Table 2-2 Minimum Use Specification

Parameter	Range	Accuracy
Height	1500 um 60 mil	± 0.25um ±0.010 mil

Table 2-3 Actual Equipment Specification

Equipment Generic Name	Range	Accuracy	Manufacturer/Model #'s Applicable
Height Gage	25 mm 0.984 inch	± 0.10 microns* ± 0.004 mils	Heidenhain CT2501 with ND287 display

*(+/- 0.03um with linear error compensation by the ND287)

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

2.4 Examination of the measurement system uncertainty

2.4.1 The first source of uncertainty considered is the change in thickness of the epoxy due to temperature variation. The thermal coefficient of the epoxy is 0.07 microns /(mm ^{o}C) and the thickest epoxy coating is 1.5mm so worst case change is 0.07 * 1.5 = 0.105 microns/ ^{o}C. The temperature of the laboratory is controlled to +/- 1 ^{o}C so uncertainty is 0.105 * 1 = 0.105 microns. Temperature change of the metal plate is not considered because the height gage is zeroed to the top of the metal surface prior to taking measurements.

2.4.2 The next source of uncertainty is from the variation in the surface of the plate underneath the epoxy. The surface variation is +/- 0.42 microns over the measurement range.

2.4.3 The uncertainty of the height gage as stated above is +/- 0.03 microns.

2.4.4 The combined uncertainty of the measurement system is calculated using the sum of squares method as follows:

$$= ((\text{height gage})^2 + (\text{temp change})^2 + (\text{plate variation})^2)^{0.5}$$
$$= (0.03^2 + 0.105^2 + 0.42^2)^{0.5}$$
$$= 0.43 \text{ microns}$$

2.5 The steel plate with a 15 micron coating has a test uncertainty ratio of 2.4:1 when used with the PosiTest G or GM.

2.6 The steel plate with a 75 micron coating has a test uncertainty ratio of 2.9:1 when used with the PosiTector F0S, F45S or F90S products

2.7 The aluminum plate with a 75 micron coating has a test uncertainty ratio of 2.9:1 when using the PosiTector 6000 NAS, N0S, N45S or N90S products.

Table 2-4 Calibration Environmental and Warm Up Requirements

Measurement Standards & Support Equipment Environmental Requirements:	Temperature: 24 ± 1° C. Relative Humidity: Less than 95%
Measurement Standards & Support Equipment Warm-up and Stabilization Requirements:	15 minutes

3 Preliminary Operations

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

3.1 Make sure the process monitoring measurement has been performed per MP5044 before calibrating any standards.

3.2 Inspect the standard for cosmetic defects on the epoxy surface. Reject any parts that have surface defects.

3.3 Inspect the bottom surface of the standard. Reject any parts that have burrs or defects that will prevent the plate from sitting flat.

3.4 Using a Q-tip and alcohol clean the bottom and top surfaces of the standard

3.5 For recertified product record the serial number on the bottom of the plate with a marker, then remove the serial number label and clean any remaining adhesive from the standard.

4 Calibration Process

Note: Whenever a test requirement is not met as indicated in table 5-1 or 5-2, verify the results of the test and take corrective action before proceeding.

4.1 Place the standard on the vacuum plate and turn on the vacuum pump.

4.2 Take a height reading on the uncoated perimeter of the plate as close to the epoxy as possible. Set this as the reference point by pressing “Reset” on the ND 287 display.

4.3 Take three additional readings as close to the epoxy as possible at equal intervals around the uncoated perimeter of the plate.

4.4 Verify the range of the readings is less than or equal to 2.54 microns. If the readings exceed this verify the measurement surfaces are clean and repeat steps 4.2-4.3.
Note: The specification of 2.54 microns is based on the parallelism of the plate over 1.5”.

4.5 Determine the midpoint of the readings. Set this as the reference point by lowering the measurement probe to the uncoated surface then press “Reset” on the ND 287 display.

4.6 Take three readings around the perimeter and verify the range is centered.

4.7 For new product record the target reference thickness in table 5-3. For recertification of an existing standard record the thickness in microns from the UUC label or certificate.

4.8 Slide the standard so the epoxy is centered under the measurement probe.

4.9 Lower the probe and let the reading settle for 1 minute before recording the result in table 5-3.

4.10 Move the plate approximately 0.1" and take another reading.

4.11 Repeat steps 4.9 and 4.10 to get a total of three readings, all three readings must be within 0.1" of each other on the plate.

4.12 Verify the range of the readings is less than or equal to 0.25 microns. For new product verify the average reading is within the specification listed in table 5-1. For recertified product verify the average reading is within the specification listed in table 5-2.
Note: The range of 0.25 microns is based on the parallelism of the epoxy over 0.1".

4.13 Attach a serial number label to the standard.

5 Performance Requirements

Note: The technician will collect the data needed to complete columns A through D of table 5-3. The technician shall then calculate the values for column E & F as indicated in the procedure and record all information in the table. Do not write in this procedure.

Table 5-1 Performance Requirements for New Coated Metal Thickness Standards

Target Thickness (microns)	Average Target Thickness Tolerance (microns)	Range Tolerance (microns)
15 – 50	± 4	0.25
>50 – 100	± 5	0.25
>100 - 200	± 10	0.25
> 200 - 1500	± 20	0.25

Table 5-2 Performance Requirements for Recertified Coated Metal Thickness Standards

Reference Thickness (microns)	Average Thickness Tolerance (microns)	Range Tolerance (microns)
15-1500	± 0.43	0.25

Table 5-3 Calibration Data for Coated Metal Thickness Standards

Standard Thickness (microns)	Measurement 1 (microns)	Measurement 2 (microns)	Measurement 3 (microns)	Average (microns)	Range (microns)
A	B	C	D	E	F

Management Procedure Change Notice

Procedure Number: MP 2592
Revision Level: A
Date of Change: September 18, 2009
Title: Calibration Procedure for Coated Metal Thickness Standards

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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