

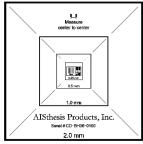
## **AISthesis Products**

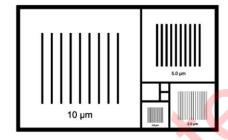
Advanced Imaging Products for Nanotechnology, Engineering and Life Sciences PO Box 1950, Clyde NC 28721





## Certificate of Calibration for Pelcotec<sup>TM</sup> Critical Dimension Magnification Standard





Product Number: Pelcotec™ 711-1 CDMS-1C-ISO-Etched

<u>Product Description:</u> 2.5x2.5mm, **Pelcotec™** 2mm-1µm Etched Critical Dimension Magnification Standard

Product Serial Number: CD-BH06-xxxx

As Received Condition: New As Returned Condition: N/A

Date of Receipt: N/A

Customer name and contact information:



P.O. Box 492477

Redding, CA 96049-2477

Tel: 530.243.2200 www.tedpella.com

The accuracy of this product with Serial Number CD-BH06-xxxx was determined using a Field Emission Scanning Electron Microscope (FE-SEM) by reference comparison to working standards traceable to the National Institute of Standards and Technology (NIST), using methods in CP 01 FE-SEM Imaging of Critical Dimension Magnification Standards (CDMS) and CP 02 Certification of Critical Dimension Magnification Standards. The data applies only to the CDMS identified in this report. All results are "asis". Repair and/or adjustments are not possible.

Below are the ISO 17025:2017 Accredited Certified 10 µm Pitch Measurements unique to Serial Number CD-BH06-xxxx and traceable to NIST Certified Standard CD-PG01-0211.

| Line                    | ISO 17025:2017  | Position of          |
|-------------------------|-----------------|----------------------|
|                         | Accredited      | Measurement          |
|                         | Certified Pitch |                      |
| 0-10 µm                 | 10.004 µm       | ± 7.5 µm from center |
| 10-20 µm                | 10.000 µm       | ± 7.5 µm from center |
| 20-30 μm                | 10.002 μm       | ± 7.5 µm from center |
| 30-40 µm                | 10.002 μm       | ± 7.5 µm from center |
| 40-50 μm                | 10.004 µm       | ± 7.5 µm from center |
| 5 <mark>0</mark> -60 μm | 10.000 µm       | ± 7.5 µm from center |
| 60-70 μm                | 10.004 µm       | ± 7.5 µm from center |
| 70-80 µm                | 10.002 μm       | ± 7.5 µm from center |
| Sum                     | 80.018 µm       |                      |
|                         |                 |                      |

Average 10.0023 μm 2-Sigma \* 0.0039 μm

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<sup>\*</sup> Corrected for sample size using the appropriate Student t-factor.

Measurements are reported with an uncertainty (k=2)\*\* of  $\pm$  0.012  $\mu$ m. Statements of Conformity are not provided in this report. Review the results and verify that they meet the requirements for the intended use. Physical damage to or contamination of the CDMS occurring after calibration may invalidate the reported measurements. Use this product at 25°C  $\pm$  5°C and at less than 80% RH.

Below are the Non-ISO 17025:2017 Accredited Certified Pitch Measurements unique to Serial Number CD-BH06-xxxx and traceable to NIST Certified Standard CD-PG01-0211.

| Line    | Number   | Position of           | Non-ISO 17025:2017           | Average Pitch |
|---------|----------|-----------------------|------------------------------|---------------|
|         | of Lines | Measurement           | Accredited Measured Distance |               |
|         |          |                       | (first to last line)         |               |
| 2.0 mm  | 2        | ± 1.00mm from center  | 2.000 mm                     | 2.000 mm      |
| 1.0 mm  | 2        | ± 0.5mm from center   | 1.000 mm                     | 1.000 mm      |
| 0.5 mm  | 2        | ± 0.25mm from center  | 0.500 mm                     | 0.500 mm      |
| 0.25 mm | 2        | ± 0.125mm from center | 0.250 mm                     | 0.250 mm      |
| 5.0 µm  | 12       | ± 20 µm from center   | 55.056 µm                    | 5.005 µm      |
| 2.0 µm  | 16       | ± 10 µm from center   | 30.025 μm                    | 2.002 µm      |
| 1.0 µm  | 17       | ± 5 µm from center    | 16.024 μm                    | 1.002 µm      |

The average pitch is derived from the stated length that was determined using measurements (taken center-to-center) over the stated number of lines (i.e., length divided by the number of lines minus one).

Date of Analysis: December 2<sup>nd</sup>, 2024

## Equipment used:

| Instrument | Model      | Serial # | Resolution | Repeatability | Temperature   | Humidity    | Reference    |
|------------|------------|----------|------------|---------------|---------------|-------------|--------------|
| FE-SEM     | FEI Apreo2 | 9958357  | 0.9nm      | 0.030%        | 21.9 ± 0.1 °C | 33.3 ± 0.8% | CD-PG01-0211 |

Location: AlSthesis Products, Inc., PO Box 1950, Clyde North Carolina 28721.

Notes:

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<sup>\*\*</sup> Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2. The reported expanded measurement uncertainty is stated as the standard measurement uncertainty multiplied by the coverage factor K such that the coverage probability corresponds to approximately 95%.

| D.S. Finch    |           |                                 |
|---------------|-----------|---------------------------------|
| Certified by  | Signature |                                 |
|               |           |                                 |
| H. Haehlen    |           | December 2 <sup>nd</sup> , 2024 |
| Authorized by | Signature | Date report issued.             |

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## Non-ISO 17025:2017 Accredited Supplemental Material.

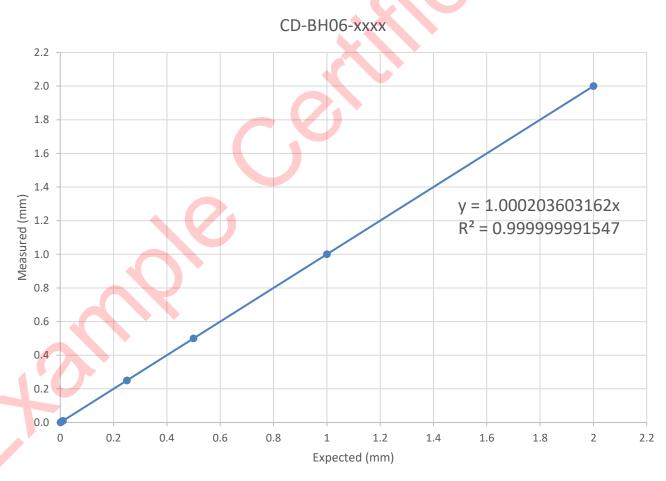


Figure 1. Expected versus actual measurements including all lines with linear regression and R<sup>2</sup> values reported.

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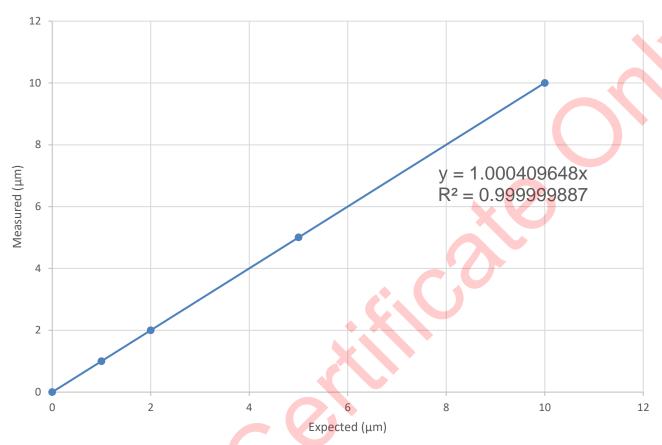


Figure 2. Expected versus actual measurements for the 10 $\mu$ m, 5 $\mu$ m, 2 $\mu$ m and 1 $\mu$ m pitch lines with linear regression and R<sup>2</sup> values reported.

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| 5 µm Line | Pitch     |
|-----------|-----------|
| 0-5µm     | 5.005 µm  |
| 5-10µm    | 5.005 µm  |
| 10-15µm   | 5.005 µm  |
| 15-20µm   | 5.010 µm  |
| 20-25µm   | 5.010 µm  |
| 25-30µm   | 5.005 µm  |
| 30-35µm   | 5.005 µm  |
| 35-40µm   | 5.003 µm  |
| 40-45µm   | 5.000 µm  |
| 45-50µm   | 5.008 µm  |
| 50-55µm   | 5.000 µm  |
| Sum       | 55.056 µm |
| Average   | 5.0051 µm |
| 2-Sigma * | 0.0075 μm |

| 0 1 !     | Dit - I   |
|-----------|-----------|
| 2 µm Line | Pitch     |
| 0-2µm     | 2.002 µm  |
| 2-4µm     | 2.003 µm  |
| 4-6µm     | 2.001 µm  |
| 6-8µm     | 2.003 µm  |
| 8-10µm    | 2.001 µm  |
| 10-12μm   | 2.001 µm  |
| 12-14µm   | 2.003 µm  |
| 14-16µm   | 1.998 µm  |
| 16-18µm   | 2.003 µm  |
| 18-20µm   | 2.001 µm  |
| 20-22µm   | 2.001 µm  |
| 22-24µm   | 2.001 µm  |
| 24-26µm   | 2.003 µm  |
| 26-28µm   | 2.001 µm  |
| 28-30µm   | 2.003 µm  |
| Sum       | 30.025 μm |
| Average   | 2.0017 µm |
| 2-Sigma * | 0.0030 µm |

| 1 µm Line | Pitch                  |
|-----------|------------------------|
| 0-1µm     | 1.001 µm               |
| 1-2µm     | 1.001 µm               |
| 2-3µm     | 1.002 µm               |
| 3-4µm     | 1.002 µm               |
| 4-5µm     | 1.001 µm               |
| 5-6µm     | 1.002 µm               |
| 6-7µm     | 1.001 µm               |
| 7-8µm     | 1.001 µm               |
| 8-9µm     | 1.003 µm               |
| 9-10µm    | 1.00 <mark>1</mark> µm |
| 10-11µm   | 1.00 <mark>0</mark> µm |
| 11-12µm   | 1.002 μm               |
| 12-13µm   | 1.001 µm               |
| 13-14µm   | 1.001 µm               |
| 14-15µm   | 1.003 μm               |
| 15-16µm   | 1.002 µm               |
| Sum       | 16.024 µm              |
| Average   | 1.0015 μm              |
| 2-Sigma * | 0.0017 µm              |

\* Corrected for sample size using the appropriate Student t-factor.

End of report.

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