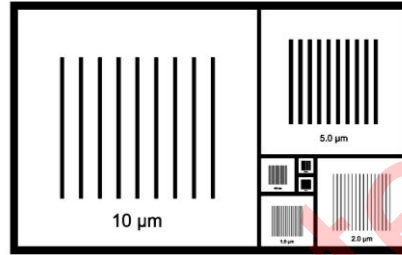
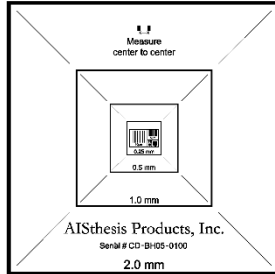


AISthesis Products

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



Certificate of Calibration for Pelcotec™ Critical Dimension Magnification Standard



Product Number: Pelcotec™ 712-01 CDMS-0.1C-ISO-Etched

Product Description: 2.5x2.5mm, Pelcotec™ 2mm-100nm Critical Dimension Magnification Standard

Product Serial Number: CD-BH05-1234

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-BH05-1234 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 "as-is". Repair and/or adjustments are not possible.

Below are the ISO 17025:2017 compliant Certified 10 µm Pitch Measurements unique to Serial Number CD-BH05-1234 and traceable to NIST Certified Standard CD-PG01-0211.

Line	ISO 17025:2017 Compliant Certified Pitch	Position of Measurement
0-10 µm	9.993 µm	± 7.5 µm from center
10-20 µm	9.980 µm	± 7.5 µm from center
20-30 µm	9.980 µm	± 7.5 µm from center
30-40 µm	9.999 µm	± 7.5 µm from center
40-50 µm	10.007 µm	± 7.5 µm from center
50-60 µm	10.014 µm	± 7.5 µm from center
60-70 µm	9.999 µm	± 7.5 µm from center
70-80 µm	9.999 µm	± 7.5 µm from center
Sum	79.971 µm	
Average	9.9964 µm	

2-Sigma *	0.0042 μm	* Corrected for sample size using the appropriate Student t-factor.
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Measurements are reported with an uncertainty (k=2)** of $\pm 0.012 \mu\text{m}$. 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 $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and at less than 80% RH.

** 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%.

Line	Number of Lines	Position of Measurement	Non-ISO 17025:2017 Compliant Measured Distance (first to last line)	Average Pitch
2.0 mm	2	$\pm 1.00\text{mm}$ from center	2.000 mm	2.000 mm
1.0 mm	2	$\pm 0.5\text{mm}$ from center	1.000 mm	1.000 mm
0.5 mm	2	$\pm 0.25\text{mm}$ from center	0.500 mm	0.500 mm
0.25 mm	2	$\pm 0.125\text{mm}$ from center	0.250 mm	0.250 mm
5.0 μm	12	$\pm 20 \mu\text{m}$ from center	55.057 μm	5.005 μm
2.0 μm	16	$\pm 10 \mu\text{m}$ from center	30.051 μm	2.003 μm
1.0 μm	17	$\pm 5 \mu\text{m}$ from center	16.033 μm	1.002 μm
500 nm	20	$\pm 4 \mu\text{m}$ from center	9.519 μm	501.0 nm
250 nm	21	$\pm 2.5 \mu\text{m}$ from center	5.018 μm	250.9 nm
100 nm	52	$\pm 2.5 \mu\text{m}$ from center	5.119 μm	100.4 nm

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: January 25th, 2024

Equipment used:

Instrument	Model	Serial #	Resolution	Repeatability	Temperature	Humidity	Ref.
FE-SEM	FEI Apreo2	9958357	0.9nm	0.030%	$21.9 \pm 0.1^{\circ}\text{C}$	$33.3 \pm 0.8\%$	CD-PG01-0211

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

Notes:

D.S. Finch
Certified by

Signature

H. Haehlen
Authorized by

Signature

January 25th, 2024
Date report issued.

This certificate shall not be reproduced without the permission of AISthesis Products, Inc.
P.O. Box 1950, Clyde, North Carolina 28721 Tel: 828.627.6555 E-mail: CDMS@aisthesisproducts.com

Non-ISO 17025:2017 Compliant Supplemental Material.

BH05-1234

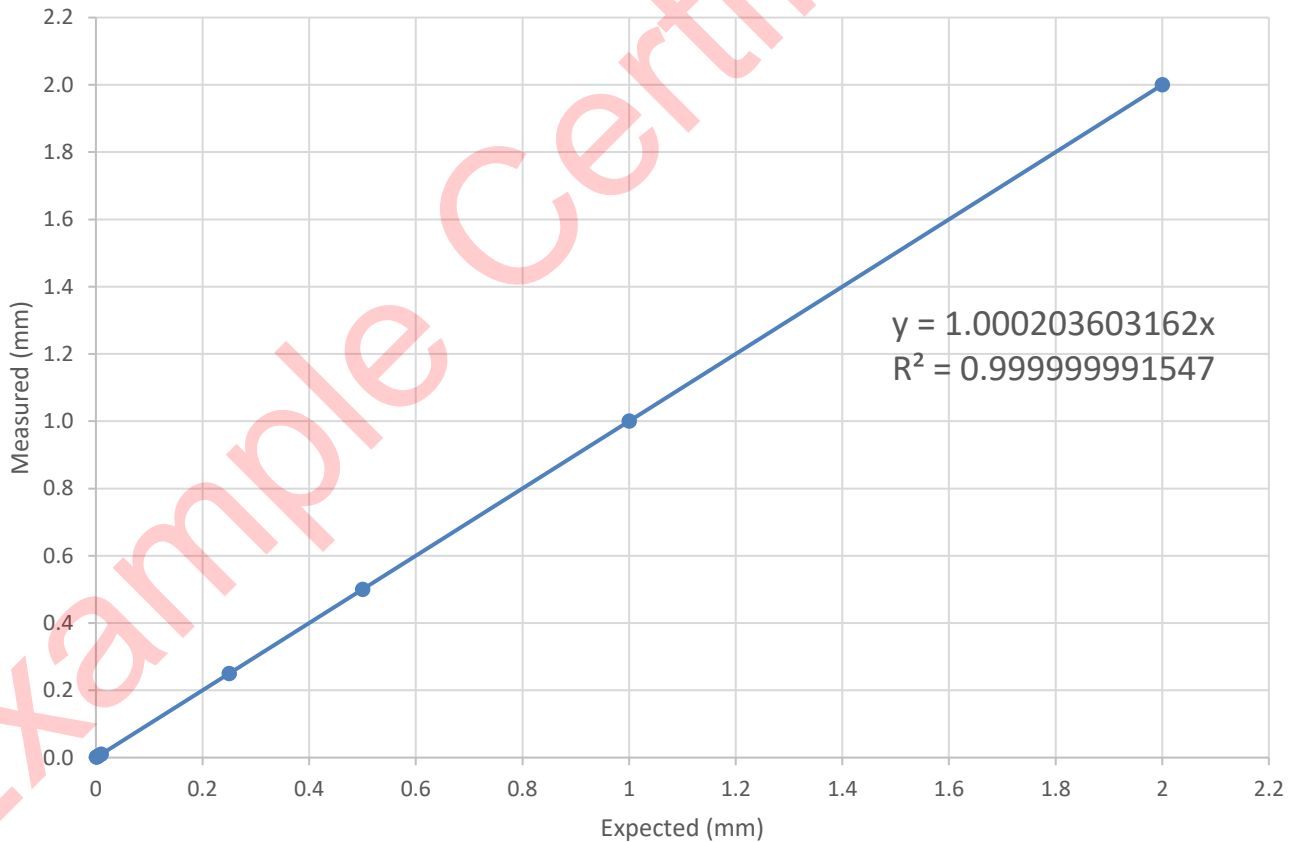


Figure 1. Expected versus actual measurements including all lines with linear regression and R² values reported.

BH05-1234

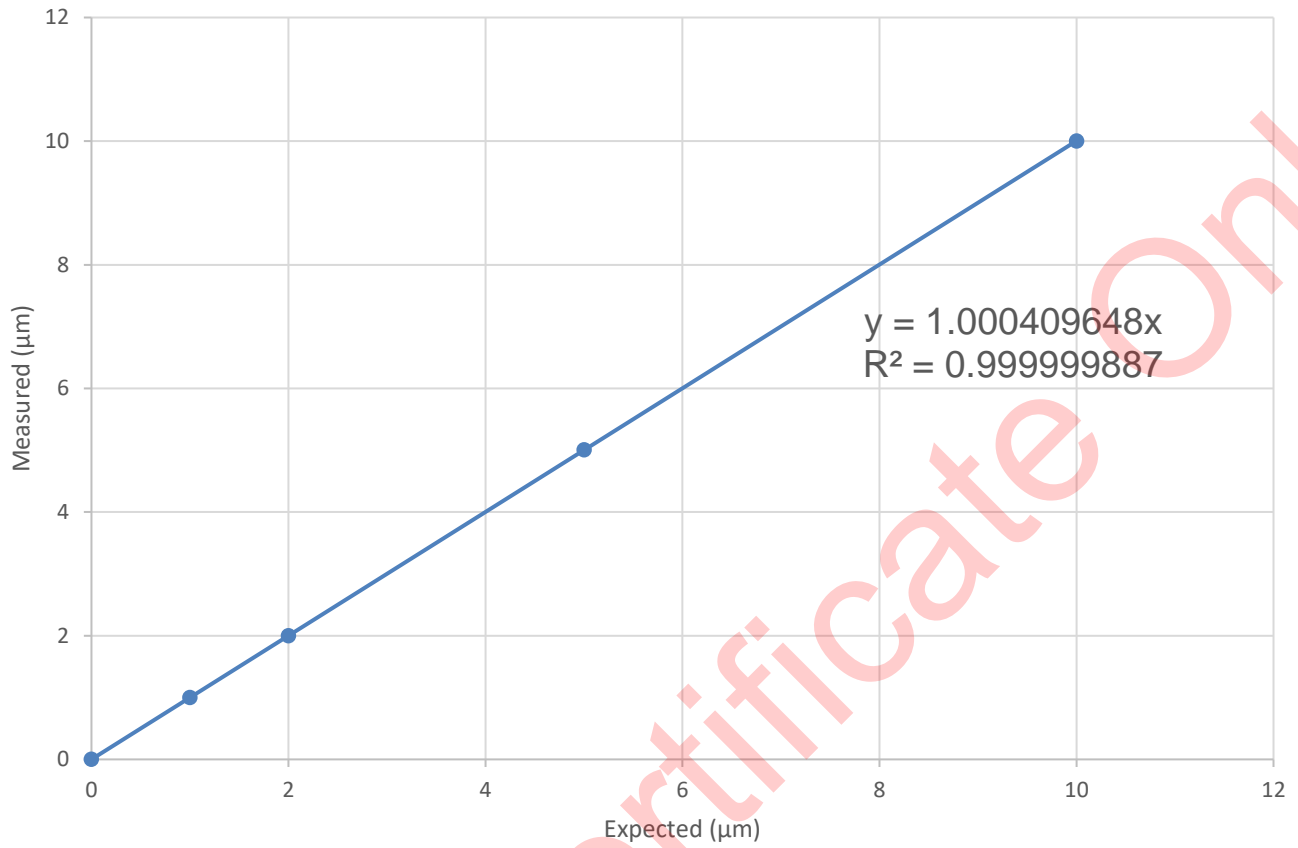


Figure 2. Expected versus actual measurements for the 10µm, 5µm, 2µm, and 1µm pitch lines with linear regression and R² values reported.

BH05-1234

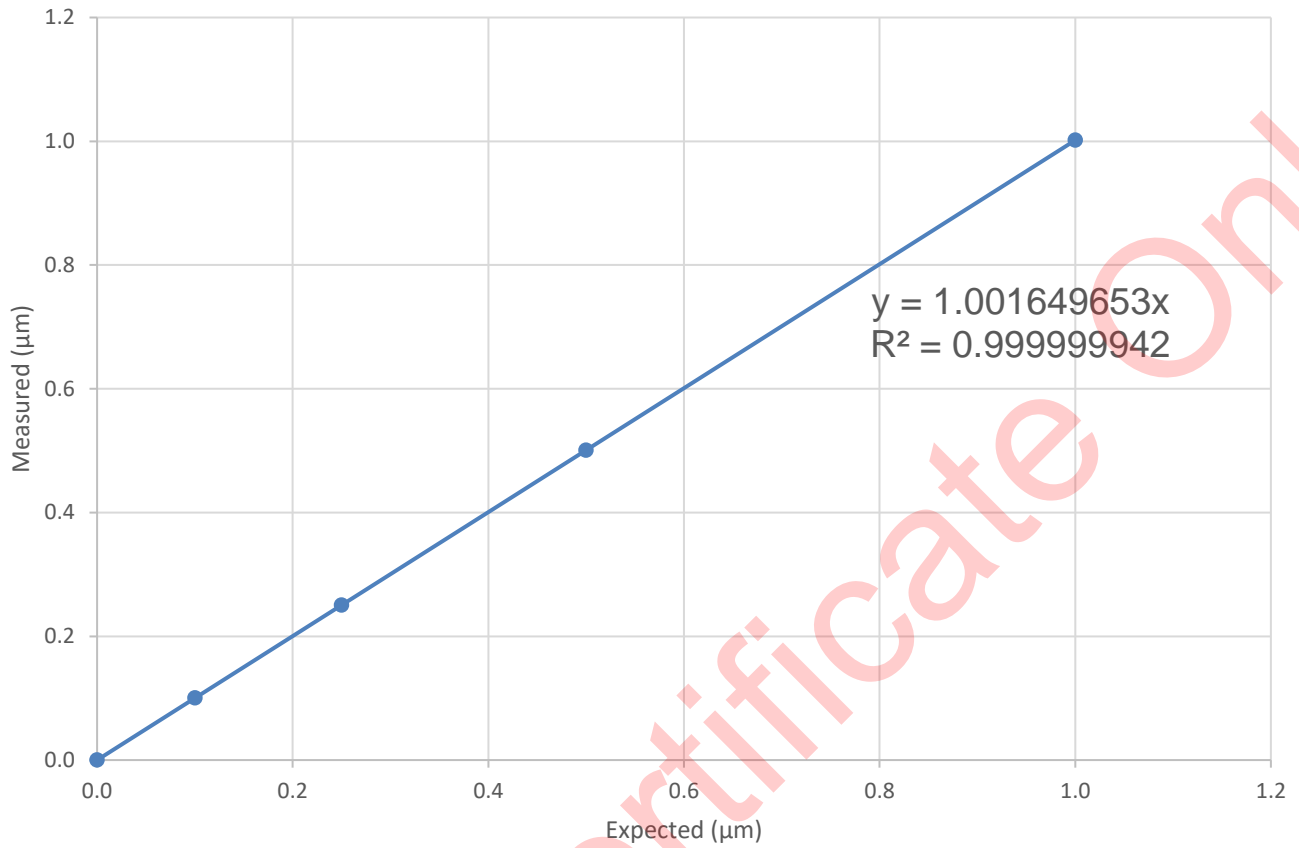


Figure 3. Expected versus actual measurements for the 1µm, 0.5µm, 0.25µm and 0.1µm pitch lines with linear regression and R² values reported.

5 μm Line	Pitch
0-5 μm	5.005 μm
5-10 μm	5.005 μm
10-15 μm	5.005 μm
15-20 μm	5.010 μm
20-25 μm	5.010 μm
25-30 μm	5.005 μm
30-35 μm	5.005 μm
35-40 μm	5.003 μm
40-45 μm	5.000 μm
45-50 μm	5.008 μm
50-55 μm	5.000 μm
<i>Sum</i>	<i>55.057 μm</i>
Average	5.0051 μm
2-Sigma *	0.0079 μm

2 μm Line	Pitch
0-2 μm	2.031 μm
2-4 μm	2.003 μm
4-6 μm	2.001 μm
6-8 μm	2.003 μm
8-10 μm	2.001 μm
10-12 μm	2.001 μm
12-14 μm	2.003 μm
14-16 μm	1.998 μm
16-18 μm	2.003 μm
18-20 μm	2.001 μm
20-22 μm	2.001 μm
22-24 μm	2.001 μm
24-26 μm	2.003 μm
26-28 μm	2.001 μm
28-30 μm	2.003 μm
<i>Sum</i>	<i>30.051 μm</i>
Average	2.0034 μm
2-Sigma *	0.0173 μm

1 μm Line	Pitch
0-1 μm	1.005 μm
1-2 μm	1.001 μm
2-3 μm	1.002 μm
3-4 μm	1.002 μm
4-5 μm	1.001 μm
5-6 μm	1.002 μm
6-7 μm	1.001 μm
7-8 μm	1.001 μm
8-9 μm	1.004 μm
9-10 μm	1.001 μm
10-11 μm	1.000 μm
11-12 μm	1.002 μm
12-13 μm	1.001 μm

13-14 μm	1.001 μm
14-15 μm	1.004 μm
15-16 μm	1.004 μm
<i>Sum</i>	<i>16.033 μm</i>
Average	1.0021 μm
2-Sigma *	0.0032 μm

0.5 μm (500nm) Line	Pitch
0-0.5 μm	0.5046 μm
0.5-1 μm	0.5015 μm
1-1.5 μm	0.4995 μm
1.5-2 μm	0.5015 μm
2-2.5 μm	0.5005 μm
2.5-3 μm	0.5005 μm
3-3.5 μm	0.5005 μm
3.5-4 μm	0.5015 μm
4-4.5 μm	0.4995 μm
4.5-5 μm	0.5026 μm
5-5.5 μm	0.4985 μm
5.5-6 μm	0.5005 μm
6-6.5 μm	0.5026 μm
6.5-7 μm	0.4985 μm
7-7.5 μm	0.5005 μm
7.5-8 μm	0.5015 μm
8-8.5 μm	0.4995 μm
8.5-9 μm	0.5026 μm
9-9.5 μm	0.5026 μm
<i>Sum</i>	<i>9.519 μm</i>
Average	0.50100 μm
2-Sigma *	0.00341 μm

0.5 μm (500nm) Line	Pitch
0-0.5 μm	0.5046 μm
0.5-1 μm	0.5015 μm
1-1.5 μm	0.4995 μm
1.5-2 μm	0.5015 μm
2-2.5 μm	0.5005 μm
2.5-3 μm	0.5005 μm
3-3.5 μm	0.5005 μm
3.5-4 μm	0.5015 μm
4-4.5 μm	0.4995 μm
4.5-5 μm	0.5026 μm
5-5.5 μm	0.4985 μm
5.5-6 μm	0.5005 μm
6-6.5 μm	0.5026 μm
6.5-7 μm	0.4985 μm

7-7.5µm	0.5005 µm
7.5-8µm	0.5015 µm
8-8.5µm	0.4995 µm
8.5-9µm	0.5026 µm
9-9.5µm	0.5026 µm
<i>Sum</i>	<i>9.519 µm</i>
Average	0.50100 µm
2-Sigma *	0.00341 µm

0.25 µm (250nm) Line	Pitch
0-0.25µm	0.2575 µm
0.25-0.5µm	0.2503 µm
0.5-0.75µm	0.2503 µm
0.75-1µm	0.2503 µm
1-1.25µm	0.2513 µm
1.25-1.5µm	0.2503 µm
1.5-1.75µm	0.2503 µm
1.75-2µm	0.2503 µm
2-2.25µm	0.2503 µm
2.25-2.5µm	0.2513 µm
2.5-2.75µm	0.2492 µm
2.75-3µm	0.2513 µm
3-3.25µm	0.2492 µm
3.25-3.5µm	0.2503 µm
3.5-3.75µm	0.2503 µm
3.75-4µm	0.2503 µm
4-4.25µm	0.2503 µm
4.25-4.5µm	0.2503 µm
4.5-4.75µm	0.2503 µm
4.75-5µm	0.2544 µm
<i>Sum</i>	<i>5.018 µm</i>
Average	0.25088 µm
2-Sigma *	0.00401 µm

0.1 µm (100nm) Line	Pitch
0-0.1µm	0.1081 µm
0.1-0.2µm	0.0989 µm
0.2-0.3µm	0.1009 µm
0.3-0.4µm	0.0999 µm
0.4-0.5µm	0.0999 µm
0.5-0.6µm	0.0999 µm
0.6-0.7µm	0.0999 µm
0.7-0.8µm	0.1009 µm
0.8-0.9µm	0.1009 µm
0.9-0.1µm	0.0989 µm

1.0-1.1µm	0.1009 µm
1.1-1.2µm	0.0989 µm
1.2-1.3µm	0.1009 µm
1.3-1.4µm	0.1009 µm
1.4-1.5µm	0.0999 µm
1.5-1.6µm	0.0999 µm
1.6-1.7µm	0.0989 µm
1.7-1.8µm	0.1009 µm
1.8-1.9µm	0.0999 µm
1.90-2.0µm	0.0999 µm
2.0-2.1µm	0.1009 µm
2.1-2.2µm	0.0999 µm
2.2-2.3µm	0.0999 µm
2.3-2.4µm	0.1009 µm
2.4-2.5µm	0.0999 µm
2.5-2.6µm	0.0999 µm
2.6-2.7µm	0.0999 µm
2.7-2.8µm	0.0999 µm
2.8-2.9µm	0.1009 µm
2.9-3.0µm	0.0999 µm
3.0-3.1µm	0.0999 µm
3.1-3.2µm	0.0999 µm
3.2-3.3µm	0.1009 µm
3.3-3.4µm	0.0999 µm
3.4-3.5µm	0.1009 µm
3.5-3.6µm	0.0999 µm
3.6-3.7µm	0.0989 µm
3.7-3.8µm	0.1009 µm
3.8-3.9µm	0.0999 µm
3.9-4.0µm	0.0999 µm
4.0-4.1µm	0.1009 µm
4.1-4.2µm	0.0989 µm
4.2-4.3µm	0.1009 µm
4.3-4.4µm	0.0999 µm
4.4-4.5µm	0.0999 µm
4.5-4.6µm	0.1009 µm
4.6-4.7µm	0.0989 µm
4.7-4.8µm	0.1009 µm
4.8-4.9µm	0.0999 µm
4.9-5.0µm	0.0999 µm
5.0-5.1µm	0.1061 µm
<i>Sum</i>	<i>5.119 µm</i>
Average	0.10038 µm
2-Sigma *	0.00317 µm

End of report.