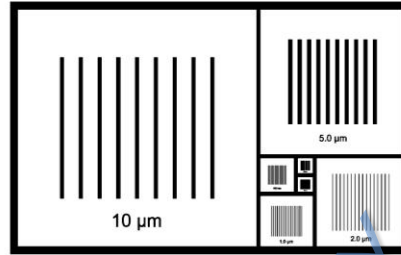
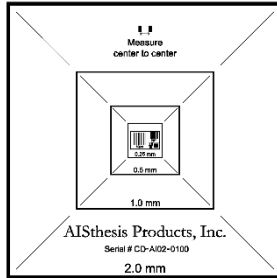


# AISthesis Products

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™ 696-01 CDMS-0.1C-ISO

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

**Product Serial Number:** CD AI02 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-AI02-1234 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-AI02-1234 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.

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 $\mu\text{m}$	12	$\pm 20 \mu\text{m}$ from center	55.057 $\mu\text{m}$	5.005 $\mu\text{m}$
2.0 $\mu\text{m}$	16	$\pm 10 \mu\text{m}$ from center	30.051 $\mu\text{m}$	2.003 $\mu\text{m}$
1.0 $\mu\text{m}$	17	$\pm 5 \mu\text{m}$ from center	16.033 $\mu\text{m}$	1.002 $\mu\text{m}$
500 nm	20	$\pm 4 \mu\text{m}$ from center	9.519 $\mu\text{m}$	501.0 nm
250 nm	21	$\pm 2.5 \mu\text{m}$ from center	5.018 $\mu\text{m}$	250.9 nm
100 nm	52	$\pm 2.5 \mu\text{m}$ from center	5.119 $\mu\text{m}$	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 29<sup>th</sup>, 2023

Equipment used:

Instrument	Model	Serial #	Resolution	Repeatability	Temperature	Humidity	Ref.
FE-SEM	FEI Verios 460L	9922551	0.9nm	0.030%	$23.3 \pm 0.3 \text{ }^\circ\text{C}$	$42.5 \pm 1.5\%$	CD-PG01-0211

Location: Analytical Instrumentation Facility, NC State University, Raleigh NC 27695-7531.

Notes:

D.S. Finch  
Certified by

\_\_\_\_\_  
Signature

H. Haehlen  
Authorized by

\_\_\_\_\_  
Signature

January 29<sup>th</sup>, 2023  
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](mailto:CDMS@aisthesisproducts.com)

**Non-ISO 17025:2017 Compliant Supplemental Material.**

AI02 1234

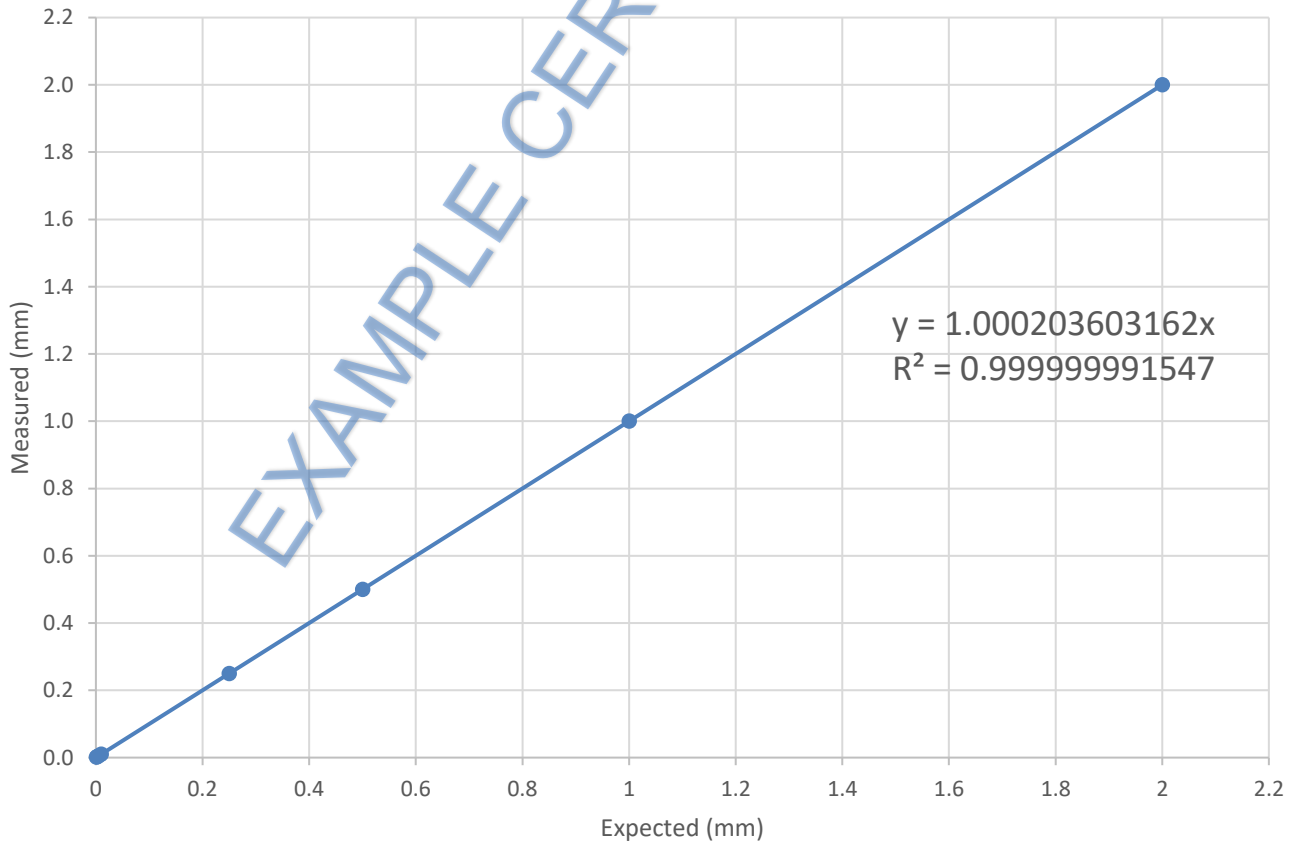


Figure 1. Expected versus actual measurements including all lines with linear regression and R<sup>2</sup> values reported.

AI02 1234

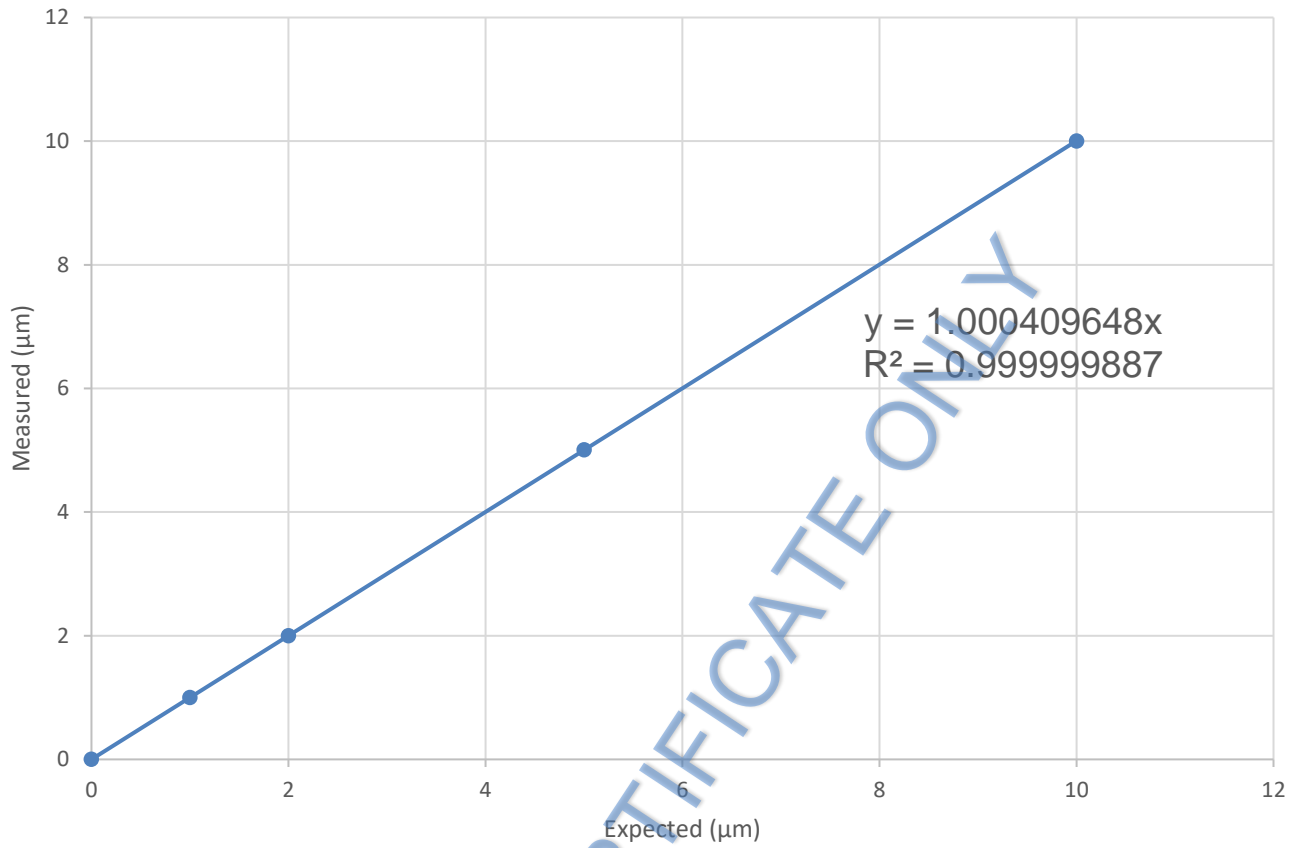


Figure 2. Expected versus actual measurements for the 10µm, 5µm, 2µm, and 1µm pitch lines with linear regression and R<sup>2</sup> values reported.

AI02 1234

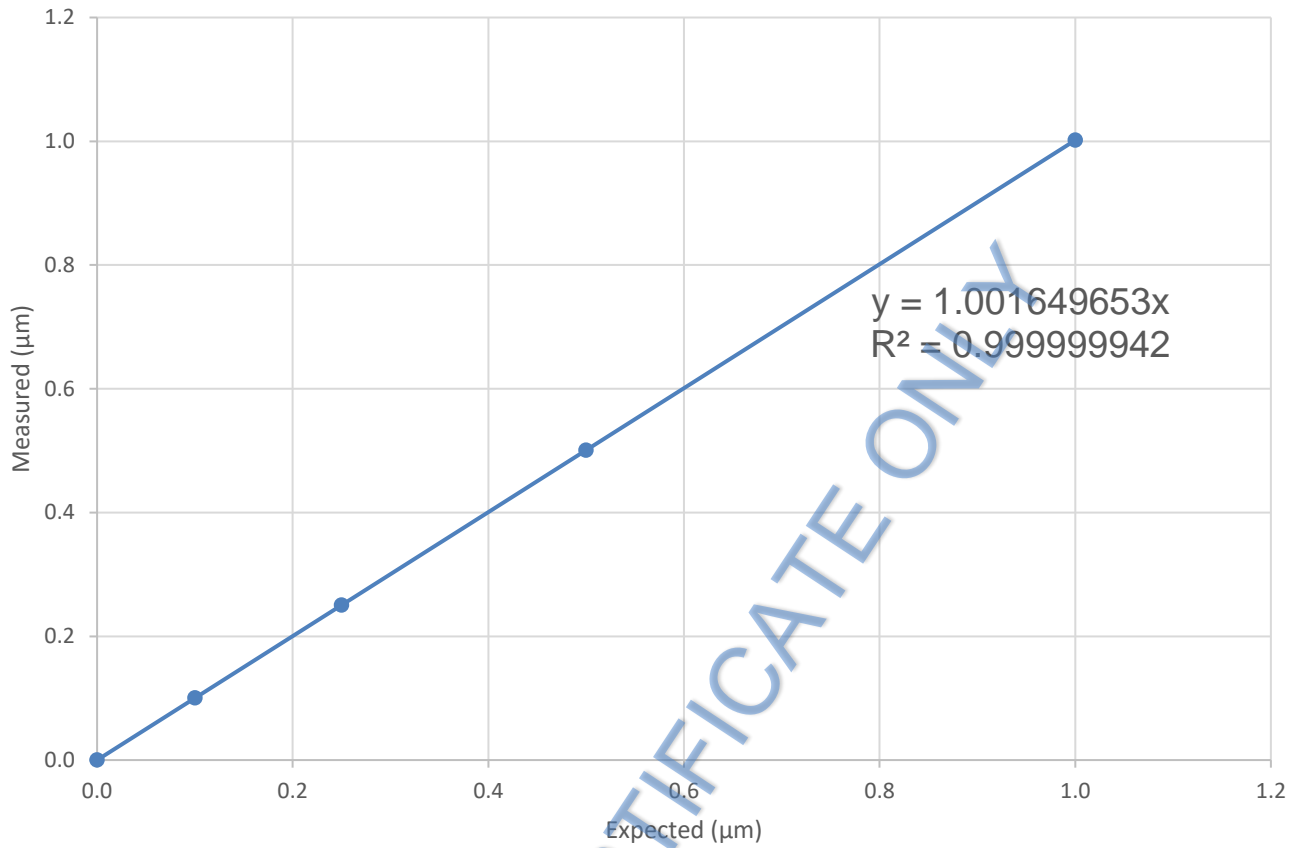


Figure 3. Expected versus actual measurements for the 1µm, 0.5µm, 0.25µm and 0.1µm pitch lines with linear regression and R<sup>2</sup> values reported.

EXAMPLE CERTIFICATE ONLY

5 $\mu\text{m}$ Line	Pitch
0-5 $\mu\text{m}$	5.005 $\mu\text{m}$
5-10 $\mu\text{m}$	5.005 $\mu\text{m}$
10-15 $\mu\text{m}$	5.005 $\mu\text{m}$
15-20 $\mu\text{m}$	5.010 $\mu\text{m}$
20-25 $\mu\text{m}$	5.010 $\mu\text{m}$
25-30 $\mu\text{m}$	5.005 $\mu\text{m}$
30-35 $\mu\text{m}$	5.005 $\mu\text{m}$
35-40 $\mu\text{m}$	5.003 $\mu\text{m}$
40-45 $\mu\text{m}$	5.000 $\mu\text{m}$
45-50 $\mu\text{m}$	5.008 $\mu\text{m}$
50-55 $\mu\text{m}$	5.000 $\mu\text{m}$
<i>Sum</i>	<i>55.057 <math>\mu\text{m}</math></i>
Average	5.0051 $\mu\text{m}$
2-Sigma *	0.0079 $\mu\text{m}$

2 $\mu\text{m}$ Line	Pitch
0-2 $\mu\text{m}$	2.031 $\mu\text{m}$
2-4 $\mu\text{m}$	2.003 $\mu\text{m}$
4-6 $\mu\text{m}$	2.001 $\mu\text{m}$
6-8 $\mu\text{m}$	2.003 $\mu\text{m}$
8-10 $\mu\text{m}$	2.001 $\mu\text{m}$
10-12 $\mu\text{m}$	2.001 $\mu\text{m}$
12-14 $\mu\text{m}$	2.003 $\mu\text{m}$
14-16 $\mu\text{m}$	1.998 $\mu\text{m}$
16-18 $\mu\text{m}$	2.003 $\mu\text{m}$
18-20 $\mu\text{m}$	2.001 $\mu\text{m}$
20-22 $\mu\text{m}$	2.001 $\mu\text{m}$
22-24 $\mu\text{m}$	2.001 $\mu\text{m}$
24-26 $\mu\text{m}$	2.003 $\mu\text{m}$
26-28 $\mu\text{m}$	2.001 $\mu\text{m}$
28-30 $\mu\text{m}$	2.003 $\mu\text{m}$
<i>Sum</i>	<i>30.051 <math>\mu\text{m}</math></i>
Average	2.0034 $\mu\text{m}$
2-Sigma *	0.0173 $\mu\text{m}$

Excluding 1 <sup>st</sup> and last lines	
Average	2.0013 $\mu\text{m}$
2-Sigma *	0.0036 $\mu\text{m}$

1 $\mu\text{m}$ Line	Pitch
0-1 $\mu\text{m}$	1.005 $\mu\text{m}$
1-2 $\mu\text{m}$	1.001 $\mu\text{m}$
2-3 $\mu\text{m}$	1.002 $\mu\text{m}$
3-4 $\mu\text{m}$	1.002 $\mu\text{m}$
4-5 $\mu\text{m}$	1.001 $\mu\text{m}$
5-6 $\mu\text{m}$	1.002 $\mu\text{m}$
6-7 $\mu\text{m}$	1.001 $\mu\text{m}$
7-8 $\mu\text{m}$	1.001 $\mu\text{m}$
8-9 $\mu\text{m}$	1.004 $\mu\text{m}$
9-10 $\mu\text{m}$	1.001 $\mu\text{m}$
10-11 $\mu\text{m}$	1.000 $\mu\text{m}$
11-12 $\mu\text{m}$	1.002 $\mu\text{m}$
12-13 $\mu\text{m}$	1.001 $\mu\text{m}$
13-14 $\mu\text{m}$	1.001 $\mu\text{m}$
14-15 $\mu\text{m}$	1.004 $\mu\text{m}$
15-16 $\mu\text{m}$	1.004 $\mu\text{m}$
<i>Sum</i>	<i>16.033 <math>\mu\text{m}</math></i>
Average	1.0021 $\mu\text{m}$
2-Sigma *	0.0032 $\mu\text{m}$

Excluding 1 <sup>st</sup> and last lines	
Average	1.0017 $\mu\text{m}$
2-Sigma *	0.0026 $\mu\text{m}$

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

<b>Excluding 1<sup>st</sup> and last lines</b>	
Average	0.50070 $\mu\text{m}$
2-Sigma *	0.00285 $\mu\text{m}$

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

<b>Excluding 1<sup>st</sup> and last lines</b>	
Average	0.25031 $\mu\text{m}$
2-Sigma *	0.00119 $\mu\text{m}$

0.1 $\mu\text{m}$ (100nm) Line	Pitch
0-0.1 $\mu\text{m}$	0.1081 $\mu\text{m}$
0.1-0.2 $\mu\text{m}$	0.0989 $\mu\text{m}$
0.2-0.3 $\mu\text{m}$	0.1009 $\mu\text{m}$
0.3-0.4 $\mu\text{m}$	0.0999 $\mu\text{m}$
0.4-0.5 $\mu\text{m}$	0.0999 $\mu\text{m}$
0.5-0.6 $\mu\text{m}$	0.0999 $\mu\text{m}$
0.6-0.7 $\mu\text{m}$	0.0999 $\mu\text{m}$
0.7-0.8 $\mu\text{m}$	0.1009 $\mu\text{m}$
0.8-0.9 $\mu\text{m}$	0.1009 $\mu\text{m}$
0.9-0.1 $\mu\text{m}$	0.0989 $\mu\text{m}$
1.0-1.1 $\mu\text{m}$	0.1009 $\mu\text{m}$
1.1-1.2 $\mu\text{m}$	0.0989 $\mu\text{m}$
1.2-1.3 $\mu\text{m}$	0.1009 $\mu\text{m}$
1.3-1.4 $\mu\text{m}$	0.1009 $\mu\text{m}$
1.4-1.5 $\mu\text{m}$	0.0999 $\mu\text{m}$
1.5-1.6 $\mu\text{m}$	0.0999 $\mu\text{m}$
1.6-1.7 $\mu\text{m}$	0.0989 $\mu\text{m}$
1.7-1.8 $\mu\text{m}$	0.1009 $\mu\text{m}$
1.8-1.9 $\mu\text{m}$	0.0999 $\mu\text{m}$
1.90-2.0 $\mu\text{m}$	0.0999 $\mu\text{m}$
2.0-2.1 $\mu\text{m}$	0.1009 $\mu\text{m}$
2.1-2.2 $\mu\text{m}$	0.0999 $\mu\text{m}$
2.2-2.3 $\mu\text{m}$	0.0999 $\mu\text{m}$
2.3-2.4 $\mu\text{m}$	0.1009 $\mu\text{m}$
2.4-2.5 $\mu\text{m}$	0.0999 $\mu\text{m}$
2.5-2.6 $\mu\text{m}$	0.0999 $\mu\text{m}$
2.6-2.7 $\mu\text{m}$	0.0999 $\mu\text{m}$
2.7-2.8 $\mu\text{m}$	0.0999 $\mu\text{m}$
2.8-2.9 $\mu\text{m}$	0.1009 $\mu\text{m}$
2.9-3.0 $\mu\text{m}$	0.0999 $\mu\text{m}$
3.0-3.1 $\mu\text{m}$	0.0999 $\mu\text{m}$
3.1-3.2 $\mu\text{m}$	0.0999 $\mu\text{m}$
3.2-3.3 $\mu\text{m}$	0.1009 $\mu\text{m}$
3.3-3.4 $\mu\text{m}$	0.0999 $\mu\text{m}$
3.4-3.5 $\mu\text{m}$	0.1009 $\mu\text{m}$

3.5-3.6 $\mu\text{m}$	0.0999 $\mu\text{m}$
3.6-3.7 $\mu\text{m}$	0.0989 $\mu\text{m}$
3.7-3.8 $\mu\text{m}$	0.1009 $\mu\text{m}$
3.8-3.9 $\mu\text{m}$	0.0999 $\mu\text{m}$
3.9-4.0 $\mu\text{m}$	0.0999 $\mu\text{m}$
4.0-4.1 $\mu\text{m}$	0.1009 $\mu\text{m}$
4.1-4.2 $\mu\text{m}$	0.0989 $\mu\text{m}$
4.2-4.3 $\mu\text{m}$	0.1009 $\mu\text{m}$
4.3-4.4 $\mu\text{m}$	0.0999 $\mu\text{m}$
4.4-4.5 $\mu\text{m}$	0.0999 $\mu\text{m}$
4.5-4.6 $\mu\text{m}$	0.1009 $\mu\text{m}$
4.6-4.7 $\mu\text{m}$	0.0989 $\mu\text{m}$
4.7-4.8 $\mu\text{m}$	0.1009 $\mu\text{m}$
4.8-4.9 $\mu\text{m}$	0.0999 $\mu\text{m}$
4.9-5.0 $\mu\text{m}$	0.0999 $\mu\text{m}$
5.0-5.1 $\mu\text{m}$	0.1061 $\mu\text{m}$

*Sum* 5.119  $\mu\text{m}$

Average	0.10038 $\mu\text{m}$
2-Sigma *	0.00317 $\mu\text{m}$

Excluding 1 <sup>st</sup> and last lines	
Average	0.10011 $\mu\text{m}$
2-Sigma *	0.00143 $\mu\text{m}$

End of report.