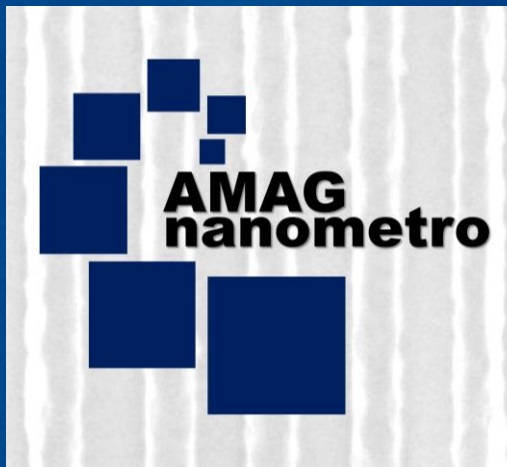
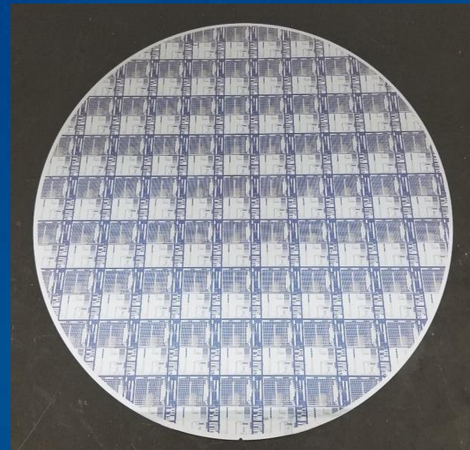
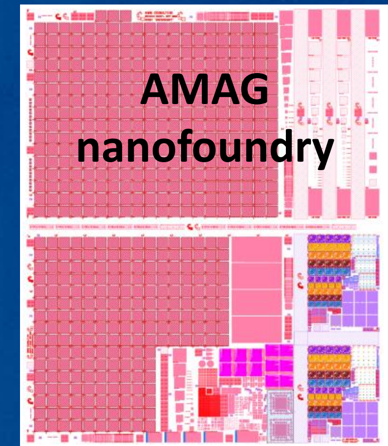





# 100nm depth oxide HM (C60P120) Via navigation & results

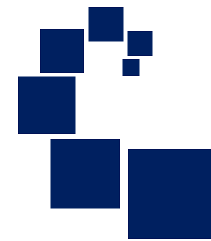
### Jan 9, 2023

**Benjamin Bunday** (President & CEO)
(cell) +1 (512) 627-7391
Ben.Bunday@AMAGnm.com
https://AMAGnm.com

**Yvette Ball** (Wafer Production Manager)
Yvette.Ball@AMAGnm.com

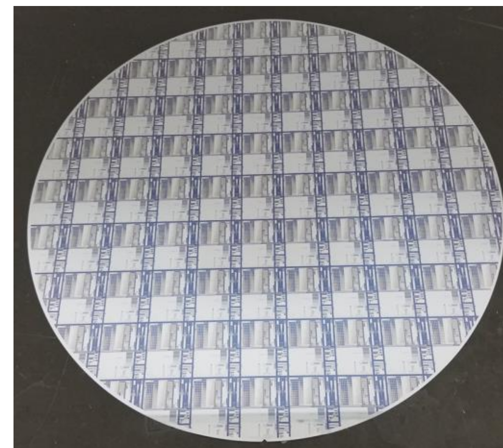
©2022 AMAG Consulting, LLC.
AMAG nanometro and AMAG Consulting logos are registered service marks of AMAG Consulting, LLC. All other service marks and trademarks are the property of their respective owners.

# AMAG7A pane is pattern on HARhole wafers

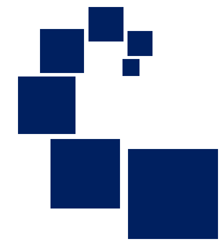


Pane AMAG7A: Darkfield content (hole, trench, variations)

- Full die repeat size is 26.000mm x 33.000mm (exactly).
- Pane A as shown is bladed to print the pattern leaving much empty space filling in ~60% area of die, important for etch loading control to achieve the etch.
- Only the pattern circled in orange to left is present, as that is the content with holes and trenches; the rest is for line/space which does not pattern at same conditions so is omitted for etch loading and defectivity reasons.



# AMAG7A pane is main pattern on HM100 Via wafers



UL corner patrec mark

C60P120 (anchor)

C64P128

C70P140

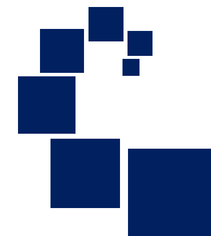
C70P140HEX

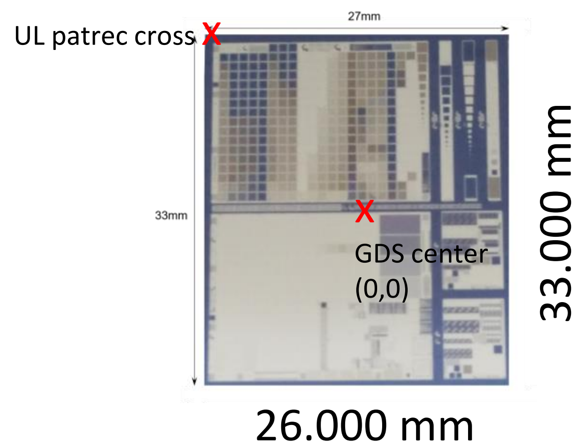
C60P120 variable pads

AMAG6 C60P120 pad copy (6th one down in that series)

C80P165 Faux Memory

# AMAG7A pane is main pattern on HARhole wafers



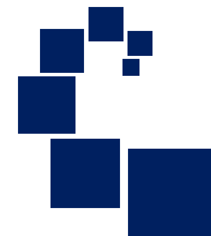


Photograph of Via pattern

(rough pattern between die is just reflection off ceiling)

| Pattern | Wafer Type | x [um] | y [um] | Tile coordinates (each tile has location in GDS) |
|---|---|---|---|---|
| UL pattern rec cross--top left corner of die | 100Hm Via | -12920.5 | 15930.7 | left of A-00 |
| AMAG7 C60P120 grating (anchor target, 800um pad) | 100Hm Via | -12040 | 12650 | A-03 |
| C70P140 grating (800um pad) | 100Hm Via | -12040 | 9150 | A-07 |
| C70P140HEX grating (800um pad) | 100Hm Via | -6600 | 9150 | G-07 |
| C80P165 Faux Memory grating (800um pad) | 100Hm Via | 1473 | 1067 | P-16 |
| AMAG6 C60P120 grating (150um pad) | 100Hm Via | -12720 | 3633 | left of A-13 |
| GDS center (cartesian coordinates) | no feature | 0 | 0 | ~center of bottom of patterned area |

# Via HM100 wafer-level CD results



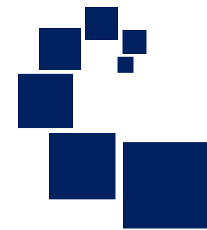
- This report shows the wafer-level averages and variation for each wafer of the first lot of the Via product.
- Specific maps for each wafer including the average & 1sigma and SEM images of all-die of C60P120 and few sites of each of the secondary targets.
- CD values convey top CD of the holes.
  - For C80P165 Faux Memory, two values represent the holes nearest trench and holes further from trench.

| **Lot ID:** | ***2240EMEM001.000*** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***Purpose:*** | ***AMAG7, Full Reticle, Via etched in 100nm Oxide. Anchor feature = C60 P120*** | | | | | | | |
| | | **Final CDSEM measurements (nm)** | | | | | | |
| | | **recipe = DNVA1FAMAG7XCDU1** | | **recipe = DNVA1FAMAG7XCDU2** | | | | |
| **Slot** | **Wfr ID** | **C60 P120 (XCH) All Die CD** | **C60 P120 (1-sigma)** | **C70 P140 HEX (NCH) 11 die** | **C64 P128 (ACH) 11 die** | **C70 P140 (BCH) 11 die** | **C80 P165 MEM (ECH) CD1, 11 die** | **C80 P165 MEM (ECH2) CD2, 11 die** |
| | | | | | | | | |
| 1 | 46JVS155SJD1 | 82.00 | 1.83 | 66.5 | 72.9 | 86.6 | 97.8 | 95.7 |
| 2 | 46JVS156SJA0 | 53.44 | 1.73 | 67.3 | 72.7 | 86.1 | 96.6 | 94.9 |
| 3 | 46JVG041SJA1 | 53.33 | 1.77 | 67.4 | 72.6 | 86.3 | 96.3 | 94.6 |
| 4 | 46IZS107SJG5 | 58.66 | 1.77 | 73.3 | 76.7 | 89.5 | 81.1 | 97.3 |
| 5 | 46IZS106SJC3 | 54.33 | 1.73 | 68.6 | 72.7 | 85.7 | 81.7 | 92.8 |
| Lot | Averages | 60.35 | 1.77 | 68.6 | 73.5 | 86.8 | 90.7 | 95.1 |

# 46JVS155SJD1(2240EMEM001 slot 1) Reference Data

## C60P120 Anchor Target

## Oct 2022

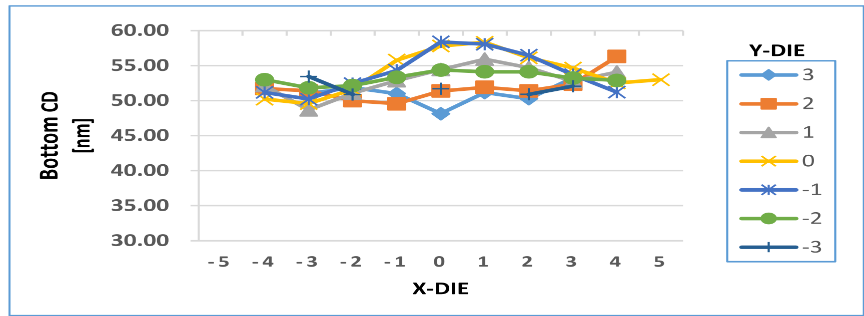


- All measurements in nm.
- Avg CD and 1sigma line-to-line variation for C60P120 anchor target for each die, reported for each die in wafer map format, and plotted to right.
- Average and 1sigma values are of 8 lines sampled at each site, from images on next page.
- CD values convey top CD of the holes.

| | | | |
|---|---|---|---|
| Full Wafer Avg CD: | 52.82 | nm | Average of all individual die CD averages (25 targets/die). |
| Full wafer 1sigma CD: | 2.36 | nm | Stdev of all die CD average of (25 targets/die), represents across wafer variation. |
| Die-to-Die 1sigma | | | Feature-to-feature variation within grating. |
| Avg: | 1.83 | nm | Arithmetic average value of feature-to-feature variation. |
| RMS: | 1.86 | nm | RMS average value of feature-to-feature variation. |
| Ellipticity Avg: | 1.06 | | Average of ratio of major axis to minor axis. |
| FOV: | 800 | nm | Size of image (field-of-view). |

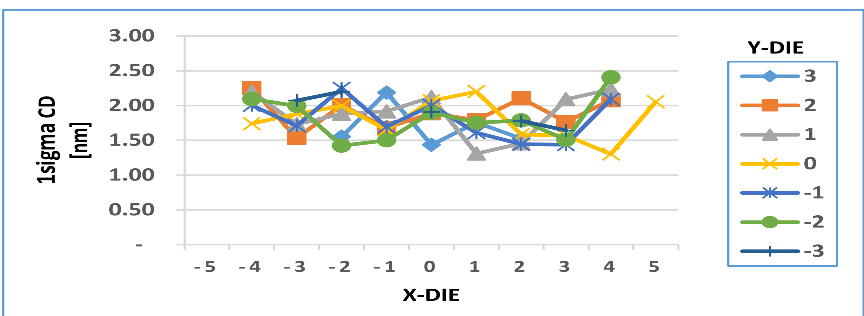
## C60P120 Anchor Target Avg CD (line)

| | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | 51.02 | 51.86 | 51.01 | 48.15 | 51.16 | 50.28 | 53.24 | | |
| 2 | | 51.73 | 51.41 | 50.01 | 49.57 | 51.39 | 51.92 | 51.40 | 52.36 | 56.32 | |
| 1 | | 52.16 | 48.68 | 51.07 | 52.87 | 54.44 | 55.93 | 54.71 | 52.76 | 54.09 | |
| 0 | | 50.23 | 49.59 | 51.62 | 55.80 | 57.81 | 58.35 | 56.13 | 54.66 | 52.53 | 53.01 |
| -1 | | 51.19 | 50.23 | 52.44 | 54.33 | 58.39 | 58.07 | 56.49 | 53.72 | 51.22 | |
| -2 | | 53.00 | 51.85 | 52.16 | 53.34 | 54.39 | 54.13 | 54.13 | 53.22 | 52.89 | |
| -3 | | | 53.44 | 50.89 | | 51.70 | | 50.90 | 52.07 | | |




## C60P120 Anchor Target 1sigma CD

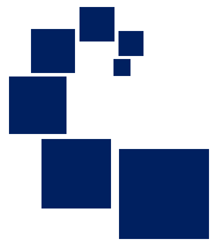
| | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | | 1.55 | 2.19 | 1.43 | 1.76 | 1.53 | | | |
| 2 | | 2.25 | 1.53 | 2.01 | 1.68 | 1.89 | 1.79 | 2.10 | 1.76 | 2.08 | |
| 1 | | 2.20 | 1.73 | 1.88 | 1.92 | 2.12 | 1.31 | 1.46 | 2.09 | 2.23 | |
| 0 | | 1.74 | 1.88 | 1.99 | 1.65 | 2.07 | 2.20 | 1.58 | 1.57 | 1.30 | 2.06 |
| -1 | | 2.00 | 1.71 | 2.25 | 1.69 | 2.00 | 1.61 | 1.44 | 1.44 | 2.09 | |
| -2 | | 2.10 | 1.99 | 1.42 | 1.50 | 1.90 | 1.75 | 1.79 | 1.51 | 2.41 | |
| -3 | | | 2.07 | 2.20 | | 1.91 | | 1.78 | 1.64 | | |



# 46JVS155SJD1(2240EMEM001 slot 1) Reference Data

## C60P120 Anchor Target

## Oct 2022



| | | |
|---|---|---|
| Full Wafer Avg CD: | 52.82 | nm |
| Full wafer 1sigma CD: | 2.36 | nm |
| Die-to-Die 1sigma | | |
| Avg: | 1.83 | nm |
| RMS: | 1.86 | nm |
| Ellipticity Avg: | 1.06 | |
| FOV: | 800 | nm |

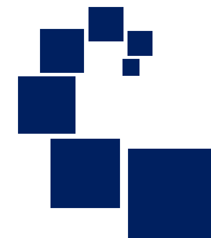
### C60P120 Anchor Target
### CD-SEM image wafer map

| | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | | | | | | | | | |
| 2 | | | | | | | | | | | |
| 1 | | | | | | | | | | | |
| 0 | | | | | | | | | | | |
| -1 | | | | | | | | | | | |
| -2 | | | | | | | | | | | |
| -3 | | | | | | | | | | | |

# 46JVS155SJD1(2240EMEM001 slot 1) Reference Data

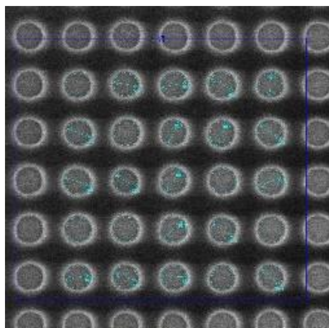
## C60P120 Anchor Target

## Oct 2022



### Anchor Target

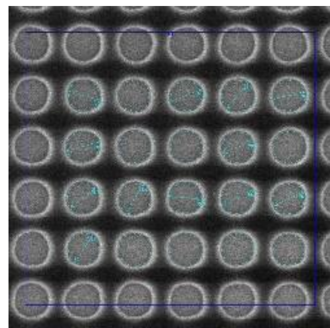
C60P120 (XCH*)



| Full Wafer Avg CD: | 52.82 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 2.36 | nm |
| Die-to-Die 1sigma | | |
| Avg: | 1.83 | nm |
| RMS: | 1.86 | nm |
| Ellipticity Avg: | 1.06 | |
| FOV: | 800 | nm |

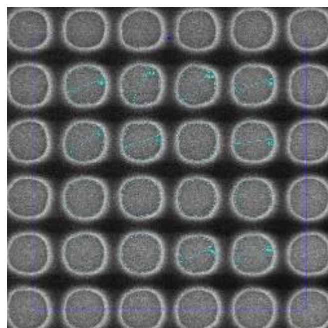
### Secondary Targets

C64P128 (ACH*)



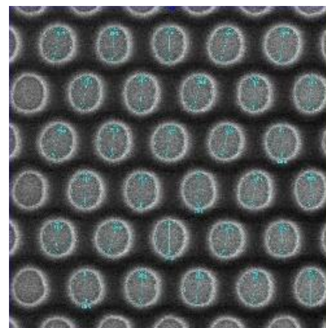
| Full Wafer Avg CD: | 72.9 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 1.91 | nm |
| Die-to-Die 1 sigma: | | |
| Avg: | 1.42 | nm |
| RMS: | 1.45 | nm |
| Ellipticity Avg: | 1.05 | |
| FOV: | 800 | nm |

C70P140 (BCH*)



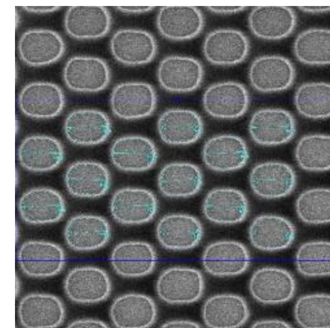
| Full Wafer Avg CD: | 86.6 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 1.70 | nm |
| Die-to-Die 1 sigma: | | |
| Avg: | 1.27 | nm |
| RMS: | 1.28 | nm |
| Ellipticity Avg: | 1.04 | |
| FOV: | 800 | nm |

C70P140HEX (NCH*)



| Full Wafer Avg CD: | 66.50 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 2.23 | nm |
| Die-to-Die 1 sigma | | |
| Avg: | 1.73 | nm |
| RMS: | 1.75 | nm |
| Ellipticity Avg: | 1.21 | |
| FOV: | 800 | nm |

C80P165MEM (ECH2*)



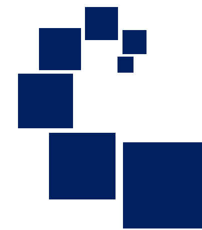
| Full Wafer Avg CD: | 95.7 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 1.96 | nm |
| Die-to-Die 1 sigma | | |
| Avg: | 3.01 | nm |
| RMS: | 3.21 | nm |
| Ellipticity Avg: | 5.12 | |
| FOV: | 1000 | nm |

* Coding labels for CD data results files

# 46JVS156SJA0(2240EMEM001 slot 2) Reference Data

## C60P120 Anchor Target

## Oct 2022

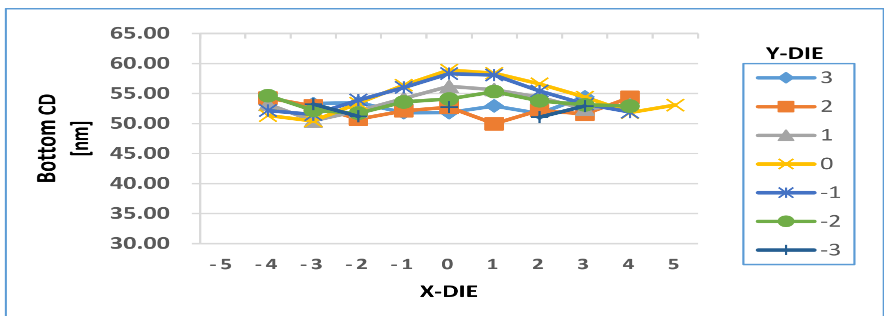


- All measurements in nm.
- Avg CD and 1sigma line-to-line variation for C60P120 anchor target for each die, reported for each die in wafer map format, and plotted to right.
- Average and 1sigma values are of 8 lines sampled at each site, from images on next page.
- CD values convey top CD of the holes.

| | | | |
|---|---|---|---|
| Full Wafer Avg CD: | 53.44 | nm | Average of all individual die CD averages (25 targets/die). |
| Full wafer 1sigma CD: | 2.05 | nm | Stdev of all die CD average of (25 targets/die), represents across wafer variation. |
| Die-to-Die 1sigma | | | Feature-to-feature variation within grating. |
| Avg: | 1.73 | nm | Arithmetic average value of feature-to-feature variation. |
| RMS: | 1.74 | nm | RMS average value of feature-to-feature variation. |
| Ellipticity Avg: | 1.05 | | Average of ratio of major axis to minor axis. |
| FOV: | 800 | nm | Size of image (field-of-view). |

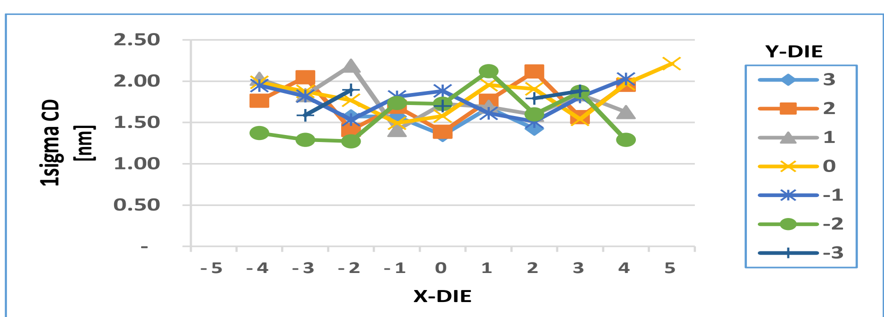
## C60P120 Anchor Target Avg CD (line)

| | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | 53.32 | 53.50 | 51.79 | 51.81 | 52.92 | 51.68 | 54.44 | | |
| 2 | | 54.24 | 52.94 | 50.74 | 52.12 | 52.70 | 49.96 | 52.18 | 51.57 | 54.34 | |
| 1 | | 53.18 | 50.43 | 52.10 | 54.19 | 56.19 | 55.64 | 54.36 | 52.42 | 53.08 | |
| 0 | | 51.32 | 50.41 | 53.39 | 56.40 | 58.90 | 58.38 | 56.61 | 54.40 | 51.82 | 53.08 |
| -1 | | 52.15 | 51.49 | 53.89 | 56.00 | 58.32 | 58.07 | 55.41 | 53.23 | 51.89 | |
| -2 | | 54.65 | 52.18 | 51.72 | 53.59 | 54.09 | 55.33 | 53.78 | 53.10 | 52.91 | |
| -3 | | | 53.23 | 51.19 | | 52.73 | | 51.06 | 52.91 | | |




## C60P120 Anchor Target 1sigma CD

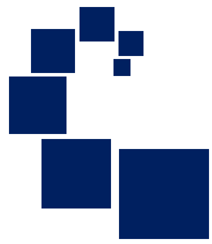
| | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | | 1.57 | 1.57 | 1.35 | 1.68 | 1.42 | | | |
| 2 | | 1.76 | 2.05 | 1.41 | 1.69 | 1.39 | 1.76 | 2.12 | 1.56 | 1.96 | |
| 1 | | 2.03 | 1.83 | 2.19 | 1.41 | 1.73 | 1.69 | 1.59 | 1.84 | 1.63 | |
| 0 | | 1.99 | 1.88 | 1.77 | 1.49 | 1.58 | 1.96 | 1.91 | 1.54 | 1.97 | 2.21 |
| -1 | | 1.95 | 1.82 | 1.53 | 1.81 | 1.88 | 1.61 | 1.51 | 1.81 | 2.03 | |
| -2 | | 1.37 | 1.29 | 1.27 | 1.74 | 1.73 | 2.12 | 1.60 | 1.87 | 1.29 | |
| -3 | | | 1.59 | 1.90 | | 1.70 | | 1.79 | 1.88 | | |



# 46JVS156SJA0(2240EMEM001 slot 2) Reference Data

## C60P120Anchor Target

## Oct 2022



| Full Wafer Avg CD: | 53.44 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 2.05 | nm |
| Die-to-Die 1sigma | | |
| Avg: | 1.73 | nm |
| RMS: | 1.74 | nm |
| Ellipticity Avg: | 1.05 | |
| FOV: | 800 | nm |

### C60P120 Anchor Target
### CD-SEM image wafer map

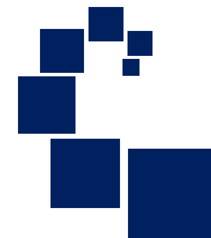
-5 -4 -3 -2 -1 0 1 2 3 4 5

3 2 1 0 -1 -2 -3

# 46JVS156SJA0(2240EMEM001 slot 2) Reference Data

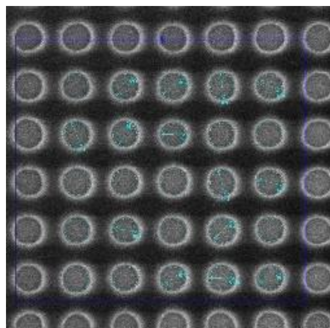
C60P120 Anchor Target

Oct 2022



## Anchor Target

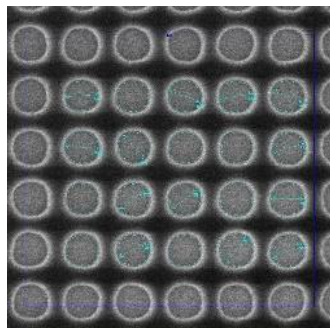
C60P120 (XCH*)



| Full Wafer Avg CD: | 53.44 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 2.05 | nm |
| Die-to-Die 1sigma | | |
| Avg: | 1.73 | nm |
| RMS: | 1.74 | nm |
| Ellipticity Avg: | 1.05 | |
| FOV: | 800 | nm |

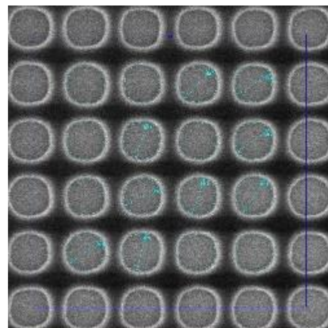
## Secondary Targets

C64P128 (ACH*)



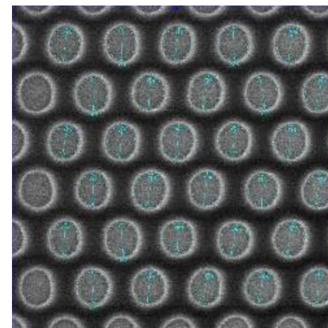
| Full Wafer Avg CD: | 72.7 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 1.83 | nm |
| Die-to-Die 1 sigma: | | |
| Avg: | 1.44 | nm |
| RMS: | 1.46 | nm |
| Ellipticity Avg: | 1.04 | |
| FOV: | 800 | nm |

C70P140 (BCH*)



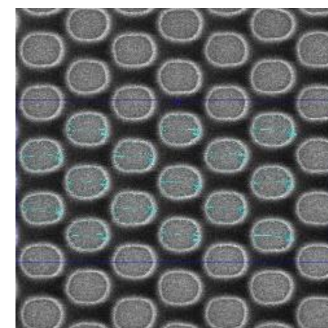
| Full Wafer Avg CD: | 86.1 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 1.64 | nm |
| Die-to-Die 1 sigma: | | |
| Avg: | 1.21 | nm |
| RMS: | 1.22 | nm |
| Ellipticity Avg: | 1.04 | |
| FOV: | 800 | nm |

C70P140HEX (NCH*)



| Full Wafer Avg CD: | 67.28 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 2.31 | nm |
| Die-to-Die 1 sigma | | |
| Avg: | 1.67 | nm |
| RMS: | 1.68 | nm |
| Ellipticity Avg: | 1.21 | |
| FOV: | 800 | nm |

C80P165MEM (ECH2*)



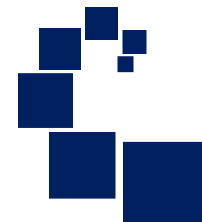
| Full Wafer Avg CD: | 94.9 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 1.41 | nm |
| Die-to-Die 1 sigma | | |
| Avg: | 1.43 | nm |
| RMS: | 1.54 | nm |
| Ellipticity Avg: | 1.25 | |
| FOV: | 1000 | nm |

* Coding labels for CD data results files

# 46JVG041SJA1(2240EMEM001 slot 3) Reference Data

## C60P120 Anchor Target

## Oct 2022

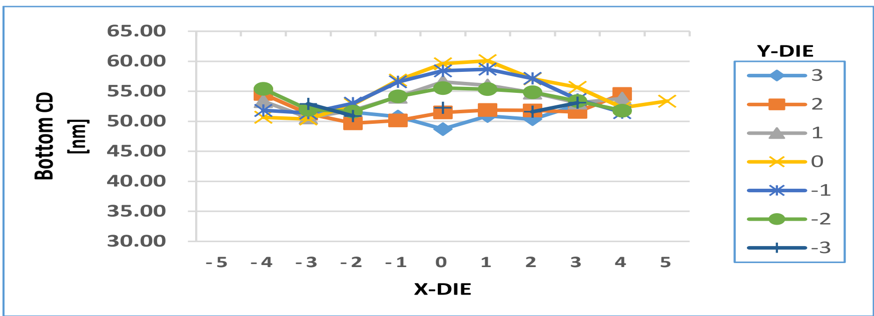


- All measurements in nm.
- Avg CD and 1sigma line-to-line variation for C60P120 anchor target for each die, reported for each die in wafer map format, and plotted to right.
- Average and 1sigma values are of 8 lines sampled at each site, from images on next page.
- CD values convey top CD of the holes.

| | | | |
|---|---|---|---|
| Full Wafer Avg CD: | 53.33 | nm | Average of all individual die CD averages (25 targets/die). |
| Full wafer 1sigma CD: | 2.58 | nm | Stdev of all die CD average of (25 targets/die), represents across wafer variation. |
| Die-to-Die 1sigma | | | Feature-to-feature variation within grating. |
| Avg: | 1.75 | nm | Arithmetic average value of feature-to-feature variation. |
| RMS: | 1.77 | nm | RMS average value of feature-to-feature variation. |
| Ellipticity Avg: | 1.05 | | Average of ratio of major axis to minor axis. |
| FOV: | 800 | nm | Size of image (field-of-view). |

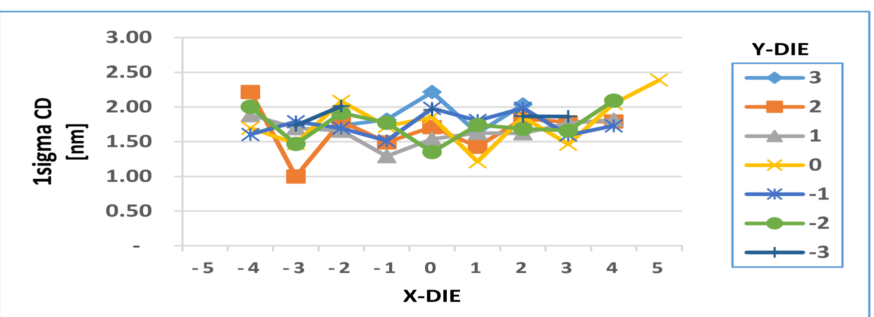
## C60P120 Anchor Target Avg CD (line)

| | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | 51.48 | 51.51 | 50.78 | 48.69 | 50.89 | 50.33 | 52.73 | | |
| 2 | | 54.54 | 51.27 | 49.67 | 50.14 | 51.47 | 51.88 | 51.82 | 51.55 | 54.58 | |
| 1 | | 53.33 | 50.62 | 51.84 | 54.09 | 56.57 | 55.98 | 54.77 | 53.08 | 53.79 | |
| 0 | | 50.65 | 50.39 | 52.82 | 56.85 | 59.58 | 60.08 | 57.08 | 55.66 | 52.26 | 53.36 |
| -1 | | 51.82 | 51.38 | 53.02 | 56.56 | 58.42 | 58.68 | 57.13 | 53.63 | 51.46 | |
| -2 | | 55.40 | 51.94 | 51.60 | 54.14 | 55.54 | 55.35 | 54.84 | 53.38 | 51.77 | |
| -3 | | | 52.90 | 50.89 | | 52.26 | | 51.59 | 53.08 | | |




## C60P120 Anchor Target 1sigma CD

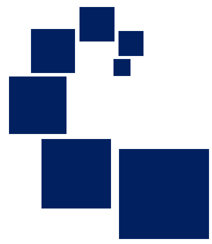
| | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | | 1.73 | 1.82 | 2.22 | 1.62 | 2.04 | | | |
| 2 | | 2.22 | 1.00 | 1.79 | 1.49 | 1.71 | 1.43 | 1.83 | 1.78 | 1.79 | |
| 1 | | 1.88 | 1.70 | 1.66 | 1.29 | 1.54 | 1.63 | 1.62 | 1.77 | 1.81 | |
| 0 | | 1.70 | 1.47 | 2.08 | 1.72 | 1.85 | 1.21 | 1.86 | 1.46 | 2.05 | 2.39 |
| -1 | | 1.61 | 1.79 | 1.69 | 1.51 | 1.98 | 1.81 | 1.98 | 1.60 | 1.73 | |
| -2 | | 2.00 | 1.47 | 1.91 | 1.77 | 1.35 | 1.74 | 1.69 | 1.66 | 2.09 | |
| -3 | | | 1.73 | 2.01 | | 1.96 | | 1.87 | 1.86 | | |



# 46JVG041SJA1(2240EMEM001 slot 3) Reference Data

## C60P120 Anchor Target

## Oct 2022



### C60P120 Anchor Target
### CD-SEM image wafer map

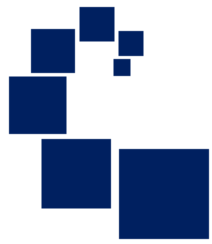
| | | |
|---|---|---|
| Full Wafer Avg CD: | 53.33 | nm |
| Full wafer 1sigma CD: | 2.58 | nm |
| Die-to-Die 1sigma | | |
| Avg: | 1.75 | nm |
| RMS: | 1.77 | nm |
| Ellipticity Avg: | 1.05 | |
| FOV: | 800 | nm |

| | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | | | | | | | | | |
| 2 | | | | | | | | | | | |
| 1 | | | | | | | | | | | |
| 0 | | | | | | | | | | | |
| -1 | | | | | | | | | | | |
| -2 | | | | | | | | | | | |
| -3 | | | | | | | | | | | |

# 46JVG041SJA1(2240EMEM001 slot 3) Reference Data

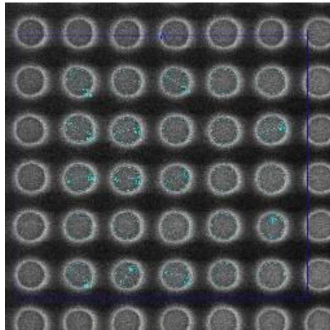
C60P120 Anchor Target

Oct 2022



## Anchor Target

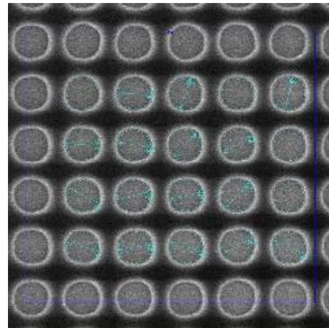
C60P120 (XCH*)



| Full Wafer Avg CD: | 53.33 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 2.58 | nm |
| Die-to-Die 1sigma | | |
| Avg: | 1.75 | nm |
| RMS: | 1.77 | nm |
| Ellipticity Avg: | 1.05 | |
| FOV: | 800 | nm |

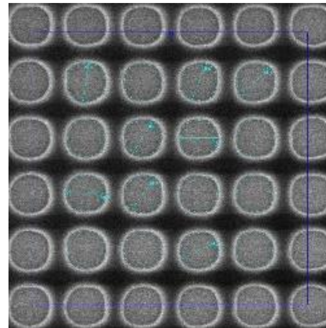
## Secondary Targets

C64P128 (ACH*)



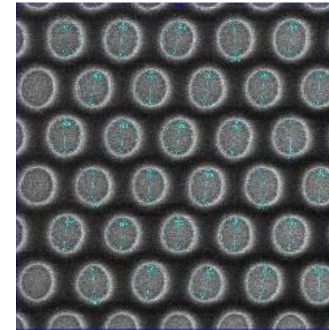
| Full Wafer Avg CD: | 72.6 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 2.12 | nm |
| Die-to-Die 1 sigma: | | |
| Avg: | 1.27 | nm |
| RMS: | 1.29 | nm |
| Ellipticity Avg: | 1.04 | |
| FOV: | 800 | nm |

C70P140 (BCH*)



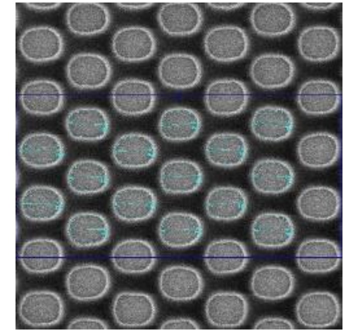
| Full Wafer Avg CD: | 86.3 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 2.03 | nm |
| Die-to-Die 1 sigma: | | |
| Avg: | 1.31 | nm |
| RMS: | 1.32 | nm |
| Ellipticity Avg: | 1.04 | |
| FOV: | 800 | nm |

C70P140HEX (NCH*)



| Full Wafer Avg CD: | 67.38 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 2.63 | nm |
| Die-to-Die 1 sigma | | |
| Avg: | 1.78 | nm |
| RMS: | 1.79 | nm |
| Ellipticity Avg: | 1.21 | |
| FOV: | 800 | nm |

C80P165MEM (ECH2*)



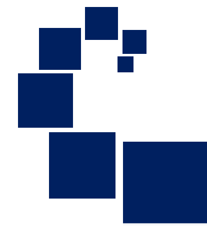
| Full Wafer Avg CD: | 94.6 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 1.41 | nm |
| Die-to-Die 1 sigma | | |
| Avg: | 1.41 | nm |
| RMS: | 1.44 | nm |
| Ellipticity Avg: | 1.22 | |
| FOV: | 1000 | nm |

* Coding labels for CD data results files

# 46IZS107SJG5(2240EMEM002 slot 4) Reference Data

## C60P121 Anchor Target

## Oct 2022

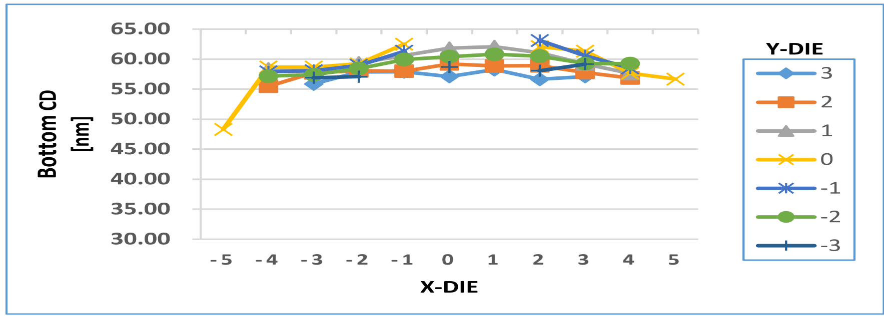


- All measurements in nm.
- Avg CD and 1sigma line-to-line variation for C60P120 anchor target for each die, reported for each die in wafer map format, and plotted to right.
- Average and 1sigma values are of 8 lines sampled at each site, from images on next page.
- CD values convey top CD of the holes.

| | | | |
|---|---|---|---|
| Full Wafer Avg CD: | 58.66 | nm | Average of all individual die CD averages (25 targets/die). |
| Full wafer 1sigma CD: | 2.23 | nm | Stdev of all die CD average of (25 targets/die), represents across wafer variation. |
| Die-to-Die 1sigma | | | Feature-to-feature variation within grating. |
| Avg: | 1.72 | nm | Arithmetic average value of feature-to-feature variation. |
| RMS: | 1.77 | nm | RMS average value of feature-to-feature variation. |
| Ellipticity Avg: | 1.05 | | Average of ratio of major axis to minor axis. |
| FOV: | 800 | nm | Size of image (field-of-view). |

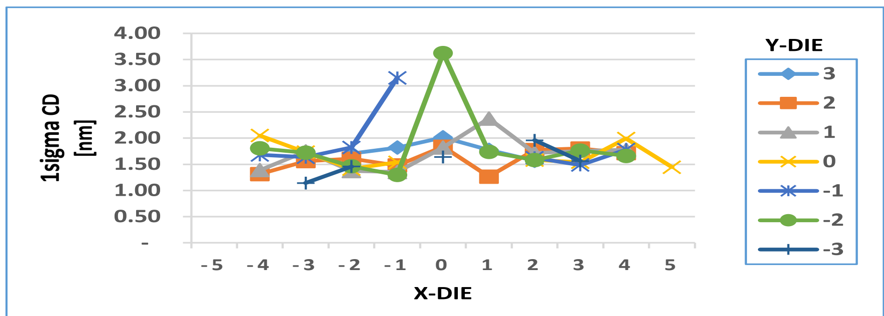
## C60P120 Anchor Target Avg CD (line)

| | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | 55.86 | 57.84 | 57.88 | 57.09 | 58.25 | 56.63 | 57.09 | | |
| 2 | | 55.47 | 57.73 | 58.05 | 57.98 | 59.21 | 58.85 | 58.90 | 57.78 | 56.85 | |
| 1 | | 58.36 | 58.00 | 59.37 | 60.62 | 61.81 | 62.08 | 61.07 | 59.21 | 57.63 | |
| 0 | 48.30 | 58.68 | 58.68 | 59.23 | 62.51 | | | 62.08 | 61.32 | 57.64 | 56.67 |
| -1 | | 57.89 | 58.07 | 58.96 | 61.31 | | | 63.11 | 60.56 | 58.52 | |
| -2 | | 57.17 | 57.41 | 58.44 | 59.94 | 60.42 | 60.80 | 60.50 | 59.26 | 59.24 | |
| -3 | | | 56.89 | 57.07 | | 58.68 | | 58.07 | 59.16 | | |




## C60P120 Anchor Target 1sigma CD

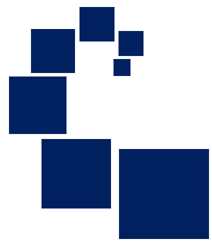
| | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | | 1.71 | 1.82 | 2.02 | 1.77 | 1.57 | | | |
| 2 | | 1.31 | 1.56 | 1.61 | 1.48 | 1.84 | 1.26 | 1.77 | 1.80 | 1.71 | |
| 1 | | 1.39 | 1.75 | 1.37 | 1.35 | 1.82 | 2.37 | 1.72 | 1.76 | 1.78 | |
| 0 | | 2.05 | 1.73 | 1.41 | 1.54 | | | 1.58 | 1.54 | 1.99 | 1.45 |
| -1 | | 1.68 | 1.64 | 1.82 | 3.15 | | | 1.62 | 1.49 | 1.78 | |
| -2 | | 1.80 | 1.72 | 1.46 | 1.30 | 3.62 | 1.74 | 1.58 | 1.76 | 1.66 | |
| -3 | | | 1.14 | 1.46 | | 1.64 | | 1.96 | 1.56 | | |



# 46IZS107SJG5(2240EMEM002 slot 4) Reference Data

## C60P120 Anchor Target

## Oct 2022



C60P120 Anchor Target
CD-SEM image wafer map

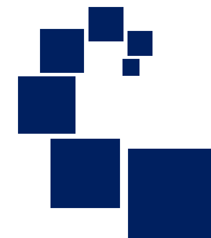
| Full Wafer Avg CD: | 58.66 | nm |
|---:|---|---|
| Full wafer 1sigma CD: | 2.23 | nm |
| Die-to-Die 1sigma | | |
| Avg: | 1.72 | nm |
| RMS: | 1.77 | nm |
| Ellipticity Avg: | 1.05 | |
| FOV: | 800 | nm |

| | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | | | | | | | | | |
| 2 | | | | | | | | | | | |
| 1 | | | | | | | | | | | |
| 0 | | | | | | | | | | | |
| -1 | | | | | | | | | | | |
| -2 | | | | | | | | | | | |
| -3 | | | | | | | | | | | |

# 46IZS107SJG5(2233EMEM002 slot 4) Reference Data

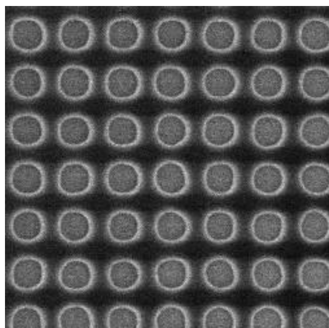
C60P120 Anchor Target

Oct 2022



## Anchor Target

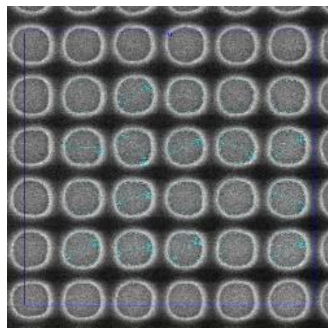
C60P120 (XCH*)



| | | |
|---|---|---|
| Full Wafer Avg CD: | 58.66 | nm |
| Full wafer 1sigma CD: | 2.23 | nm |
| Die-to-Die 1sigma | | |
| Avg: | 1.72 | nm |
| RMS: | 1.77 | nm |
| Ellipticity Avg: | 1.05 | |
| FOV: | 800 | nm |

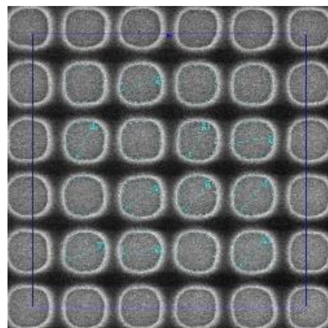
## Secondary Targets

C64P128 (ACH*)



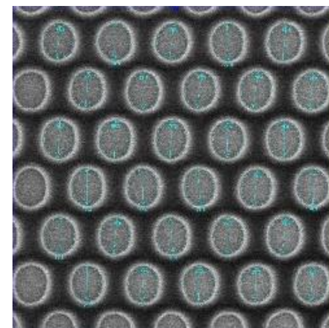
| | | |
|---|---|---|
| Full Wafer Avg CD: | 76.6 | nm |
| Full wafer 1sigma CD: | 2.00 | nm |
| Die-to-Die 1 sigma: | | |
| Avg: | 1.29 | nm |
| RMS: | 1.30 | nm |
| Ellipticity Avg: | 1.04 | |
| FOV: | 800 | nm |

C70P140 (BCH*)



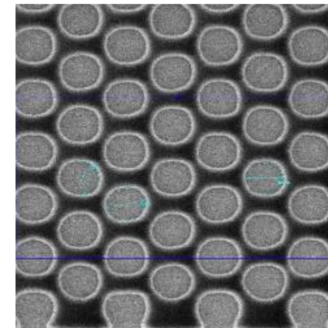
| | | |
|---|---|---|
| Full Wafer Avg CD: | 89.5 | nm |
| Full wafer 1sigma CD: | 1.66 | nm |
| Die-to-Die 1 sigma: | | |
| Avg: | 1.08 | nm |
| RMS: | 1.11 | nm |
| Ellipticity Avg: | 1.04 | |
| FOV: | 800 | nm |

C70P140HEX (NCH*)



| | | |
|---|---|---|
| Full Wafer Avg CD: | 73.34 | nm |
| Full wafer 1sigma CD: | 2.07 | nm |
| Die-to-Die 1 sigma | | |
| Avg: | 1.51 | nm |
| RMS: | 1.54 | nm |
| Ellipticity Avg: | 1.24 | |
| FOV: | 800 | nm |

C80P165MEM (ECH2*)



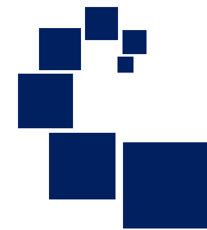
| | | |
|---|---|---|
| Full Wafer Avg CD: | 97.3 | nm |
| Full wafer 1sigma CD: | 1.95 | nm |
| Die-to-Die 1 sigma | | |
| Avg: | 2.98 | nm |
| RMS: | 5.44 | nm |
| Ellipticity Avg: | 1.19 | |
| FOV: | 1000 | nm |

* Coding labels for CD data results files

# 46IZS106SJC3(2233EMEM002 slot 5) Reference Data

## C60P120 Anchor Target

## Oct 2022

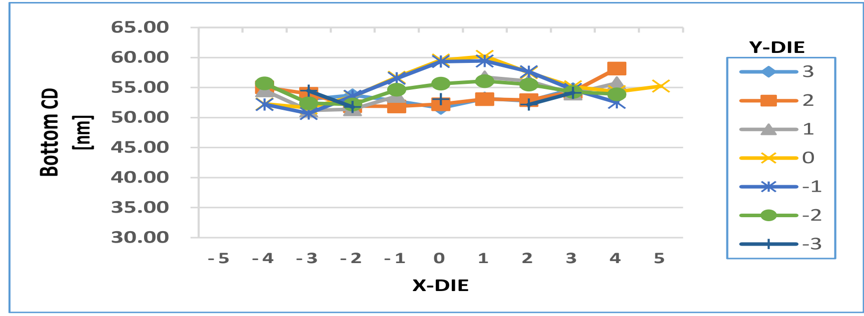


- All measurements in nm.
- Avg CD and 1sigma line-to-line variation for C60P120 anchor target for each die, reported for each die in wafer map format, and plotted to right.
- Average and 1sigma values are of 8 lines sampled at each site, from images on next page.
- CD values convey top CD of the holes.

| | | | |
|---|---|---|---|
| Full Wafer Avg CD: | 54.33 | nm | Average of all individual die CD averages (25 targets/die). |
| Full wafer 1sigma CD: | 2.28 | nm | Stdev of all die CD average of (25 targets/die), represents across wafer variation. |
| Die-to-Die 1sigma | | | Feature-to-feature variation within grating. |
| Avg: | 1.73 | nm | Arithmetic average value of feature-to-feature variation. |
| RMS: | 1.74 | nm | RMS average value of feature-to-feature variation. |
| Ellipticity Avg: | 1.05 | | Average of ratio of major axis to minor axis. |
| FOV: | 800 | nm | Size of image (field-of-view). |

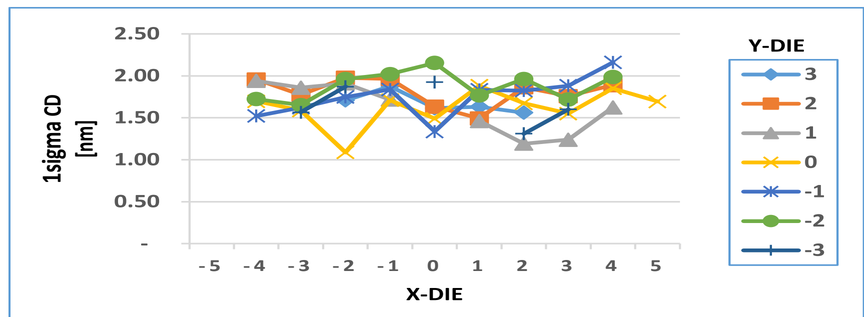
## C60P120 Anchor Target Avg CD (line)

| | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | 53.03 | 53.72 | 52.75 | 51.58 | 53.16 | 52.74 | 54.73 | | |
| 2 | | 55.04 | 53.96 | 51.90 | 51.85 | 52.22 | 53.07 | 52.91 | 54.29 | 58.17 | |
| 1 | | 54.51 | 51.18 | 51.38 | 53.57 | | 56.72 | 56.07 | 53.97 | 55.75 | |
| 0 | | 52.26 | 51.61 | 53.47 | 56.71 | 59.57 | 60.20 | 57.49 | 55.13 | 54.30 | 55.23 |
| -1 | | 52.17 | 50.67 | 53.55 | 56.52 | 59.32 | 59.43 | 57.65 | 54.66 | 52.53 | |
| -2 | | 55.68 | 52.38 | 52.17 | 54.62 | 55.63 | 56.07 | 55.50 | 54.28 | 53.88 | |
| -3 | | | 54.46 | 51.76 | | 53.07 | | 52.15 | 54.13 | | |




## C60P120 Anchor Target 1sigma CD

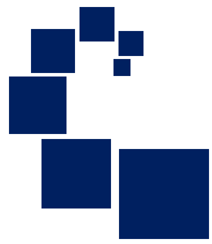
| | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | | 1.71 | 1.88 | 1.62 | 1.63 | 1.56 | | | |
| 2 | | 1.96 | 1.77 | 1.98 | 1.96 | 1.63 | 1.49 | 1.86 | 1.76 | 1.89 | |
| 1 | | 1.94 | 1.86 | 1.91 | 1.72 | | 1.46 | 1.19 | 1.24 | 1.63 | |
| 0 | | 1.70 | 1.59 | 1.09 | 1.71 | 1.49 | 1.88 | 1.67 | 1.55 | 1.85 | 1.69 |
| -1 | | 1.52 | 1.62 | 1.75 | 1.84 | 1.34 | 1.83 | 1.82 | 1.88 | 2.16 | |
| -2 | | 1.72 | 1.65 | 1.96 | 2.02 | 2.15 | 1.77 | 1.96 | 1.72 | 1.99 | |
| -3 | | | 1.57 | 1.87 | | 1.93 | | 1.31 | 1.60 | | |



# 46IZS106SJC3(2233EMEM002 slot 5) Reference Data

## C60P120 Anchor Target

## Oct 2022



### C60P120 Anchor Target
### CD-SEM image wafer map

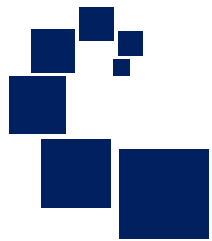
| Full Wafer Avg CD: | 54.33 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 2.28 | nm |
| Die-to-Die 1sigma | | |
| Avg: | 1.73 | nm |
| RMS: | 1.74 | nm |
| Ellipticity Avg: | 1.05 | |
| FOV: | 800 | nm |

| | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | | | | | | | | | | |
| 2 | | | | | | | | | | | |
| 1 | | | | | | | | | | | |
| 0 | | | | | | | | | | | |
| -1 | | | | | | | | | | | |
| -2 | | | | | | | | | | | |
| -3 | | | | | | | | | | | |

# 46IZS106SJC3(2233EMEM002 slot 5) Reference Data

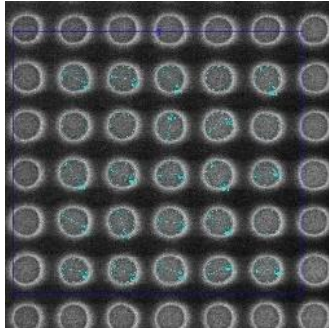
## C60P120 Anchor Target

## Oct 2022



### Anchor Target

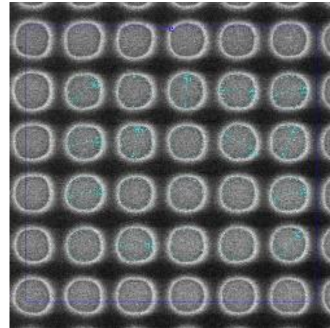
C60P120 (XCH*)



| Full Wafer Avg CD: | 54.33 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 2.28 | nm |
| Die-to-Die 1sigma | | |
| Avg: | 1.73 | nm |
| RMS: | 1.74 | nm |
| Ellipticity Avg: | 1.05 | |
| FOV: | 800 | nm |

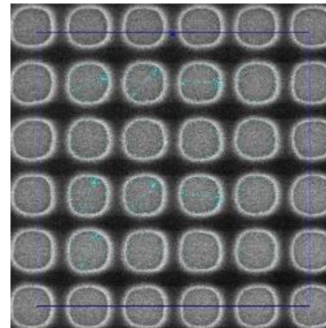
### Secondary Targets

C64P128 (ACH*)



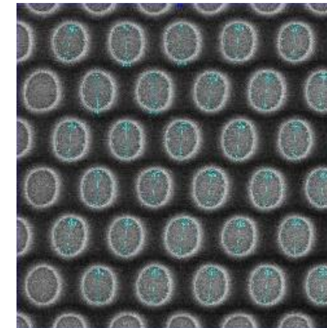
| Full Wafer Avg CD: | 72.7 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 1.92 | nm |
| Die-to-Die 1 sigma: | | |
| Avg: | 1.34 | nm |
| RMS: | 1.35 | nm |
| Ellipticity Avg: | 1.04 | |
| FOV: | 800 | nm |

C70P140 (BCH*)



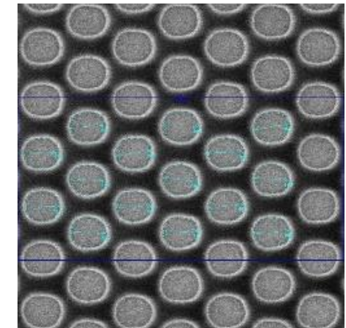
| Full Wafer Avg CD: | 85.7 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 1.77 | nm |
| Die-to-Die 1 sigma: | | |
| Avg: | 1.24 | nm |
| RMS: | 1.27 | nm |
| Ellipticity Avg: | 1.03 | |
| FOV: | 800 | nm |

C70P140HEX (NCH*)



| Full Wafer Avg CD: | 92.8 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 5.88 | nm |
| Die-to-Die 1 sigma | | |
| Avg: | 3.93 | nm |
| RMS: | 8.77 | nm |
| Ellipticity Avg: | 1.24 | |
| FOV: | 1000 | nm |

C80P165MEM (ECH2*)

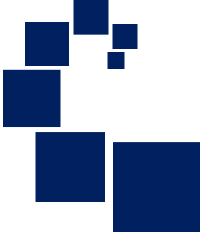


| Full Wafer Avg CD: | 68.61 | nm |
|---|---|---|
| Full wafer 1sigma CD: | 2.32 | nm |
| Die-to-Die 1 sigma | | |
| Avg: | 1.48 | nm |
| RMS: | 1.49 | nm |
| Ellipticity Avg: | 1.28 | |
| FOV: | 800 | nm |

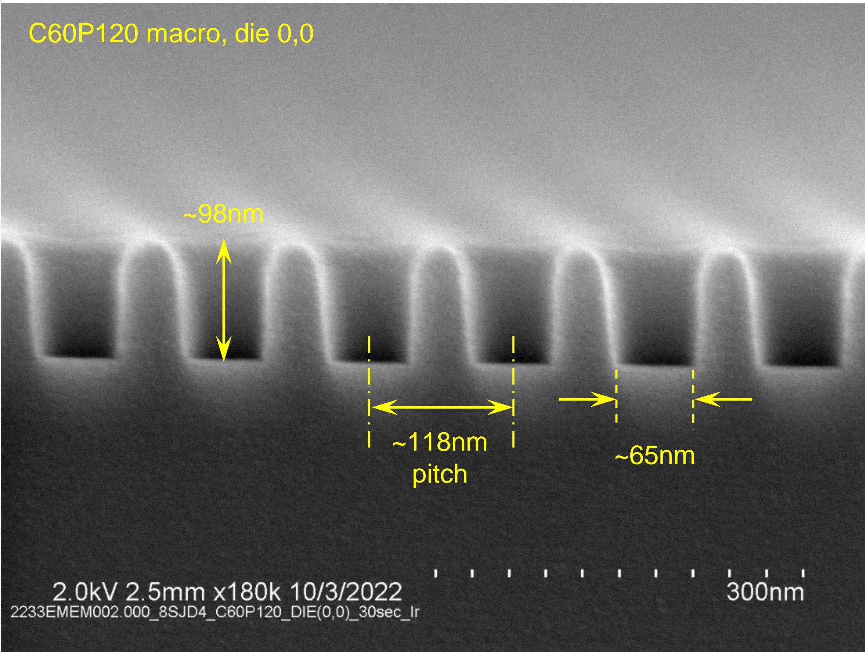
* Coding labels for CD data results files

# C60P120 Target XSEM Reference Data

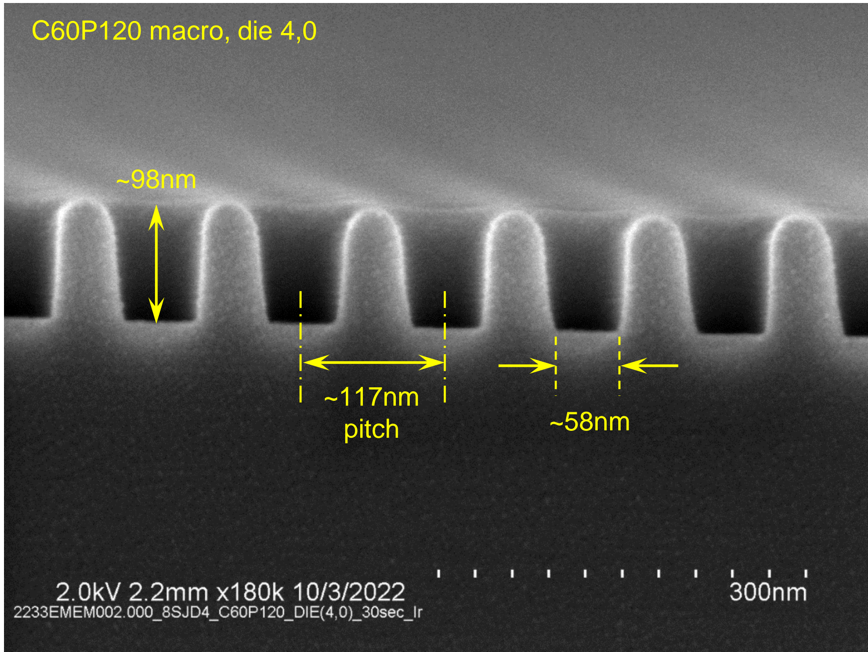
Oct 2022



Target XSEM images

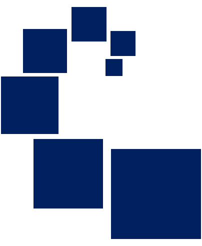



Center




Edge

# Conclusions



- Thank you for your purchase of AMAG wafers!
- We hope this guide of reference CD-SEM metrology adds significant value to the use of these wafers.
- This report represents the standard metrology AMAG nanometro provides for such wafers, and future lots and wafer types will have similar companion data sets.

# Thank you for your Attention!

Cross-section SEM image of typical profiles of C60P120 contact holes, showing very uniform 1.03 μm depth.

1.03 μm

500nm

Top down CD-SEM image of typical C60P120 grating. FOV = 660 nm.
Note image cropped on right.