Review / Discussion of 4584B
- P40 update -
Ballot Voting Results

EUV Mask TF Co-chairs:
Tsuneyuki Hagiwara (Nikon)
George Huang (UMC assignee SEMATECH)
Akira Miyake (Canon)
Kazuya Ota (Selete)
John Zimmerman (ASML)

The revisions for P-40 have been approved by SEMI

Submitted Responses For SEMI Draft Document 4584B

As Cast Ballot Tally Summary For Document 4584B	
Return Percentage: 60.00%	Voting Member Returns: 33 Voting Member Distribution: 55
Total votes Received: 41	***Number of Abstains: 21***
Number of Accepts: **20** Accept %: **100.00%**	Number of Rejects: **0**
Total Comments: **1**	Total Rejects: **0**
Comment Issuer(s): **NIST - James Potzick**	***Reject Issuer(s):***

Approved by SEMI NA Micropatterning committee on 7/14, 2009 and published on 9/04, 2009

4584B - P40 Mounting Requirements for EUV Masks

Table 1 Flatness of the Mounting Surface

Mounting Quality Area (millimeters^2)	*Maximum Peak-to-Valley Flatness (nanometers)*
W x D	30

Table 2 Local Slope of the Mounting Surface

Area over which local slope is measured (millimeters²)	*Local Slope Error (microradians)*
20 x 20	≤ 1.0

Table 3 Clamping Pressure

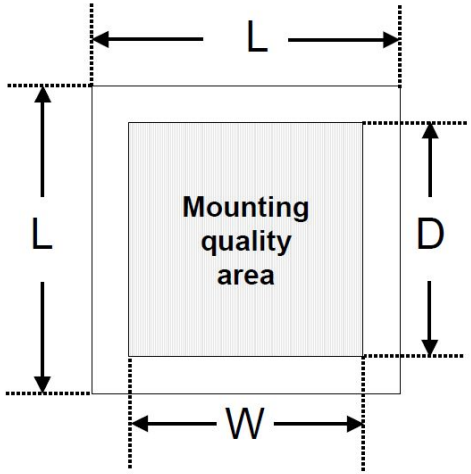
Max Clamping Pressure on contacted area (kPa)	*Maximum Range of Clamping Pressure within Flatness Quality Area (%)*
≤ 2000	20

Table 4 Minimum Effective Bending Stiffness of the Chuck Cross Section

Bending Stiffness (Newton-meter) [#1]
300,000

[#1] The effective bending stiffness (D) of a chuck with a solid cross section is given by:

$$D = \frac{E h^3}{12(1-\nu^2)}$$



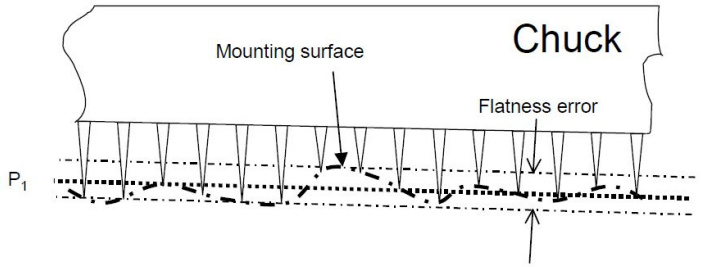


Figure 3
Definition of Flatness Error for a Pin or Pedestal Chuck
Note: P1 is the best fit plane determined through least squares fitting

Flatness Requirement - ITRS

Year of Production	*2008 **	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*
EUVL-specific Mask Requirements									
Substrate defect size (nm) [L]	41	39	37	35	34	32	30	29	27
Mean peak reflectivity	65%	66%	66%	66%	67%	67%	67%	67%	67%
Peak reflectivity uniformity (% 3 sigma absolute)	0.69%	0.58%	0.47%	0.42%	0.37%	0.33%	0.29%	0.26%	0.23%
Reflected centroid wavelength uniformity (nm 3 sigma) [M]	0.08	0.07	0.06	0.05	0.05	0.05	0.04	0.04	0.04
Absorber sidewall angle tolerance (± degrees) [P]	1	1	0.75	0.69	0.62	0.5	0.5	0.5	0.5
Absorber LER (3 sigma nm) [N]	3.9	3.4	3.0	2.6	2.4	2.1	[illegible]	1.7	1.5
Mask substrate flatness (nm peak-to-valley) [O]	68	59	51	46	41	36	32	29	26

- 30nm P-V flatness can serve the need up to 2014
- Keep improving Manufacture/Metrology capability to achieve 30nm P-V flatness and below as technologies move on
- Keep improving stiffness to minimize the e-chuck deformation to reduce image placement error.

Considerations for future changes to P-40

- In order for flatness compensation to work, tighter chuck flatness requirements are needed for tool generations beyond 2012
  - Current specification of 30nm non-flatness could contribute up to 0.75nm image placement error at wafer
  - SEMI EUV Mask Task Force must begin work on future chuck requirements.

SEMI E152 Update

Oct 22, 2009

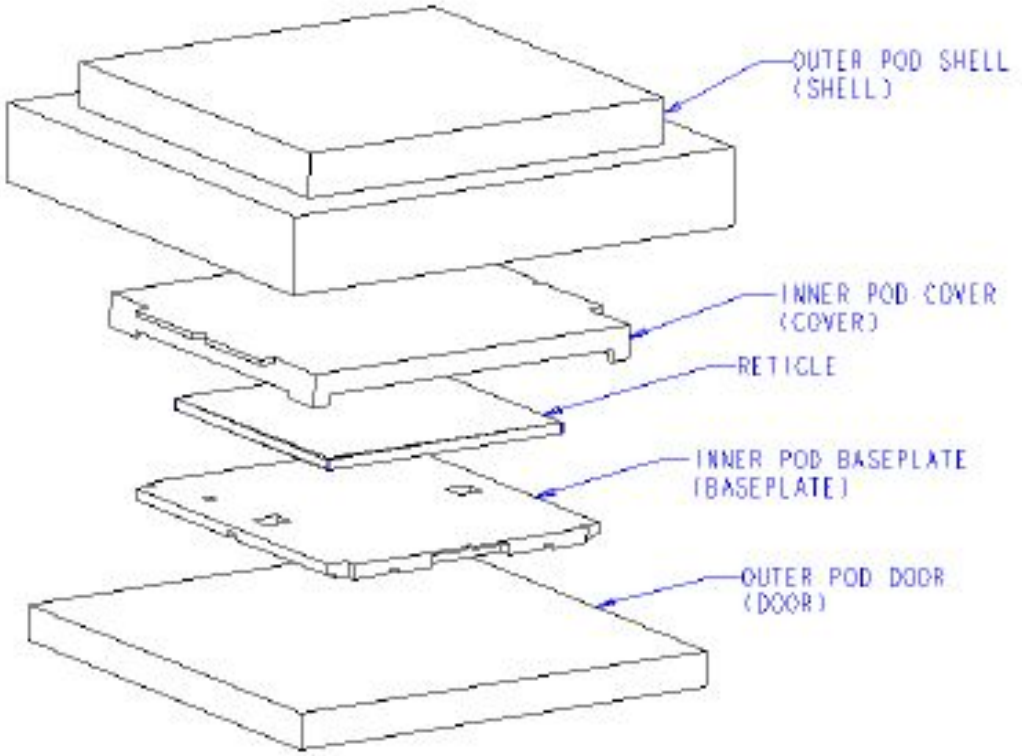
TF Co-chairs:

Long He (Intel)
Dave Halbmaier (Entegris)
John Zimmerman (ASML)
George Huang (SEMATECH/UMC)

Outline

- E152 Passed in Apr. 1 and officially published in July 2009
- E152-Compliant Dual Pod Data
- Commercial Pod Status
- Dual Pod Implementation for Mass Production

4466B: *Mechanical Specification of EUV Pod for 150 mm EUVL Reticles*



Explored view of EUV Pod

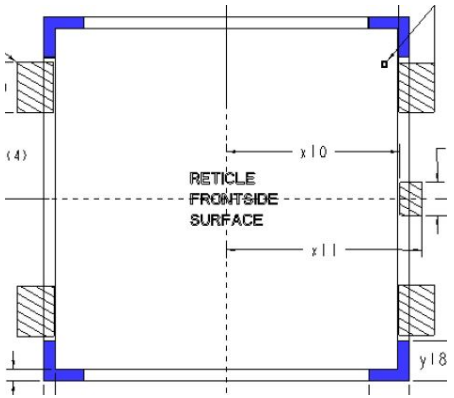
Ballots Response For SEMI Draft Document 4466B

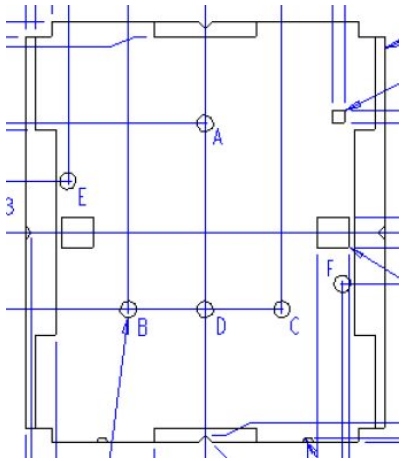
As Cast Ballot Tally Summary For Document 4466B	
Return Percentage: 61.45%	**Voting Member Returns: 51** **Voting Member Distribution: 83**
Total votes Received: 65	*Number of Abstains: 45*
Number of Accepts: 19 **Accept %:** 95.00%	**Number of Rejects:** 1
Total Comments: ~~2~~ **4**	**Total Rejects:** 1
Comment Issuer(s): ISMI - Kevin Orvek Intel - Long He Asyst – Mikio Otani	*Reject Issuer(s):* Silveira - Jeff Silveira

NA PIC Committee approved on Apr.1 2009 after All rejects and comments are well addressed and responded.

2 types of EUV inner pods in SEMI E152

Feature	*Specification*	
	Type A	*Type B*
Reticle Location Tolerance	± 0.55 mm	± 0.25 mm
Reticle Location Tolerance	± 0.55 mm	± 0.25 mm
Front Edge Grip Exclusion Volumes	Required	Not Required
Baseplate Apertures	Required	Not Required
Baseplate Corner Notch	72.00 ± 0.20 mm	Prohibited
Baseplate Corner Notch	3.00 ± 0.25 mm	Prohibited
Secondary Baseplate Exclusion Volume	3.00 ± 0.25 mm	Prohibited
Secondary Baseplate Exclusion Volume	6.00 ± 0.25 mm	Prohibited
Baseplate Notch	3.00 ± 0.25 mm	Prohibited
Cover Edge Limit (above base plate, along x22)	5.00 mm, Minimum	Prohibited
Baseplate Exclusion Volume	50.00 ± 0.25 mm	40.00 ± 0.25 mm
Baseplate Exclusion Volume	25.00 ± 0.25 mm	20.00 ± 0.25 mm
Baseplate Registration Hole Assignments	A, B, C, D, E, F	A, B, C

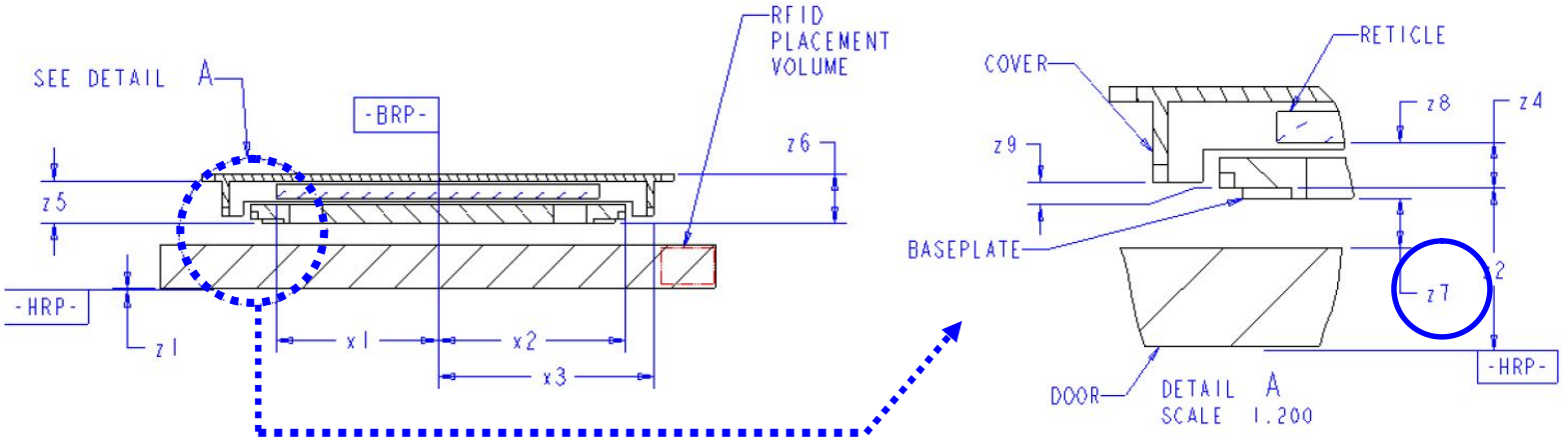




- Type A inner pods specifically address the needs of EUV-pods needed by lithography tools
- The feature differences in this table prevent Type B pods from being used where Type A pods are needed. Type A pods can be used in place of Type B pods.

All SEMI-Compliant Dual Pods

SEMI Standard		Type B (Sematech Type)		Type A (Scanner Supplier Type)
Inner Pod Type		sPod1	sPod3	Scanner supplier type
Outer Pod Type		Prototype 1	Prototype 2	Prototype 2
SEMI Compliance		**Non-compliant**	SEMI-compliant	SEMI-compliant
Z7	>= 10 mm	**3.8**	**10**	**10**
Z8	8.6 +/- .5 mm	8.6	8.71	8.71
Z5	16.25+/-.25 mm	16.3	16.05	16
Z4	6.4+/-.25 mm	-	6.47	6.53



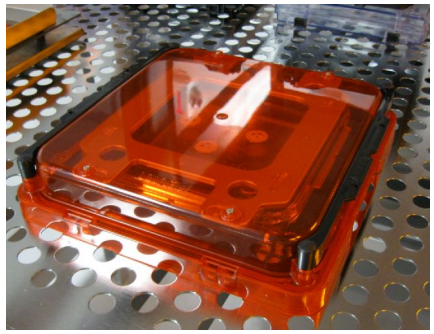
Z7 defines the separation between the bottom of inner pod and top of outer carrier door

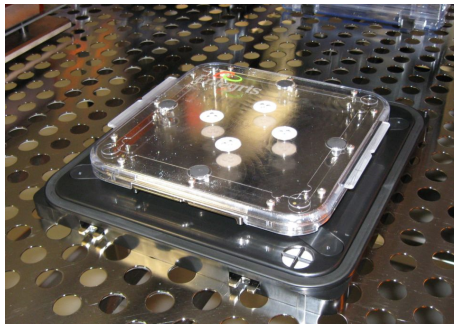
- Two types of different SEMI-compliant dual pods were built: type B for SEMATECH and type A for scanner suppliers
- Z7 increased from 3.8 mm (sPod1) to ≥ 10 mm in SEMI standard to facilitate robotic handling

sPod1 vs. sPod3 (SEMATECH Pods)

- sPOD1: An early version of an EUV pod

whole pod

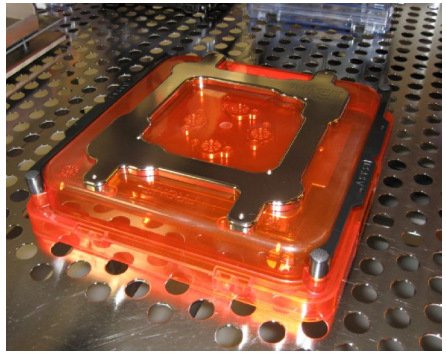


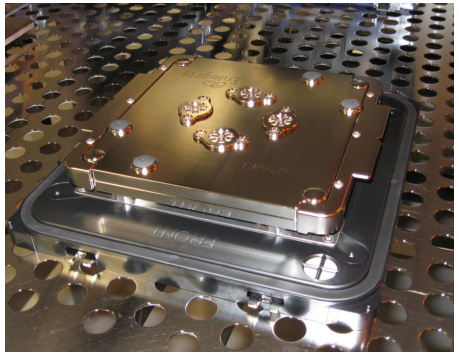


inner pod

- sPOD3: SEMI-compliant version of an EUV pod

whole pod





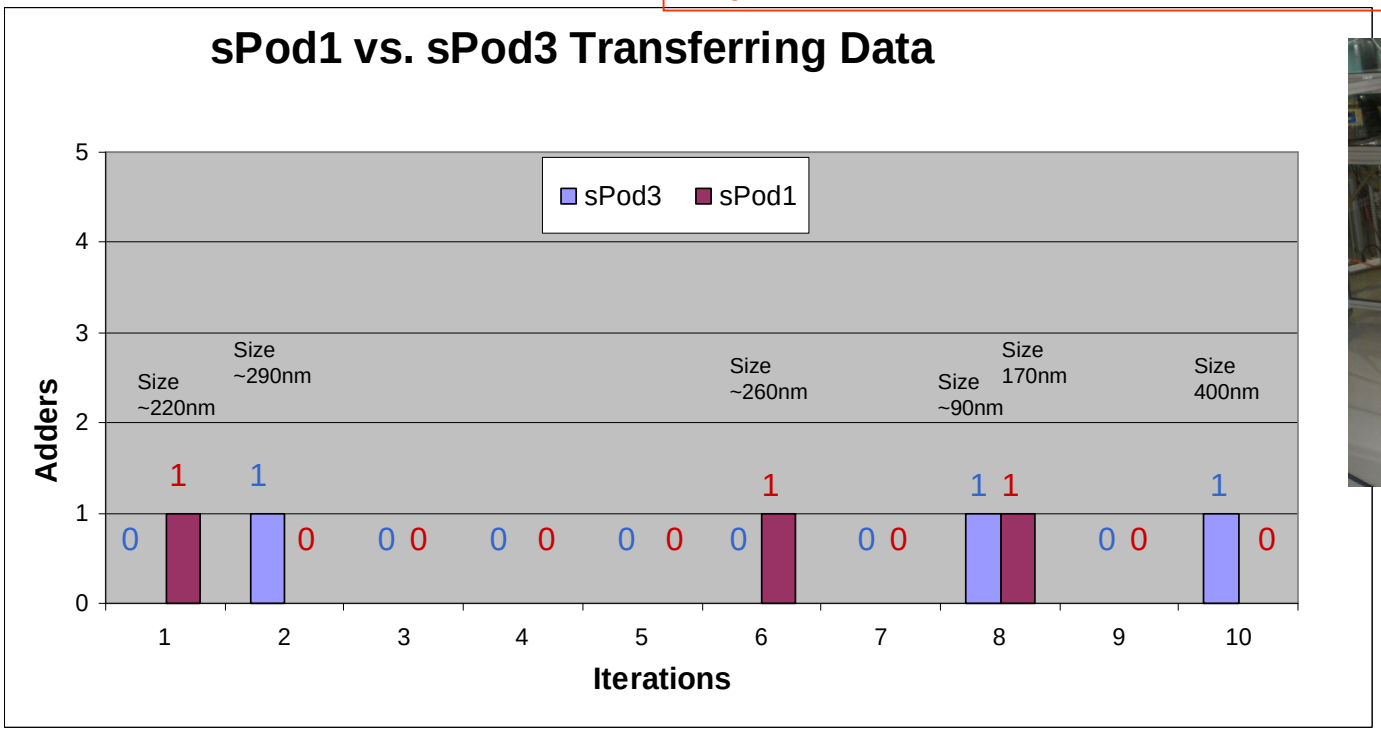
inner pod

- Limited outer pod room
- Metal frame moved to outside of the outer pod

- Inner Pod: sPod3 has a metallic inner pod construction (aluminum)
- Outer Pod: The prototype outer pod was modified from the old pod with more room to comply with SEMI E152

sPod1 vs. sPod3 Robotic Transfer in Atmosphere

Inspection sensitivity: 48 nm polystyrene latex (PSL) equivalent; inspected area: 142 mm x 142 mm



- Every data point represents a 30-cycle transfer test
- Three adders were observed on both sPod1 and sPod3 out of a 300-cycle transfer test
- 0.01 adder/cycle on both the sPod1 and sPod3
- sPod3 and sPod1 demonstrate the same particle protection capability

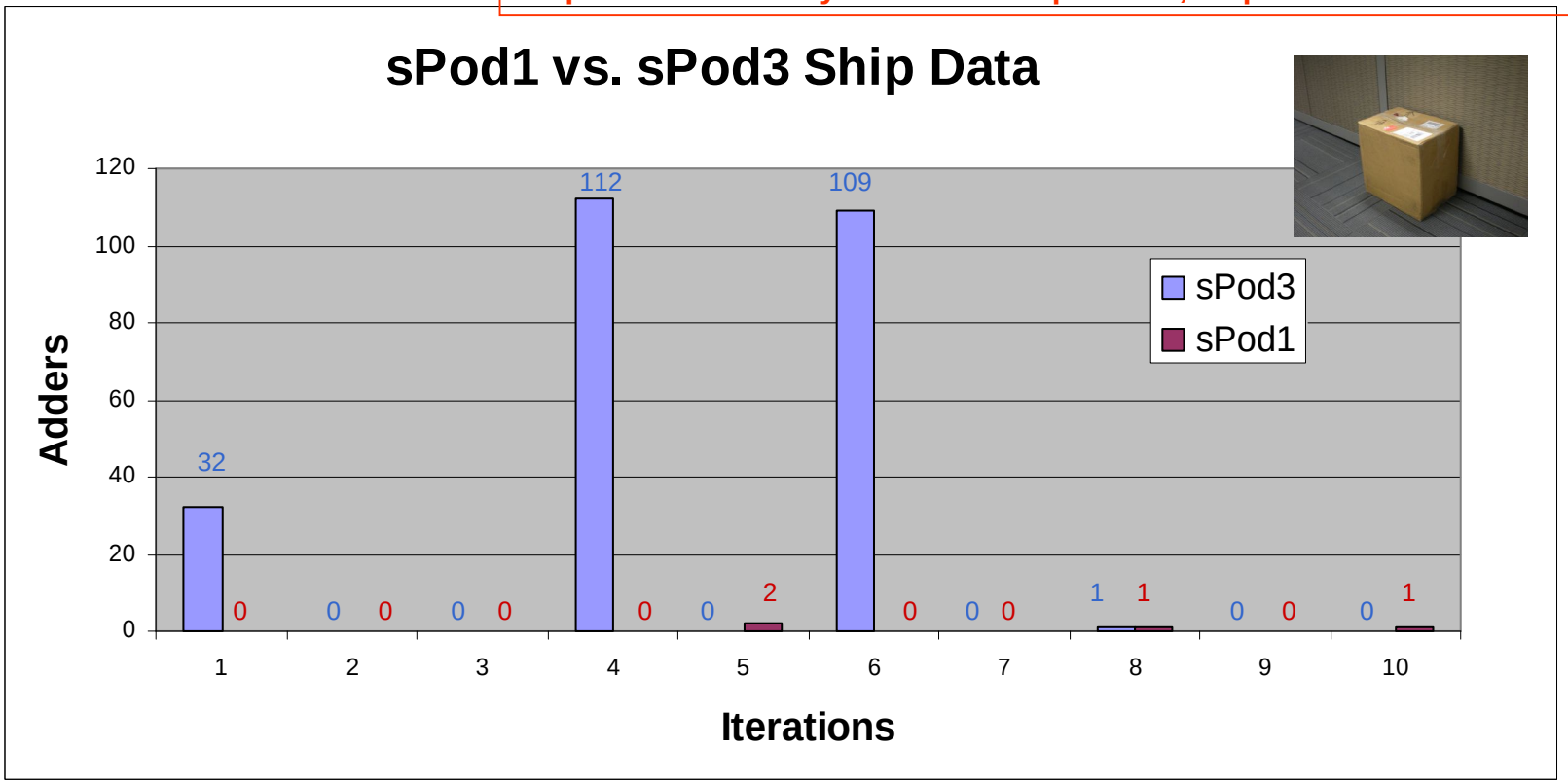
sPod1 vs. sPod3 Storage Data

Inspection sensitivity: 48 nm PSL equivalent; inspected area: 142 mm x 142 mm

- 2 weeks storage in the office without a bag
- Both sPod1 and sPo3 demonstrate zero particle adders @48 nm and above

sPod1 vs. sPod3 Ship Data (Albany<-> Austin)

Inspection sensitivity: 48 nm PSL equivalent; inspected area: 142 mm x 142 mm

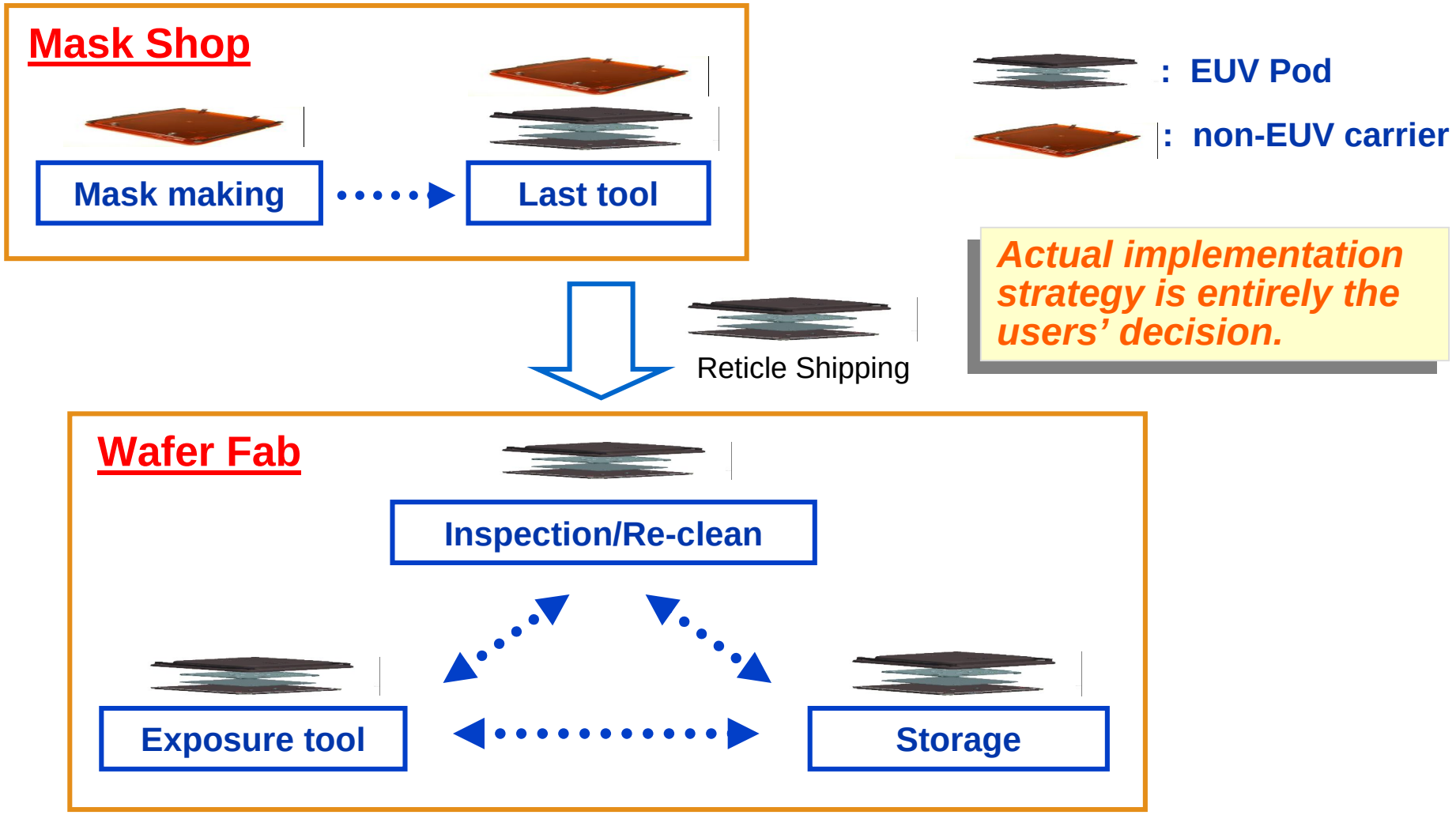


- Each data point represents one shipping round between Albany and Austin
- sPod3 data is not as good as expected—3 high adders reported out of 10 cycles—while sPod1, as control group, remains stable
- sPod3 shipping data is not as good as originally expected

Commercial Outer Pod Status

- 4 sample production outer pods arrived at SEMATECH in October
- The performance test will be completed in October
- The final commercial outer pods will be delivered to SEMATECH in November
- Commercial outer pods will be available for all users by the end of 2009
- Contamination and reliability data will be reported at SPIE in 2010

Concept for Implementing a Reticle Handling Solution in EUVL Production



E152 Allowed Carrier Dedication

- Low level of carrier dedication is allowed.
  - **All the differences are limited to one component only, which is the inner pod baseplate.**
  - **But, the future goal must be minimal or no dedication as called for by Comment 2 (Items 1-3) and Comment 3.**

	Type B	Type A		
		Vender X	Vender Y	Vender Z
Exp. Tool (Vender X)				
Exp. Tool (Vender Y)				
Exp. Tool (Vender Z)				
Any other tools: Inspection, Clean, etc…				

Color codes:	Compatible	Incompatible

Recommendations for Near Term Standard Improvements on E152 (Carriers)

- Eliminate the needs for further Type-A carrier dedication if possible among exposure tool venders, and/or different tool sets from a single vender.
  - Share the same window glass/optical property, by adopting similar wavelengths to read and align EUVL mask.
- Eliminate the two extensions of Type A baseplate, which is defined by y38 and x22, etc…
  - Pave the way to eliminate Type A, B dedication in the future.
- But, for now leave the general Type A and Type B alone, until demonstrating at least one of the two types meets 16nm hp requirements.
  - Unlikely to have the needed inspection capability in two years

Backup

Reject #1

- Reject Item 1: The concern is that when published, the 4466B document may not explicitly inform the users/readers of that there is an IP involved.
  - **When the 4466B ballot is approved for publishing, SEMI Publications will attach appropriate end notice to notify future users the existence of a NuFlare IP and the licensing terms based on Nuflare letter statement submitted to SEMI.**
    - **The Nuflare IP statement is archived at SEMI, available upon request.**
  - **The task force, Committee, and SEMI have done sufficient due diligence to meet the requirements specified in the Regulations.**
  - **Jeff Silveira indicated "the inclusion of the proper notice is acceptable, as long as the IP in question deals only with implementation/use of the pod (such as E62)," which is exactly the case:**
    - **The IP claims the use of a "device" to transfer reticle to vacuum. In 4466B, the inner pod is partially intended for use to transfer a reticle into exposure tool vacuum.**
    - **The IP is NOT needed for meeting any specific requirement set forth within 4466B.**

Reject #1

- Reject Item #2: Figure 2 and 3 readability:
  - **Identical figures have been re-created with bigger fonts and drawings, and with improved coloration scheme, see attached MS word document.**

Comments #1

Comments
Silveira Consulting:
Jeff Silveira
jeffsilveira@sbcglobal.net

1. General - Many of the section numbers appear in italics. Please de-italicize where needed.

Section 5.9

2. a) the last sentence is actually a significant limitation of what the document does not cover and should be placed either in the scope section discussing material selection or in a limitation section.
3. b) there needs to be a concerted effort to use consistent terminology across all section. For example, Section 5.9 (baseplate features) discusses windows or apertures (in that order). When moving to table 2 by reference, I spent some time looking for the word "window" as it was first/primary in the list. Please either insert "window" in the appropriate row of Table 2 or switch the order of "window" and aperture" in Section 5.9
4. c) "aperture", while a valid term in the context it is used, has a similar definition - that when it is used to describe a device that controls the amount of light allowed (such as a camera aperture). Due to this I would recommend removing the term "aperture" to reduce the risk of potential confusion.

5. Section heading (e.g., Sections 5.6, 5.12) – properly capitalize the italicized text

Section 5.10.2

6. a)- As this section is already listed as an exception by the text of 5.10, the first sentence of this paragraph is not needed, as what torque is required is explicitly listed in the next sentences.
7. b) it would be helpful to actually list the values "t" and "f" in the text rather than a table reference elsewhere as
   1) "t" and "f" only appear in this section and Table 1
   2) it is easier to reference a specific number than a generic table when writing documentation