



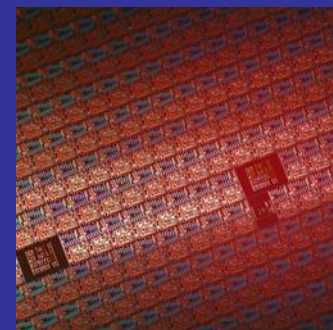
Accelerating the next technology revolution

EUV Mask Standards Update

iEUVi Mask TWG, October 16, 2011

Long He, SEMATECH/Intel

David Chan, SEMATECH



SEMI EUV Reticle Handling Task Force

Chartered for EUV Carrier Standardization



- **Membership:**

- Open to the entire community
- SEMI rule requires to register as a Standard member, to attend TF meetings.
 - One must register as a voting member to vote.

- **Feel free to contact TF co-chairs:**

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Kazuya Ota, Nikon: ota@nikon.co.jp

- **TF chartered under SEMI North America Physical Interfaces & Carriers (NA PIC) Committee**

Outline

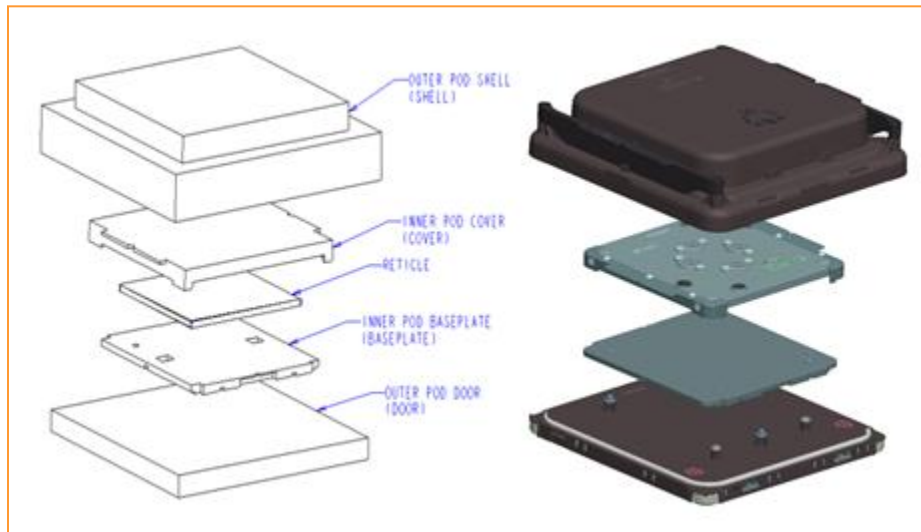


- **Update on E152 revision ballot**
- **Differences between Type-A & B, as E152 specifies**

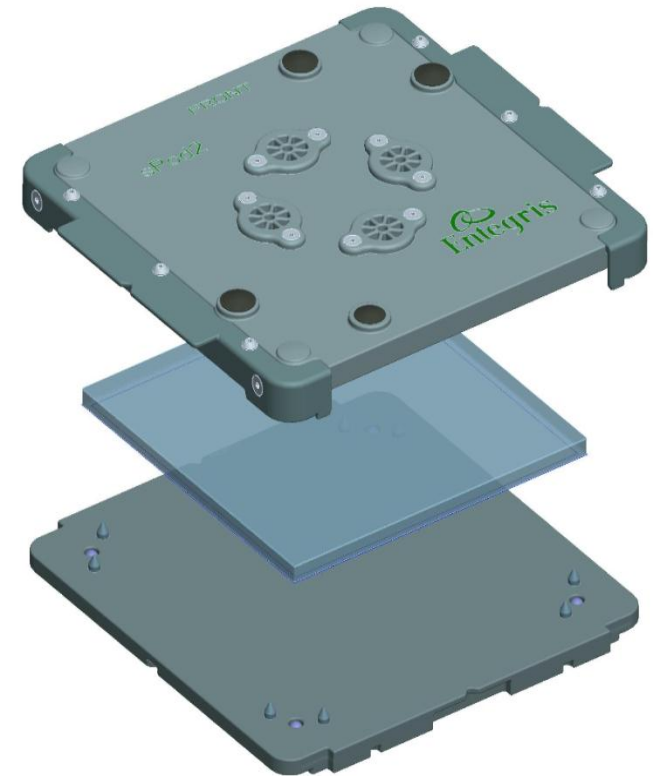
Visualizing E152 EUV-pod Carrier



Photo of an EUV-pod reticle carrier



On the left is E152 concept of EUV reticle carrier. On the right is a computer model by Entegris.



Illustrating how mask can be mounted in an inner pod (Courtesy of Entegris)

EUV Mask Standard Status



- **EUV carrier standard (E152) is active and under revision.**
 - Nine changes have been proposed in the current revision.
 - Ballot voting is currently extended to meet the rule of at least 60% return rate. Please vote if you have not done so.
(Voting should be closed on 10/12, but ~40% of voting members voted so far.)
 - The voting period extension may lead to missing adjudication as scheduled for 10/26, in SEMI Fall Standard Meeting, Santa Clara, CA
- **P37 blank standard TF activity is low, but no urgent need.**
(P38 was merged to P37 in last revision.)
 - *Integrated mask reflectivity* is proposed, vs. reflectivity at mask level as currently defined.
 - No consensus has been reached to move forward.
- **P48 fiducial mark standard implementation is at works between users and blank suppliers.**
- **P40 EUV mask mounting and T16 data matrix fall in background.**

E152 Revision Mainly Includes Nine Changes



- **Additions** are primarily specified in Sections 5.10.3, 5.16, 5.17, Tables 1 and 3, and Figure 10:
 1. Two (2) primary and two (2) optional purge port locations / areas
 2. One (1) carrier presence sensing ring / area
 3. Eight (8) carrier info pad configurations
- **Improvements** are primarily made in Sections 4.2.6, 5.5, 5.10.2, Tables 1, 2 and 3, Figures 6, 9, and 10:
 1. Clarification of carrier orientation
 2. Clarification of reticle positioning on inner pod baseplate
 3. Clarification of outer pod door force and torque
 4. Clarification RFID location in outer pod door
 5. Clarification / specification of the height of OHT flange
 6. Correction of KC pin spec error

Additions to E152 Standard for Purging and Carrier Detection

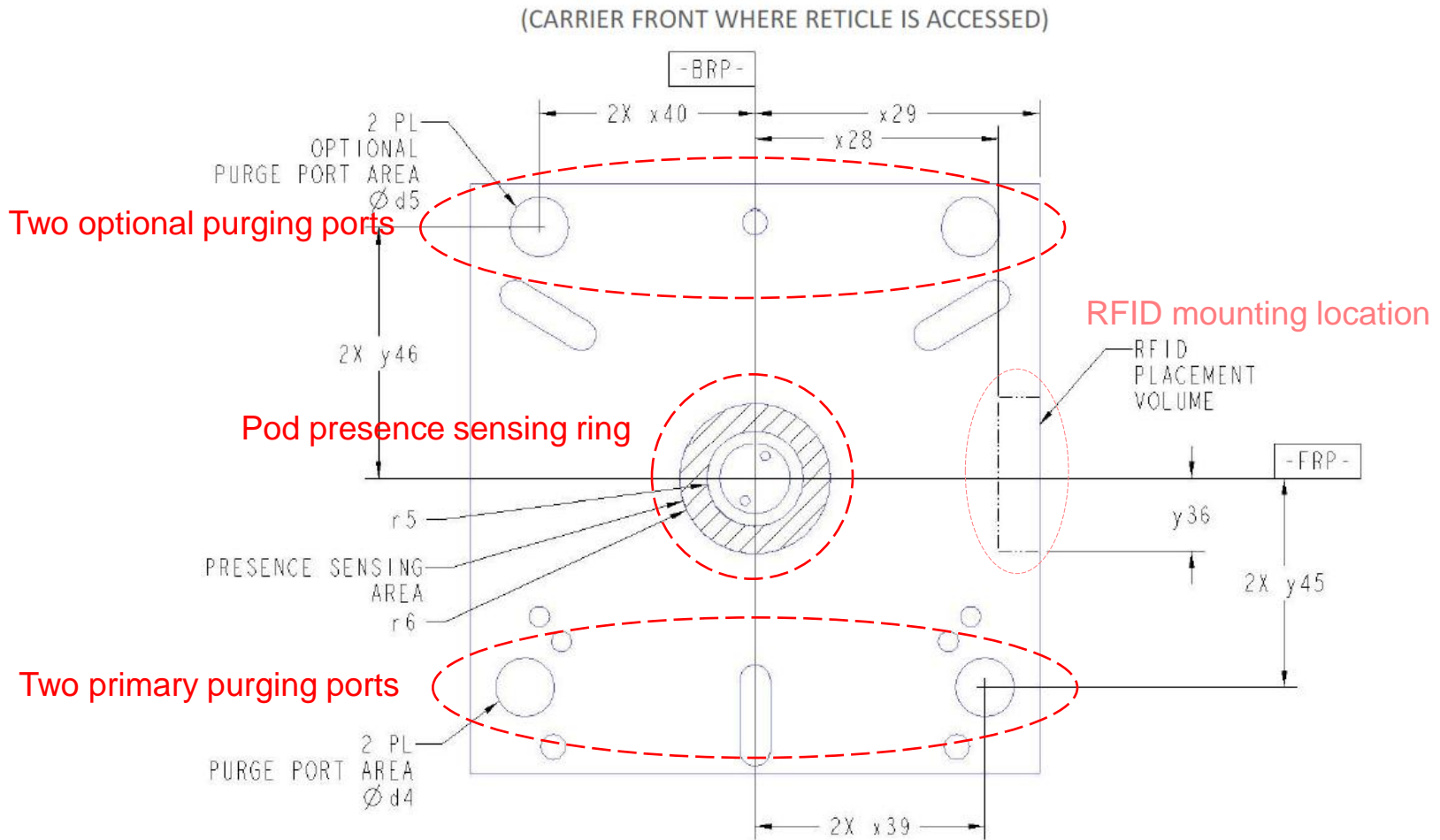


Figure 10
Bottom View of Outer Pod Door

Additions to E152 Standard for Carrier / Reticle Management



Manage by RFID and Info pad configurations

- RFID location standardized
- Eight (8) possible info-pad configurations defined
- How to use them is all up to end-users

Table 3 Info Pad Assignment

Configuration	Info Pad			
	A	B	C	D
EUV-1	●	●	○	○
EUV-2	○	○	○	○
EUV-3	●	○	○	○
EUV-4	○	●	○	○
EUV-5	●	●	●	○
EUV-6	○	○	●	○
EUV-7	●	○	●	○
EUV-8	○	●	●	○

●: Info pad (hole) plugged

○: Info pad (hole) open

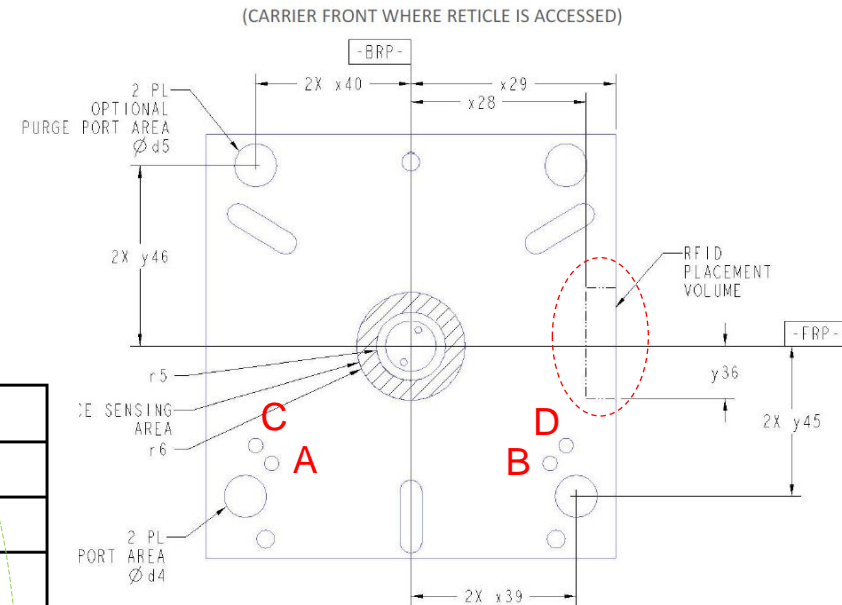


Figure 10
Bottom View of Outer Pod Door

What's Left Out in the Current Revision



- **Define a single type EUV-pod**

Holdout: no single carrier solution demonstrated and lack of consensus

- **Specify optical property of the windows, to eliminate possibility for further carrier dedication among exposure tools.**

Holdout: requires consensus among exposure tool suppliers

- **Standardize RFID data format**

Holdout: can't standardize a specific type of RF transponder. It needs to be specified between pod suppliers and users.

Four (4) Baseplate Differences Define EUV-pod to Type-A or Type-B



E152 defines two types of inner pod by two hard differences: (1) and (4), and two soft differences: (2) and (3).

Table 2 Type A/B Inner Pod Baseplate Specification

Feature	Symbol Used	Figure	Section	Specification	
				Type A	Type B
Reticle Constraint Location	x1		5.5	76.55 ± 0.04 mm	76.25 ± 0.04 mm
Reticle Constraint Location	y1		5.5	76.55 ± 0.04 mm	76.25 ± 0.04 mm
Front Edge Grip Exclusion Volumes		3	5.2	Required	Not Required
Baseplate Windows		5, 8	5.9	Required	Not Required
Baseplate Exclusion Volume	y28	5, 8	5.7.1	50.00 ± 0.25 mm	40.00 ± 0.25 mm
Baseplate Registration Hole Assignments		5, 8	5.14	A, B, C, D, E, F	A, B, C
Baseplate Corner Notch	x22	5, 8	5.8	72.00 ± 0.20 mm	Prohibited
Baseplate Corner Notch	y38	5		3.00 ± 0.25 mm	Prohibited
Secondary Baseplate Exclusion Volume	y5	5	5.7.1	4.6 ± 0.25 mm	Prohibited
Secondary Baseplate Exclusion Volume	z3	7	5.7.1	6.00 ± 0.25 mm	Prohibited
Baseplate Notch	y29	5	5.7.1	3.00 ± 0.25 mm	Prohibited
Cover Edge Limit (above base plate, along x22)	z17	7		5.00 mm, Minimum	Prohibited
Baseplate Exclusion Volume	x4	5	5.7.1	25.00 ± 0.25 mm	Prohibited

(1)

(2)

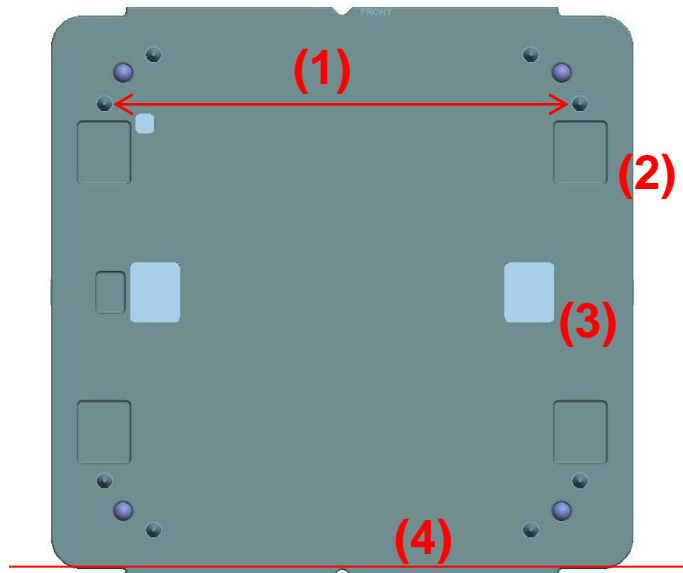
(3)

(4)

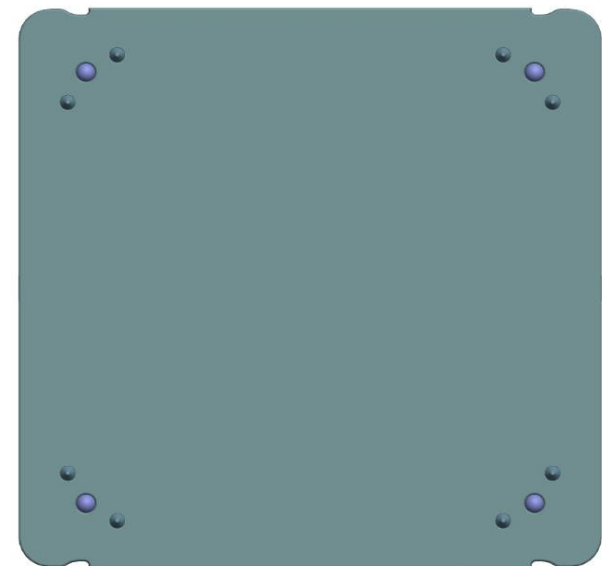
A closer Look at the Differences Between Type-A and -B Baseplates



- (1) - Type-A has 0.3 mm more mask positioning tolerances in all four directions.
- (2) - Five lowered areas for access to mask front edges by end effectors are “Required” by Type-A, “Not Required” by Type-B.
- (3) - Three windows are “Required” for Type-A, “Not Required” for Type-B.
 - Optical properties of the windows are not defined by E152. Potential impact is further dedication among Type-A carriers.
- (4) - Type-A has two extend-outs, one at top and another at bottom, “Prohibited” for Type-B. And other non-essential differences on the bottom of baseplate for type-identification.

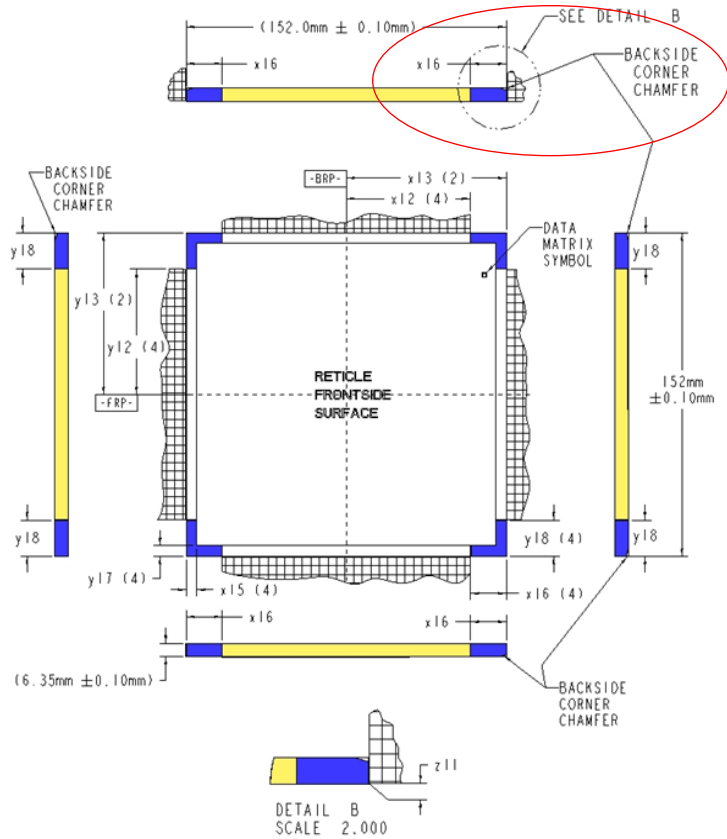


Type-A baseplate



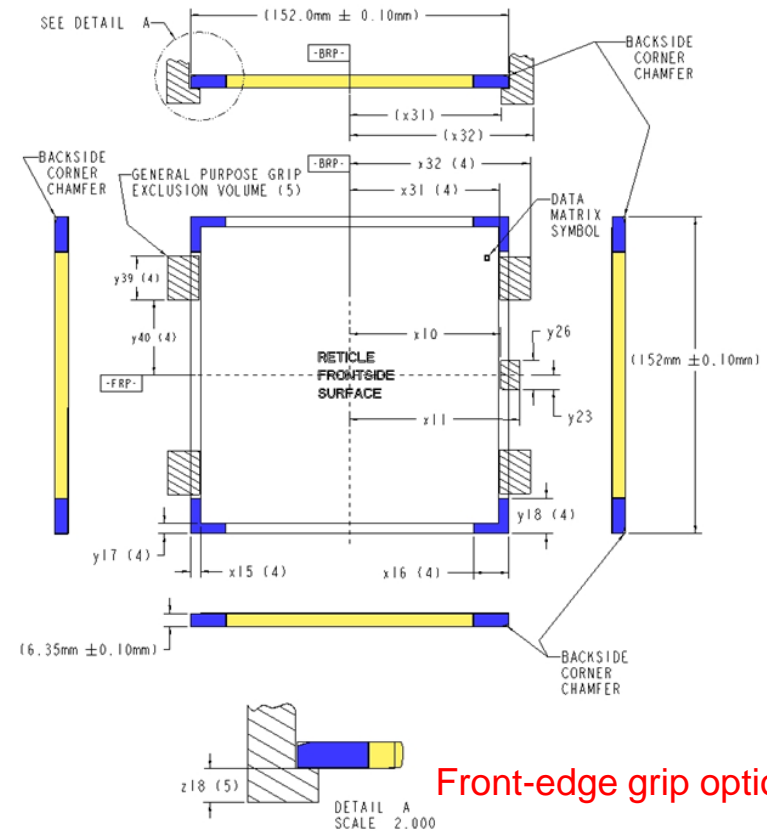
Type-B baseplate

E152 Defines “Reticle Handling and Contact Exclusion Area & Volume”



Coloration	Description
Yellow	Automated Handling Area
Blue	Baseplate Contact Area
Grid	Side Grip Exclusion Volume

Figure 2
Reticle Handling and Contact Exclusion Area & Volume



Front-edge grip option

Coloration	Description
Yellow	Automated Handling Area
Blue	Baseplate Contact Area
Diagonal Hatch	Front Edge Grip Exclusion Volume

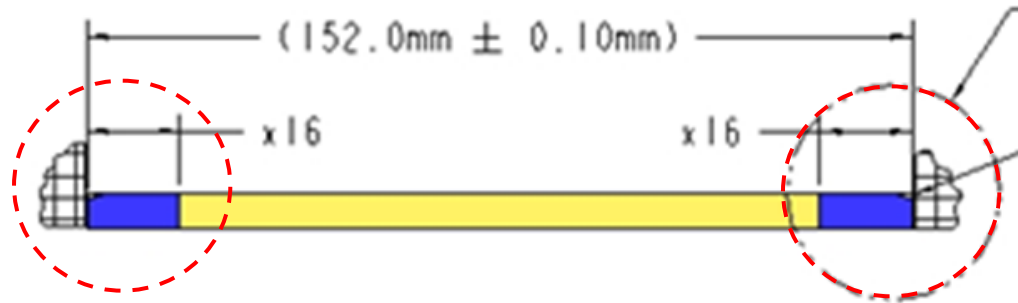
Figure 3
Contact Exclusion Area & Volume for Front Edge Grip Option

What all Those Mean to non-scanners' Interface Designs & Entire Reticle Handling Infrastructure?



- **Non-scanners can properly interface with all (E152) standard-compliant carriers, once complied with the following two E152 specifications:**
 1. *Load/unload mask to/from the central 152.5mm x 152.5mm square.*
 2. *Only contact the (mask) side walls when gripping.*

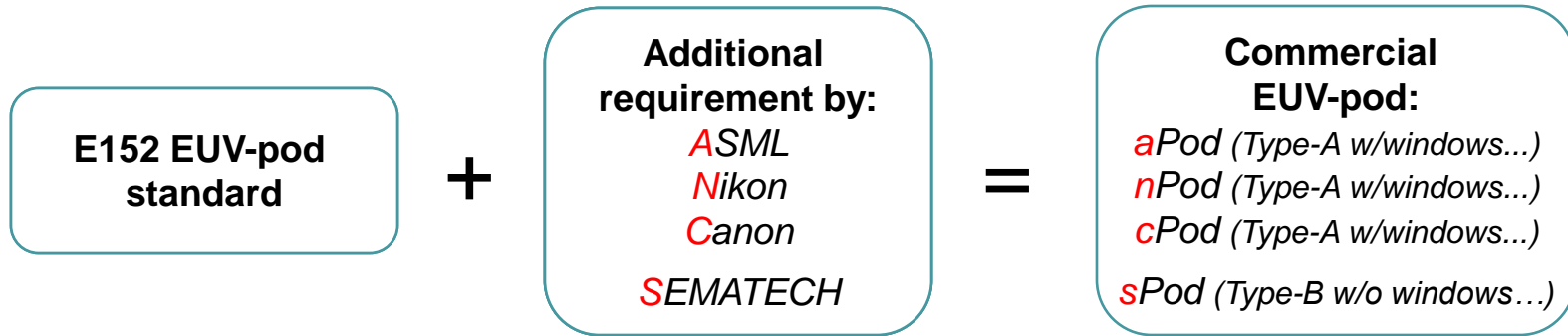
Reticle handling and contact exclusion area & volume, see E152 Figure 2 for detail



... All those mean:

- ***We effectively have only one type of carrier to deal with once E152 is fully complied, except for exposure tools.***
- ***If needed to track, that's what RFID and info-pad for.***

EUV Pod Availability



Entegris EUV-pod Part Numbers:



EUV-1000A-A110

Gudeng developed prototype EUV-pods, available for customer evaluations

evaluations available for customer

The Bottom Lines



Tool automation:

- *Exposure tools interface with Type-A only.*
- *All the rest of mask infrastructure can treat all carriers as one type, once E152 is fully complied.*
 - *Type-A allows more mask positioning errors than Type-B: 0.3 mm more in all four directions.*
 - *Type-A and Type-B both allow end-effectors to only contact side walls when gripping mask.*
 - *Type-A further allows end-effectors to contact mask front edges as an option.*

Particle protection:

- *The best Type-A pod one could possibly build is equal to Type-B, but not to exceed it, based on following three assumptions:*
 - *Mask and pod should not have any relative movement when pod is moved, by securing mask in place as best as possible.*
 - *Robotic fingers should stay away from mask front as far as possible.*
 - *Type-B baseplate provides full mask coverage. Type-A provides reduced mask coverage.*