1) Summary:

Category	total line items	H	M	L	Not ranked
Must-haves	126	45	41	35	5
Questions	98	35	43	15	5
Data	66	24	38	3	1

2) A total of 16 companies participated in the survey. Thank you!

	items address Pass 1	items address Pass 2
Alcatel	X	X
AMD	X	
AMTC	X	X
ASET	X	
ASML	X	X
Canon	X	X
DNP	X	X
Entegris		X
Freescale	X	
Hoya		X
IMEC	X	X
Intel	X	X
KLA-Tencor	X	
M+W Zander FE	X	
Nikon	X	X
Toshiba	X	

Category #1	Ranking of Must-have items for EUV mask standards in the scale of 1 to 10. (1 = **the least** important, 10 = **the most** Impotant)				**Comments**	**Approx. equivalent items**				
Item	**Items MUST be included in EUV mask standards**	**Median**	**Average**	**# comp's ranked 10 - 8**	not clearly defined					
1	Enclosure (Inner Pod / Frame)									
2	enclosure dimension	9.5	8.5	7						
3	enclosure contacts points	10.0	8.4	7			white survey		n support	
4	Frame domain, size, mass, …	9.5	7.4	6					ebeam,	
5	if there is a permanent reticle frame it must be <= 7" square	5.0	4.7	3					of contact	contacts,
6	if there is a permanent reticle frame it must not hang more than .25" below the reticle	4.5	4.4	3						
7	if there is a permanent reticle frame it must not go more than .25" above the reticle	4.5	4.3	2						
8	Pellicle solution standard(s).	1.0	4.1	3	Q					
9	If the standard includes inner case to be opend in exposure tools, how is it opend ?	7.0	6.8	4	Q					
10	Locations where bracket may contact mask	9.0	7.8	7			white survey			
11										
12	Outgassing									
13	maximum outgassing rate of the enclosure	7.5	6.3	5	Q					
14	maximum outgassing rate of the carrier	7.5	6.1	5	Q					
15	Definition of allowed contaminations / deposits	7.5	5.7	5		15,16,17,46				
16	outgassing limits: water adsorbtion, hydrocarbons, inorganic & organic contamination	8.0	7.1	6						
17	Materials of the Contamination, Contamination Level	7.5	5.4	5						
18	The dependence of the defects and contamination levels on the surface materials of carrier or	3.0	4.1	2	Q					
19	structure	3.0	4.1	2	Q					
20	The dependence of the defects and contamination levels on the methods of holding masks	3.0	4.1	2	Q					
21	The dependence of the defects and contamination levels on the surface materials of mask	3.0	4.1	2	Q					
22	outgassing of reticle, carrier, frame, ...	6.0	5.0	4						
23	Airborne Molecular Contamination and Particle Class for Mask handling and storage	8.0	6.8	7						
24										
25	Carrier (RSP 200)									
26	Physical property									
27	carrier dimension: definition of handling zone,	10.0	8.4	8						
28	General domensions as has been included in the present optical mask standard.	8.0	6.8	6						
29	Carrier Size, Dimensions	8.5	8.4	8						
30	Carrier base form factor	8.0	7.1	5						
31	the lift clearance zone must be same or larger than RSP 150/200	4.0	4.3	2						
32	carrier volume form factor for stocker, inspection and exposure tool design	7.0	5.9	4						
33	Space occupied by bracket	10.0	8.9	8						
34	tightness of the carrier	8.0	6.6	6	Q	34,36				
35	Mask protection			0						
36	Sealing performance (air tightness)	7.5	6.6	5	Q					
37	breather valves for vacuum release (if necessary)	5.0	4.8	2	Q					
38	carrier conditioning following experimental results: purged, vacuum compatibility	6.5	5.9	4	Q					
39	maximum pressure that can be applied on the enclosure	7.5	6.7	5	Q					
40	maximum pressure that can be applied on the mask inside the enclosure:	7.5	6.7	5	Q					
41	ESD Protection	9.0	7.6	6			how much resistance, where is electrical contact			
42	Atmosphere/Gas/Pressure in pod	7.5	5.9	5	Q					
43	Temperature ranges	6.5	6.5	4	Q					
44	Orientation of mask in carrier for compatibility	9.5	9.1	9		44,50	unique orientation	pattern down	bevel in "location"	
45	Carriers/Pods protection effectiveness (e.g., less than x number of particles added over N cycles)	7.0	7.0	4	Q	45,51,74				

46	Contamination specs	9.5	7.9	6			particle contamination			
47	No constant purge required for pod	5.0	4.2	3	Q					
48	Carrier with defect control CR use and Shipping	7.0	5.6	4	CR?					
49	Environmental Cobndition inside Carrier	8.0	5.8	5						
50	Pattern side down for reticle in pod	9.5	8.7	9			yes			
51	Particles per Recticle Pass for each steps inclusive storing	8.0	6.6	5			keep existing purge locations as an option (RSP)			
52	Inert gas purge options	8.0	6.4	6	Q					
53										
54	Interface									
55	Interface to exposure tools	10.0	9.3	10						
56	How should the mask be transfered in exposure tools? Maybe, by showing end effecter zones.	8.0	6.2	6		56,57,58				
57	Interface information from this point of view should be included.	8.0	6.4	5						
58	physical interface compatible dimension	9.5	9.1	10						
59	Carrier Interface Structure	9.0	8.7	8		59,60				
60	Carrier, interface, ..	9.5	8.7	8						
61	Pod must use standard interface to indexer (either RSP150 or 200)	6.5	5.7	3						
62	Mask handling areas that would be allowed	10.0	9.1	8						
63										
64	Loadport Standard									
65	all critical physical dimensions (mm)	10.0	8.9	8						
66	Datum planes such as horizontal, bilateral, facial	9.0	8.2	7						
67	opening and closing forces	8.5	8.4	7	Q					
68	Opening & closing mechanism /key turn forces	9.0	8.6	7	Q					
69	Drawings	6.5	6.1	5	?					
70	Carrier ID	8.0	7.4	5	?					
71	Vacuum application	5.0	6.2	4	?					
72	carrier sensing	6.5	6.7	4	?					
73	Inert gas purge options	6.5	5.9	5	Q					
74	Particles per Reticle Pass	8.0	7.0	6						
75	ESD Protection	8.0	7.0	6						
76	Sealing performance (air tightness)	7.5	6.3	5	Q					
77	breather valves for vacuum release (if necessary)	5.0	5.4	3	Q					
78										
79	Reticle handling, contact, fiducial, etc …									
80	Handling exclusion areas, contact areas	10.0	9.3	9		80,89,96				
81	Definition of Human Readable Code for EUV Reticles	5.0	5.6	3						
82	Mark layout, fiducial marks, bar codes, alignment marks, …	8.0	7.7	6		82,83,86,87				
83	Mark layout, fiducial marks, bar codes, alignment marks, …	8.0	6.9	5	repeats 82					
84	maximum shipping, handling accelerations	7.0	5.9	3						
85	Conducting path, side coating	8.0	7.7	6						
86	Fiducial mark area	10.0	7.7	6						
87	Bar-code, 2D-code area and mask name area	8.0	6.8	5						
88	Substrate/blank/mask tracking method and standard.	8.0	7.2	6						
89	Mask Holding Positions	10.0	7.6	6						
90	Mask Holding Method	9.0	7.0	5						
91	How will reticles be loaded/mounted into handling frames?	8.0	7.7	8						
92	How wil reticles be held(clamped) in metrology tools?	8.5	7.9	8						
93	How wil reticles be loaded (clamped) in e-beam patterning tools?	8.5	7.9	8						
94	Blank or substrate identification method and related standard.	8.0	7.1	6						
95	End effector exclusion zone must be same size or larger than current RSP 150/200	4.0	4.6	3	?					

96	Handling/ Storage contact area	10.0	8.7	8	<---Move to Storage section 191					
97	Definition of Bar Code for EUV Reticles	5.5	5.4	4						
98										
99	EUV Reticle									
100	Conducting path, grounding:									
101	Grounding method for pattern side of the reticle	8.0	7.1	5		Don't have an answer if back and front is conductively connected				
102	Front to back side conductive or ground connection	9.5	8.0	6	Q	There are isolated structures on a patterned mass, so you can' tcompletely discharge the mask?				
103	Conducting path, side coating	8.5	7.4	5	Q					
104	Backside electrically conducting film, conducting path, side coating	9.5	8.0	6	Q					
105	Layout - front side - including exclusion and handling and grounding zones	8.5	7.3	5		What about saying all contact zones will electrically condutive to pattern.				
106	Layout - back side - including exclusion, handling and grounding zones	8.5	7.3	5						
107	electrical grounding protocol	7.0	6.6	4						
108	Back side conductivity and area, including reticle side wall surface	8.0	7.5	6						
109	Conductive contact point/area for EB writer	6.0	6.5	3						
110	Optical property									
111	Updated Reflectivity definition - ML coating, absorber	6.5	5.9	3		All spec'ed will in P38				
112	EUV reflectivity for incident angle 6 degree, uniformity, wavelength dependence(near 6 degree)	5.5	5.5	3	Q					
113	Flare caused ny mask surface	5.5	5.0	2	Q	Need to maintain the optical and physical proerties of P38.				
114	Optical reflectivity/contrast for ML and Absorber folm, 266 or 267 and 198.5nm wavelength	6.0	5.6	3						
115	Mask contrast for EUV(6 deg)	5.5	5.3	3	Q					
116	EUV reflection/contrast assurance methodology and classification.	6.0	5.5	3	Q					
117	Material, Physical property									
118	Definition of blank flatness (current standards define substrate flatness)	7.5	6.1	4						
119	Mask flatness, local slope angle @ λ>1mm (already defined at λ<1mm)	7.5	6.1	4	?					
120	Mask thickness variation	7.0	5.8	3						
121	All dimensional specification(x, y, z_size and flatness with definition/area size, frequency avlue and micro scratches so on)	6.5	5.5	3	Q					
122	Substrate backside flatness/roughness standard(s).	6.0	5.6	3						
123	Blank stack structure standard.	5.5	5.4	4	already in standards?					
124	Substate material standard or classification.	5.5	5.3	4	already in standards?					
125	Substrate backside material standard(s).	4.0	4.4	2						
126	Physical properties: Young's Modulus, Termal expansion coef., Termal conductivity	4.0	4.8	3						
127	Other									
128	Mask suface chemical residual classification.	5.0	5.8	4	Q					

129	Substrate recycle method and recycle related classification.	5.0	4.3	2	Q					
130										
131	Storage									
132	Storage Box ID definition	8.0	6.4	5						
133	Storage Box materials	4.0	4.0	1						
134	Storage Box environment	6.0	5.8	3						
135	Mask storage (cleanliness & time limitation)	6.0	5.7	4	Q					
136	Handling/ Storage contact area	10.0	8.7	8		Handling Zone on bracket, frame, inner pod	Define contact points for Enclosure	or feature/notch engagement		
137	Shipping									
138	Shipping (maskshop to wafer fab) and storage method and related standard.	7.0	6.8	4						
139										
140	Others									
141	any incomplete items from SEMI specs P37, P38, P40	6.5	5.6	3						
142	On site mask cleaning method.	3.0	4.8	3	Q					
143	Mask cleaning	3.0	4.9	4	Q					
144	Logistics (foundries)	3.0	3.4	1	?					
145	Mask inspection	3.0	4.8	4	Q					
146	Assumptions/Expectations about evacuating and venting the reticle enviornment	7.0	6.2	4	Q					
147										
148										
149	**New entries**									
150										
151	specific guidelines for substrate defectivity testing and dispositioning	9.0	9.0	1						
152	mask substrate specifications	7.0	7.0	0						
153	Limitation of mask handling (contacting) during the entire life of a mask, starting from ML depo	8.0	8.0	1						
154	options for in-situ testing at point of use (reflectivity, flatness, defectivity, …)	10.0	10.0	1						
155	guidelines for cleaning and performance testing in the wafer fab	10.0	10.0	1						

Column X: Consolidated / Re-phrased Questions.

Columns U and V contained grouped item #'s.

Colum W: "x" =grouped or re-phrased question; "blank"=not grouped / not re-phrased.

Column T: P= possible proprietary complications

Items	Questions MUST be answered in the process of EUV mask standards developments					
	3 blue					
	Other color combinations					
	any pink					
Category #2	Ranking of the Queations to be answered in the scale of 1 to 10. (1 = **the least** important, 10 = **the most** Impotant)					
1	Strategy					
2	The strategy to achieve the final goal which needs to be sattisfied in using EUV masks.					0
3	What is the optimal combination of solutions/procedures/schedules/specifications to maximize productivity?					
4	How can the productivity be measured in a production setting in order to continually improve productivity?				x	How often do we need to inspect the reticle?
5	manual or automatic mask handling					
6	Does the mask have to be handled in a bracket			6,9,12,30,41,42,43,45,48,55, 60,61,67,81,82,84,76,85-88 (16 and all related), 97-102	x	What is the best protection concept? Partial enclosure (bracket/frame); Full enclosure (Inner Pod); No enclosure
7						
8	Enclosure					
9	Box in Box concept vs handling frame vs none of this				x	
10	in case of handling frame: 1.) removabel or permament attched 2.) attached when? Mask House?			10,11	x	When is the protective enclosure used in the blank and mask material flow?
11	When is the protective enclosure used in the blank and mask material flow?				x	
12	Pellicle/reticle protection needs need to be answered				x	
13						
14	Carriers					
15	Should EUV carrier and Loadport base on allready existing SEMI Standards : SMIF SEMI E19 + E19.3 & RSP150 SEMI E111 (bottom opening), SMIF SEMI E19 + E19.4 & RSP200 SEMI E100 (bottom opening), FFO SEMI E104 & E15.1 & E62 & ? E47 (Front opening). If yes, should we take the prinicple only or also use the basic dimensions? If no, what opening concept: front, bottom or top?		15,28,29,31,37,38	35,36	x	Should carrier and Loadport be based on existing standards? If yes, how much of the standard should be utilized?
16	Shoud the carrier be part of vacuum system (airless pumped) and withstand athmospheric pressure			16,17,20,21,32,33,65,89	x	What is the internal carrier atmosphere? Vacuum, Purged, etc. What are the pumping/purging protocols?
17	Do we need vacuum, inert gas, or some other environment inside the pod?				x	
18	one carrier design for all purposes: Waferfab, Mask House, Mask Shipping, Blank Shipping, or one design concept but tailored for specific applications, or specilized carrier designs applications oriented.				x	
19	Best pod/box closing mechanism				x	
20	What is the atmosphere required in the shipping and storage container				x	
21	Does the same carrier have to be used in the mask shop as in the wafer fab (and shipping)?		21,22,23,24,25,26	18,27	x	Should One carrier or multipe-carriers be used throughout the mask material flow?
22	Should we use the same storage box for shipping & hanlding as well as in fab use?				x	
23	Is it one carrier for lifetime of mask? (both at mask house and at customer)				x	
24	one carrier for the all mask operations: manufacturing, use in the fab, storage, shipping? one type of carrier common to all lithography tool?				x	
25	Will the same carrier be used by both all process equipment? Is it feasible to use the same carrier for shipping?				x	
26	The way to use carrier should be answered: shipping and/or installing masks into exposure tools.				x	
27	Compatibility of carriers/pods for different tools (e-beam, scanner, stocker, etcher…)				x	
28	Storage Box size - RSP 150, RSP 200 , FOUP?				x	
29	SMIF pod or FOUP technology				x	
30	Single carrier concept on defect management,how effective or not?				x	
31	Basic dimensions that would be compatible with all equipment during life of mask				x	

32	tightness of the carrier				x	
33	What environment (vacuum or atmospheric pressure) will the interior of the carrier have? Prefer atmosphere.				x	
34	Guidance needed in standard to state that carrier needs to be designed for cleanability.			34,62,63,64,66,105,122	x	What is the cleaning specfication? What is the acceptable reticle state after cleaning: particles, molecular contaminants? What are the acceptable carrier and enclosure states after cleaning? What is the number of times the reticle can be cleaned?
35	How will we identify storage boxes, and identify/verify that they contain a reticle?				x	
36	Are there any external areas that cannot be touched (by humans or equipment)? External design needs to be ergo friendly and automation compatible (OHV flanges, storage).				x	
37	Should we consider revisiting RSP150 and RSP200 standards for EUV specific?				x	
38	Loadport design may need to be considered depending on carrier form factor.				x	
39						
40	Handling					
41	maximum stresses, accelerations during shipping, handling, contacting			41,42,43	x	Are particles generated during handlng or chucking? How can particle generation be minimized? Is chucking standard P40 adequate? Is reticle standard P38 adequate?
42	maximum safe contact forces, pressures				x	
43	particle generation from contacting, handling, chucking	P			x	
44	maximum changes in reticle pattern distortion associated with chucking to different chucks	P		44,43,46,47,48	x	
45	What are the various procedures for shipping and handling the reticle?				x	
46	Dose e-chuck cause mask back side damege?	P			x	
47	What kind of character is needed for e-chuck material?	?, P			x	
48	Any requirement from handling point of view on mask back side coating? Needs to be specified in P38.				x	
49						
50	Grounding					
51	How will the connection from front side to back side of the reticle be achieved?		51,52,56,57	53,54	x	Should the reticle be grounded in the carrier/enclosure and during handling and if so, how? How much of the reticle surface should be electrically connected? Is reticle standard P38 adequate?
52	Do we need to ground the pattern side of EUV reticles to prevent charging?				x	
53	How will the isolated grounding paths be achieed on the backside of the reitcle?	?			x	
54	How will grounding contact for electrostatic clamping be made to the backside of the reticle?				x	
55	ESD may be bigger impact as feature sizes get smaller. What do we need to do to minimize ESD problems?				x	
56	Do we need a conductive path from front to back of reticle for ESD purposes?				x	
57	Will electronic charging occure during exposure, and does the mask need a mechanism to prevent it?				x	
58						
59	Particle protection					
60	What are the mechanisms that cause particle generation, particle migration, and particle adhesion?	P?			x	
61	What are the various solutions to eliminate, reduce, neutralize, or leverage the aforementioned mechanisms? (Some Examples Include) Front side cover, backside cover, thermophoresis, electrophoresis, grounding, filtration, seals, contact materials, restraining means,	P			x	
62	What are the various solutions for detecting particles?	P			x	
63	What are the various solutions for removing particles?	P			x	
64	What are the various schedules for reticle & carrier inspection and cleaning?				x	
65	What are the various specifications for Evacuation/Venting of the reticle enviornment?				x	
66	Durability for mask cleaning				x	

67	Is there a preferred coating for the mask front and back side for mitigation of particle generation? What contact materials on the mask front side are preferred., e.g., ULE, ML, Absorber. -- mask coatings need to be specified in P38.	P			x	
68						
69	Reticle, metrology					
70	Metrology tool performance on defect, size and EUV reflectivity			70,71,73-75,77	x	What is the sensitivity of the metrology perfomance to the properties of the reticle?
71	Metrology tool peformance on flatness measurement(Resolution, repeatability, reproduceability, roughness freaquency)				x	
72	Target lithography conditions: Exposure dose, shots count, EUV pulse energy on mask, ESC parameters, Vacuum/Air cycles	P				
73	What kind of HRC will be visible on an EUV (reflective) reticle?	P				
74	Mask reflectivity uniformity specification for Contact/Via, dence line/space, gate, matal layers	P				
75	Mask sidewall profile/roughness specification?	P				
76	Does the mask need to be inspected in the container			76-78	x	What is the sensitivity of the inspection perfomance to the properties of the reticle? Is there a need to inspect the reticle when it is within the carrier and/or the enclosure?
77	Should each masks be pattern-inspected at wavelegth?				x	
78	Should the at-wavelength reflection/contrast be measured and assured for each mask?				x	
79						
80	Contamination					
81	maximum outgassing rate of the enclosure				x	
82	maximum outgassing rate of the carrier				x	
83	Contamination Level		83,91,92,93	94	x	What are the carrier and enclosure outgassing specifications?
84	Materials of the Contamination	wh at ar			x	What are the sources of molecular contamination?
85	The dependence of the defects and contamination levels on the surface materials of carrier or inner box	P			x	
86	The dependence of the defects and contamination levels on the surface materials of holding structure	P			x	
87	The dependence of the defects and contamination levels on the methods of holding masks	P			x	
88	The dependence of the defects and contamination levels on the surface materials of mask				x	
89	type of environments to be compatible with? atmospheric, purged, or vacuum environments				x	
90	Resist outgassing level					
91	Vacuum clealiness level: C-H, H_2O, O_2	P			x	
92	Outgassing/contamination requirements				x	
93	maximum amount of outgassing from reticle, carrier, frame,...				x	
94	What kind and amount of chemical residue will cause growing defects during exposure?				x	
95						
96	Contact area					
97	"lifetime" (number of contacts without deterioration) of contact areas on reticle, carrier, frame ...	P			x	
98	Can we restrict the contact areas to certain areas (4 corners?) instead of the entire 4 edges?				x	
99	What is the absolute minimum number of contact points?				x	
100	What is the minimum mm^2 for each and total contact points?				x	
101	Do we need to have front and back contact points?				x	
102	How do we separate out automation vs carrier contact points?	?			x	
103						
104	Cleaning					
105	Mask cleaning efficiency				x	
106						
107	others					
108	Ask Sematech to review past surveys (for additional concerns/topics).					
109	Secondary packaging guidance/recommendations (but the standard should not specify)					
110	Necessity					

111	IP issues					
112	Benefit					
113	satisfying SEMI P40				x	
114	The mask orientation (pattern side up or down) may not need to be specified in standard; the preferred orientation can be stated but should be specified by the end user.				x	
115						
116	**New entries**					
117						
118	How can we check cleanliness of the EUV mask at the point of exposure (with a certain level of confidence)					
119	How can we check reflectivity intactness of the EUV mask at the point of exposure (with a certain level of confidence)					
120	How can we check flatness of the EUV mask at the point of exposure (with a certain level of confidence)					
121	Is flatness of a completed MASK constant over time?					
122	How long can we keep an EUV mask usable				x	

	3 blue	≥7.0	≥7.0	6 - 7			
	Other color combinations	4 - 6.x	4 - 6.x	3 - 5			
	any pink	< 4	< 4	0 - 2			
Category #3	Ranking of What data to acquire in the scale of 1 to 10. (1 = **the least** important, 10 = **the most** Impotant)						
Items	**What data MUST be acquired for mask standards development**	**Median**	**Average**	**# comp's ranked 10 - 8**	**Approx. equivalent items**		
1	Impact of molecular contamination on mask ageing and quality	10.0	8.1	6	1, 2, 7, 8, 9, 10, 11, 12, 26, 30, 46, 53, 54, 55, 56, 57, 58	x	Impact of molecular contamination on mask aging and quality - Outgassing levels of materials used in current and candidate designs - water absorption - hydrocarbons - other - contamination mechanisms
2	Particles and molecular contamination on EUV masks for different operation:handling in the fab, shipping, storage _with different kinds of enclosure _with different carriers _with different conditioning of the carrier (purged, vacuum, sealing performance…)	10.0	9.0	6	2, 20, 25, 26, 30, 5, 13, 15, 16, 17, 18, 19, 32, 24, 39, 62, 65	x	Particles and molecular contamination on EUV masks for different operation:handling in the fab, shipping, storage _with different kinds of enclosure _with different carriers _with different conditioning of the carrier (purged,vacuum…)
3	Impact of mask cleaning on mask ageing	8.0	6.7	5		x	Impact of mask cleaning on aging
4	Cleaning efficiency	9.0	6.9	5	4, 6, 43	x	Cleaning efficiency
5	Particle adder for correspond action.	8.0	6.4	4		x	
6	cleanliness after carrier cleaning in regards to remaining particles, metals, ionic etc.	8.0	6.7	4		x	
7	outgassing limits	9.0	8.9	6		x	
8	water adsorbtion	9.0	8.9	6		x	
9	hydrocarbons	9.0	8.9	6		x	
10	inorganic & organic contamination	9.0	8.9	6		x	
11	Temperature ranges	6.0	7.1	3			
12	Inert gas purge options	8.0	7.9	4		o - design dependent	
13	Particles per Recticle Pass for each steps inclusive storing	10.0	8.9	6		x	
14	ESD Protection	8.0	8.0	5	14, 27, 28, 29, 48, 61	x	ESD protection -effects of ESD on reticle and patterns -sensitivity to ESD during RH, pumpdown/purge, chucking, exposure -dependence on carrier design
15	Sealing performance (air tightness)	10.0	8.7	6		o - design dependent	
16	breather valves for vacuum release (if necessary)	6.0	6.0	1		o - design dependent	
17	Added particles in shipping with various carrier designs	9.0	7.9	4		x	
18	Added particles in handling with various bracket designs	9.0	8.6	5		x	
19	Particles added during handling and transport of EUV storage boxes	9.0	8.0	4		x	
20	Molecular outgassing/contamination of storage boxes - current and proposed EUV solutions	9.0	8.9	6	7, 8, 9, 10, 20	x	
21	Conductivity of backside coating material candidates	9.0	7.7	5	21,23	x	Conductivity of Backside coating material candidates
22	Max forces that Reticles must withstand for Handling and Transport	7.0	6.6	3	22, 31, 44	x	Max forces that Reticles must withstand for Handling and Transport
23	Achieveable conductivity of front to backside conneciton(s)	8.0	6.4	4		x	
24	Must test different handler/pod concepts in a real tool (such as that in Albany)	7.0	6.3	3		x	
25	Added defects for best carrier candidates	10.0	9.6	7		x	
26	Contamination/lifetime of mask in best carrier candidates	9.0	8.6	6		x	
27	Electrostatic discharge protection performance for best carrier candidates	8.0	8.0	5		x	
28	Theoretical basis	7.0	6.7	3		x	
29	Experimental/analytical results	9.0	7.7	5		x	
30	outgassing from materials used for reticle, carrier, frame,...	9.0	8.9	6		x	

31	stresses and accelerations during reticle shipping, handling, contacting (including grounding)	5.0	6.4	3		x	
32	particle generation during reticle shipping, handling, chucking	10.0	9.4	7		x	
33	particle generation for contacts with different materials	10.0	9.4	7	32, 33, 34, 35, 39, 49, 60	x	Number & size of particles generated for various combinations of contact materials, various contact forces, ambient conditions, normal/sliding contact conditions, and cycles.
34	particle generation for repeated contacts i.e. contact lifetime	10.0	8.7	6		x	
35	particle generation with/without grounding	10.0	8.6	4		x	particle contamination with/without grounding
36	flatness, pattern distortion data for representative sample of reticles on several chucks satisfying P40	7.0	5.9	3		na	This is a P40 item: will be data for P40 draft
37	Theoretical basis	7.0	5.7	3		na	too vauge
38	Experimental/analytical results	9.0	6.7	4		na	too vauge
39	Number & size of particles generated for various combinations of contact materials, various contact forces, ambient conditions, normal/sliding contact conditions, and cycles.	10.0	9.0	6	39, 40	x	Particle generation mechanisms - contacts: material, geometry, forces, lifetimes - gas jets
40	The forces required for causing adhered particles of various sizes and materials to become airborne; the velocity of the released particles	8.0	7.0	5		x	
41	Parametric study measuring the productivity of various combinations of solutions/procedures/schedules/specifications. (Includes a combination of experimental and analytical results)	2.5	3.8	2			
42	Mask carrier defect control data	9.0	6.7	4		x	
43	Mask carrier cleaning/and cleaning cycle data	8.0	6.9	4		x	
44	Mask carrier shipping test data (w/wo Air plane, Shock test)	9.0	7.9	4		x	
45	Mask handling robot cycle test on defect addition	10.0	8.9	6		x	
46	Exposure induced growing contamination severeness in EUV.	9.0	8.3	5		x	
47	Irradiation durability of blank materials/films.	8.0	6.1	4		na	
48	Exposure induced charging and its impact on electrostatic pattern failure etc..	8.0	6.1	4		x	
49	Mask bask side damage by E-chuck on/off.	5.0	5.3	3		x	
50	Defect Generation Level	9.0	8.8	6	42, 45, 50, 51, 52, 55, 56, 57, 58	x	Mask defect generation (as opposed to particles) -dependence on surface materials -holding methods Need clarification on the definition / usage of defect in this survey.
51	Defect Size	9.0	8.7	5		x	
52	Materials of the Defects	9.0	8.8	6		x	
53	Contamination Level	8.0	8.5	6		x	
54	Materials of the Contamination	9.0	8.9	7		x	
55	The dependence of the defects and contamination levels on the surface materials of carrier or inner box	8.0	6.4	4		x	
56	The dependence of the defects and contamination levels on the surface materials of holding structure	8.0	6.4	4		x	
57	The dependence of the defects and contamination levels on the surface materials of mask	6.0	5.7	3		x	
58	The dependence of the defects and contamination levels on the methods of holding masks	6.0	5.7	3		x	
59							
60	What impact do particles have that are generated by contact points? Do particles generated at contact points migrate? If not, can we restrict contact points to 4 corners? Shock and vibration impact on particle generation.	9.0	8.4	5		x	
61	Collect ESD impact on 22nm node feature sizes in different environments (RH, T, nitrogen purge, etc)	8.0	7.3	4		x	
62	Pattern up/down decision: shipping data, particle migration data, does contact point strategy change with pattern orientation, how many particles do we add by flipping the reticle, e-chucking requirements may drive reticle orientation	10.0	9.1	6	45, 62	x	Pattern up/down decision: shipping data, particle migration data, does contact point strategy change with pattern orientation, how many particles do we add by flipping the reticle, e-chucking requirements may drive reticle orientation This item needs more refinement...Seems largely related to Cell 9W
63	Which reticle protection scheme is deemed most viable? ie top two options defined and then a volume can be defined.	9.0	9.0	7			This is really a "question to answer" and not Data to Acquire
64	Can we get away without a reticle protection scheme? ie final clean in the fab or insitu in scanner?	10.0	9.6	7			

65	Is it possible to for the reticle to fit in a RSP150 format with available pellicle designs? What # particles are generated by transferring between carrier types (shipping carrier vs process carrier going to fab)?	5.0	4.9	2		x	
66	What mask coating materials generate the least particles when contacting carrier contact points?	8.0	7.7	4		x	
67							
68							
69	**New entries**						
70							
71	impact of chucking on mask flatness and amount of hysteresis	7.0	7.0	0		na	This is a P40 item: will be data for P40 draft

Questions MUST be answered in the process of EUV mask standards developments

- **Enclosures/Carriers/Loadports**
- What is the best protection concept? Partial enclosure (bracket/frame); Full enclosure (Inner Pod); No enclosure
- When is the protective enclosure used in the blank and mask material flow?
- Should carrier and Loadport be based on existing standards? If yes, how much of the standard should be utilized?
- Should One carrier or multipe-carriers be used throughout the mask material flow?
- What is the internal carrier atmosphere? Vacuum, Purged, etc.
- What are the pumping/purging protocols?
- Should the reticle be grounded in the carrier/enclosure and during handling and if so, how? How much of the reticle surface should be electrically connected? Is reticle standard P38 adequate?
- **Outgassing, airborne molecular contamination, particle requirements**
- What are the carrier and enclosure outgassing specifications?
- What are the sources of molecular contamination?
- **Particle Generation & Contamination**
- Are particles generated during handling or chucking? How can particle generation be minimized? Is chucking standard P40 adequate? Is reticle standard P38 adequate?
- What is the particle generation levels due to in FAB and inter FAB / Mask supplier handling or shipping? How can particle generation be minimized?
- **Reticle Metrology & Inspection**
- What is the sensitivity of the metrology perfomance to the properties of the reticle?
- Is there a need to inspect the reticle when it is within the carrier and/or the enclosure?
- **Cleaning**
- What is the cleaning specification? What is the acceptable reticle state after cleaning: particles, molecular contaminants? What are the acceptable carrier and enclosure states after cleaning? What is the number of times the reticle can be cleaned?
- How often do we need to inspect the reticle?

Item	Items MUST be included in EUV mask standards
	Enclosures (= Inner pod, Frame, Bracket, etc ...)
1	Enclosure domian and dimensions (exclusion volumes)
2	Enclosure mass
3	requirements to open and close enclosure
	Carriers
4	Carrier ID location
	Physical property
5	Carrier size, or dimensions
6	Carrier base form factor
7	Carrier mass
8	
9	carrier volume form factor for stocker, inspection and exposure tool design
10	maximum force that can be applied on the enclosure
11	maximum force that can be applied on the mask inside the enclosure
12	Environmental condition inside Carrier, such as what gas, temperature, and pressure
	Mask protection
13	ESD Protection
14	outgassing Contamination specs
15	Reticle orientation standard, or pattern side down in carriers
16	Particles per Recticle Pass for all steps including storage
	Interfaces
17	Carrier interfaces with process and metrology tools, including structure and dimensions
18	Pod must use standard interface to indexer (either RSP150 or 200)
19	The lift clearance zone must be same or larger than RSP 150/200
20	Carrier handling zones
	Outgassing, airborne molecular contamination, particle requirements
21	Carrier and enclosure outgassing limits: water adsorbtion, hydrocarbons, inorganic & organic contamination, etc.
22	Outgassing of reticles
23	Particle Classification
	Loadport Standard
24	All critical physical dimensions
25	Datum planes such as horizontal, bilateral, facial
26	Opening and closing mechanisms and their forces
27	carrier sensing
28	Vacuum application, purging option, vacuum seal requirements, and breathing valves
29	Particles per Reticle Pass
30	ESD Protection
	Reticle handling, contact/fiducial area, etc ...
	Contact areas
31	Dedicated contact areas for end effectors, enclosures, storage handling, holding, grounding etc.
32	Dedicated exclusion zones for end effector
	mask handling methods
33	maximum shipping, handling accelerations
34	Shipping (maskshop to wafer fab) and storage methods and related standards.
	EUV reticle and substrate
	Conducting path, grounding (P38/P40)
35	electrical grounding protocol

Item	Data To Acquire That will Help answer the questions
	Enclosures (= Inner pod, Frame, Bracket, etc ...)
1	Impact of molecular contamination on mask ageing and quality (Outgassing levels of materials used in current and candidate designs, water absorption, hydrocarbons, other, contamination mechanisms including temperature and environments)
2	Particles and molecular contamination for different operation:handling in the fab, shipping, storage: [different enclosures, different carriers, different pattern orientation up / down; and carrier conditions (purged,vacuum…)]
	Carriers
	Cleaning
6	cleanliness after carrier cleaning in regards to remaining particles, metals, ionic etc.
4	Cleaning efficiency; Mask carrier cleaning/and cleaning cycle data
	Physical property

No.	Item
1	Impact of molecular contamination on mask ageing and quality (Outgassing levels of materials used in current and candidate designs, water absorption, hydrocarbons, other, contamination mechanisms including temperature and environments)
2	Particles and molecular contamination for different operation:handling in the fab, shipping, storage: [different enclosures, different carriers, different pattern orientation up / down; and carrier conditions (purged,vacuum…)]
	Outgassing, airborne molecular contamination, particle requirements
20	Molecular outgassing/contamination of storage boxes - current and proposed EUV solutions, outgassing limits water adsorbtion hydrocarbons inorganic & organic contamination
33	Number & size of particles generated for various combinations of contact materials, various contact forces, ambient conditions, normal/sliding contact conditions, and cycles.
50	Mask defect generation (as opposed to particles) -dependence on surface materials -holding methods Need clarification on the definition / usage of defect in this survey.
	Loadport Standard
1	Impact of molecular contamination on mask ageing and quality (Outgassing levels of materials used in current and candidate designs, water absorption, hydrocarbons, other, contamination mechanisms including temperature and environments)
2	Particles and molecular contamination for different operation:handling in the fab, shipping, storage: [different enclosures, different carriers, different pattern orientation up / down; and carrier conditions (purged,vacuum…)]
33	Number & size of particles generated for various combinations of contact materials, various contact forces, ambient conditions, normal/sliding contact conditions, and cycles.
	Reticle handling, contact/fiducial area, etc …
	mask handling methods
45	Mask handling robot cycle test on defect addition
22	Maximum forces that Reticles must withstand for Handling and Tranpsort
31	stresses and accelerations during reticle shipping, handling, contacting (including grounding)
44	Mask carrier shipping test data (w/wo Air plane, Shock test)
	EUV reticle and substrate
	Physical
66	What mask coating materials generate the least particles when contacting carrier contact points?
	Cleaning
3	Impact of mask cleaning on mask ageing
	Conducting path, grounding (P38/P40)
14	ESD protection -effects of ESD on reticle and patterns -sensitivity to ESD during RH, pumpdown/purge, chucking, exposure -dependence on carrier design
21	Conductivity of backside coating material candidates; Achieveable conductivity of front to backside conneciton(s)