ITRS Facility Technology Roadmap

Year of Production	2003	2004	2005	2006	2007
	100 nm	90 nm	80 nm	70 nm	65 nm
Scope/Specifications	300mm	300mm	300mm	300mm	300mm
Critical particale size (nm)	52	45	38	35	33
<pre># Particle > critical size (#/m3)</pre>	3	2	2	1	1
Facility Service Life (nodes)	3	3	3	3	3
Mass of Move in Packages (kg)	6000				
Production Floor Loading (kg/m2) Mass on .6 m / .6 m floor tile	1000 (SEMI E72)	?	?	?	Litho Tool (2X)
Vibration Criteria					
Wafer level (Litho, Metrology?	VC E	VC E	VC E	VC E	VC F
Wafer level (Other Areas?)	VC E	VC E	VC E	VC E	VC E
Tool/Tool Maintenance Leve	VC E	VC E	VC E	VC E	VC E
Facility/Functional Area	VCD	VCD	VCD	VCD	VCD
Classification of air cleanliness					
Wafer level	ISO Class 2	ISO Class 1	ISO Class 1	ISO Class 1	ISO Class 1
Tool/Tool Maintenance Leve	ISO Class 4	ISO Class 4	ISO Class 4	ISO Class 4	ISO Class 4
Facility/Functional Area	ISO Class 5	ISO Class 6 or worse			
Temperature Requirements					
Wafer level	68 F ± 0.2	68 F ± 0.2	68 F ± 0.1	68 F ± 0.1	N2 Purge?
Tool/Tool Maintenance Level	70 F ± 2	70 F ± 2			
Facility/Functional Area	74 F ± 5	74 F ± 5	74 F ± 5	74 F ± 5	74 F ± 5
Humidity Requirements					
Wafer level	40% ± 2%				N2 Purge?
Tool/Tool Maintenance Level	45% ± 5%				
Facility/Functional Area	Control?				
Floor Space Effectiveness	1X	1X	1X	1X	1X
Tool Height (Max) Fab (m)	3.5				NGLitho Tool (5 m?)
Tool Height (Max) SubFab (m)	2				NGLitho Tool (4 m?)
Tool Installable area/Wafer starts per month (m2/WSPM)					
Metal Gate (Cross Contamination - dedicated tools)					
Increased use of Implant Steps					
Tool Installable Area/Volume					
NGLitho (Size and Move-in)					2X larger

2010	2013	2016
45 nm	32 nm	22 nm
300mm	450mm	450mm

3	3	3
?	?	?
VC F	VC F	VC F
VC E		
VC E		
VC D		
ISO Class 1	ISO Class 1	ISO Class 1
ISO Class 4	ISO Class 4	ISO Class 4
ISO Class 7 or worse	ISO Class 8 or worse	ISO Class 9 or worse
N2 Purge?	N2 Purge?	N2 Purge?
74 F ± 5	74 F ± 5	74 F ± 5
N2 Purge?	N2 Purge?	N2 Purge?
1X	1X	1X
ZA larger		

Maximum allowable electrostatic field on facility surfaces (V/cm)	100	100	75	75	50	50	
N2 Purging (NGLitho)							

Ga	s, Chemical, Water Purity								
Bulk Gases		-							
	N2, O2, Ar, H2:H2O, O2, CH4 (ppt, each)		<1000	<1000	<1000	<100	<100		<100
Mafar Loval	# particles > Critical size (/liter)		<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
waler Lever	NGLitho (N2) (ppt)						10		10
	Bulk CO2 (Interconnect)	Volume		Volume?					
	Bark CO2 (Interconnect)	Purity		Purity?					
Tool/Tool Maintenance Level	N2, O2, Ar, H2:H2O, O2, CH4 (ppt, each)								
	# particles > Critical size (/liter)							ı C	
Facility/Funcitonal	N2, O2, Ar, H2:H2O, O2, CH4 (ppt, each)								
7.004	# particles > Critical size (/liter)							ı C	
Specialty Gases								ı C	
Wafer Level	Eluorine (Chamber Clean)	Volume							
	Pluonine (chamber clean)	Purity							
	High k Gate Stack (Need Gas Specs)	Volume							
	ingi il outo otaol (recel otao opeco)	Purity							
	Metal Gate (Cross Contamination)							ı L	
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								L L	
	Power Consumption								
	Power Utilization (demand/installed)		60%	70%	70%	70%	80%		80%
Wafer Level	Overall Fab Equipment (KWh/cm2)		0.4-0.5	0.4-0.5	0.3-0.4	0.3-0.4	0.3-0.4	i 🗧	0.3-0.4
	NGLitho						Power Hungry	P	Power Hungi
	PVD Cu Nucleation	1	250KW	250KW	250KW	250KW	250KW		
Facility/Funcitonal Area	Fab Facility (KWh/cm2)		0.4-0.5	0.4-0.5	0.3-0.4	0.3-0.4	0.3-0.4		0.3-0.4

<100	<100	<100
<0.1	<0.1	<0.1
10	10	10
80%	70%	80%
0.3-0.4	0.3-0.4	0.3-0.4
Power Hungry	Power Hungry	Power Hungry
0.3-0.4	0.3-0.4	0.3-0.4

W	Water Consumption			
T Wafer Level	fool UPW use (liters/cm2, per wafer pass)	0.25	0.25	0.20
Facility/Funcitonal Area	Fab UPW use (liters/cm2)	5-7	5-7	4 - 6

0.15	0.15	0.15
3 - 5	3 - 5	3 - 5

Environmental Impact

Wafer Level Exhaust

Waste Steams

Schedule						
Factory Construction Time from Groundbreaking to all Facility Systems Operational (months)	12	10	10	10	10	10
Groundbreaking to first tool move-in (months)	9	8	8	8	7	6

0.20

4 - 6

- 6

0.20

4 - 6

10	10	10	
6	5.5	5	DO THESE TIMES AND SEQUENCES MAKE SENSE?

First tool move-in to first full loop wafer out (months)	3.6	5	3	3	2.5	2.5
Tool Hookup (weeks)						
Capital Cost						
Facility capital cost per Total factory capital cost including process equipment (percent)	159	%	15%	15%	15%	15%
Production Equipment Installation cost per Production Equipment capital cost (percent)	8%	6	6%	6%	6%	6%
Facility capital cost per wafer outs (planned)						
Facility Capital Cost per Tool Installable area						

Operational Cost					
Facility operating cost including utilities per Total fab operating cost (percent)	13%	13%	13%	13%	13%
Utility cost per Total fab operating cost (percent)	3%	3%	3%	3%	3%

2	1.5	1

15%	15%	15%
6%	8%	6%

13%	13%	13%		
3%	3%	3%		

Blue - Technology Nodes

White–Manufacturable Solutions Exist, and Are Being Optimized Yellow–Manufacturable Solutions are Known Red–Manufacturable Solutions are NOT Known



				Long term table remains the same
				Not sure this metric has much meaning, but do we move in first tool in 9 months in 2002? Then 2003 and 2004 should be the same.
				A more meaningful metric would be first tool hookup to first full loop wafer out? First tool hook up tied to facility systems operational? Maybe for 2003
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				Do you feel comfortable with the 1X going white in 2002. This means that we are currently having the same footprint area in subfab and fab?