INTERNATIONAL 300 mm INITIATIVE

300 mm Test Wafer Specifications for 0.25 µm Technology

International 300 mm Initiative
Technology Transfer # 97063306A-TR

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June 30, 1997

Abstract: 0.25 µm targeted test wafer specifications suggested by I300I for use in 1997 are detailed. Use of, and exceptions to, SEMI standards are noted.

Keywords: 300 mm Wafers, Specifications

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1 INTRODUCTION

These are the 300 mm wafer specifications suggested by I300I for use after mid-1997. They are similar to those used by I300I for purchasing wafers for 1997 demostrations. **These are 0.25 μm technology targeted test wafers.**

In all cases a particular supplier will have various parameters which they were unable to deliver for Furnace, Particle, and Lithography wafers. This is due to the immaturity of the 300 mm generation. Lack of volume process data and measurement equipment is a key problem for silicon suppliers. In most cases, "best effort" from reliable suppliers is sufficient to proceed with early work. I300I accepted negotiated or best effort values for several parameters. In all cases, *some* supplier has demonstrated capability for the parameters specified.

Because of limited capacity and no production-quality measurement equipment, I300I accepted process control data rather than 100% inspection in most cases. This is important to control cost.

The SEMI Standards ballots for M1 (basic prime wafer) and M28-97 (extended developmental parameters) were passed in March 1997. Standards used are noted; exceptions are shaded.

The 1997 SIA Roadmap is used as noted. Contact Howard Huff at SEMATECH [(512) 356-3334 PHONE] for complete information.

The site pattern for lithography is a working layout system in the electronic version of this document. Contact Randy Goodall at I300I to receive a copy.

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2 0.25 µm I300I SPECIFICATIONS

Statistical Specification

Values shall be 100% guaranteed, unless otherwise noted or negotiated.

If statistically significant manufacturing capability data is available (usually in the form of parameter distributions, that is, histrograms), then a 99.75% distribution conformance level (or other negotiated level) of risk will be accepted by I300I (normal, log-normal, or other distribution shape shall be negotiated on a parameter basis).

When reporting (R) sample/typical values, the sampling plan and test method (including measurement equipment supplier and model) shall be identified.

Empak CrystalPak shipping box preferred.

I300I designation			TW301	TW302	TW303	TW304		
ITEM		SEMI Standard	MECHANICAL WAFER	FURNACE WAFER	PARTICLE WAFER	LITHOGRAPHY WAFER	COMMENTS	TEST METHOD
Per SEMI M18; missing = "NS"		Unless otherwise noted, all specs are **M28-97** (exceptions to standards are shaded) "(R)" = Report sampled/typical value; "NS" = Not Specified						Test methods are negotiable. (Methods listed are not all verified appropriate)
1. GENERAL CHARACTERISTICS								
1.1	Growth Method		Cz or MCz	Cz or MCz	Low COP crystal	Cz or MCz	Supplier Option	
1.2	Crystal Orientation	M8.12	{100} ± 2°	{100} ± 2°	{100} ± 2°	{100} ± 2°	Use tighter tolerance for Implant work	ASTM F 26, JEIDA 18, DIN 50433
1.3	Conductivity type		p	p	p	p		ASTM F 42, JIS 0607, DIN 50432
1.4	Dopant		B	B	B	B		ASTM F 1389, ASTM F 1630, DIN 50438/3
1.5	Nominal Edge Exclusion	M1	3 mm	3 mm	3 mm	3 mm		
2. ELECTRICAL CHARACTERISTICS								
2.1.1	Resistivity (Nominal)		NS	≥ 1 Ω-cm (R)	NS	NS	Center Point	ASTM F 84, F 673 , JIS H0612, DIN 50431
2.1.2	Resistivity (Tolerance)		NS	(R)	NS	NS	Center Point	
2.2	Radial Resistivity Variation (RRG)		NS	(R)	NS	NS		
2.3	Resistivity Striations		NS	NS	NS	NS		
2.4	Minority Carrier Lifetime		NS	NS	NS	NS		
3. CHEMICAL CHARACTERISTICS								
3.1.1	Oxygen Concentration (Nominal)	("old" ASTM)	(R)	20 - 31 ppma (R)	(R)	(R)	Spec ≤ 24 for contamination tests (no internal gettering) OR ≥ 30 for precipitation testing	F 1188, F 1366, F 1619, DIN 50438/1
3.1.2	Oxygen Concentration (Tolerance)		NS	± 3 ppma	NS	NS	Within shipment	
3.2	Radial Oxygen Variation		NS	≤ 10% (R) 10 mm From Edge	NS	NS		ASTM F 951
3.3	Carbon Concentration		NS	≤ 0.2 ppma	NS	NS		ASTM F 1391, DIN 50438/2
3.X	Total Bulk Fe		NS	≤ $5.0 \times 10^{10}/cm^3$	NS	NS	Supplier to state test method	ASTM F 978 or Extension of ASTM F391, ASTM F1531
4. STRUCTURAL CHARACTERISTICS								
4.1	Dislocation Etch Pit Density		NS	≤ $500/cm^2$ (R)	NS	NS		ASTM F 47, JIS H0609, DIN 50434
4.2	Slip		NS	none	none	none		ASTM F 47, JIS H0609, DIN 50434
4.3	Lineage		NS	none	none	none		ASTM F 47, JIS H0609, DIN 50434
4.4	Twin		NS	none	none	none		ASTM F 47, JIS H0609, DIN 50435
4.5	Swirl		NS	none	none	none		ASTM F 416
4.6	Shallow pits		NS	NS	NS	NS		ASTM F 1049
4.7	Oxidation-Induced Stacking Faults (OSF)		NS	≤ $20/cm^2$	NS	NS	May be difficult to reach $20/cm^2$ AND 100 particles at 0.12um due to crystal growth issues. Negotiate based on most critical need. OISF is often harmless for equipment demo	ASTM F 416 (P-type wafer; 2 hrs @ 1100 C steam)
4.8	Oxide Precipitates (BMD) Interstitial Oxygen Reduction (ΔO_i)		NS	NS	NS	NS	Must specify thermal cycle	

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5. WAFER PREPARATION CHARACTERISTICS								
5.1	Wafer ID Marking	M28-96	Frontside OCR (M12)	Frontside OCR (M12)	Frontside OCR (M12)	Frontside OCR (M12)	Position 5 (alphanumeric) reserved for **I300I Wafer Type Code** (see below)	NOTE: T2 Laser ID Mark on backsurface near notch is permitted
5.2	Front Surface Thin Film(s) Appl		NS	NS	NS	NS		
5.3	Denuded Zone		NS	NS	NS	NS		
5.4	Extrinsic Gettering Treatment		NS	none	none	none		
5.5	Backseal		NS	NS	NS	NS		
5.6	Annealing		NS	Donor annihilation permitted if required for metrology (R)	NS	Donor annihilation permitted if required for metrology (R)	Alternate Anneals Require User/Supplier Mutual Agreement	
6. MECHANICAL CHARACTERISTICS								
6.1	Diameter	M1	300 ± 0.2 mm	300 ± 0.2 mm	300 ± 0.2 mm	300 ± 0.2 mm		ASTM F 613, DIN 50441/4
6.2	Diameter Notch Dimensions	M1						
6.2.1	Notch Depth	M1	1 +0.25,-0.00 mm	1 +0.25,-0.00 mm	1 +0.25,-0.00 mm	1 +0.25,-0.00 mm		F 1152
6.2.2	Notch Angle	M1	90 +5,-1 degrees	90 +5,-1 degrees	90 +5,-1 degrees	90 +5,-1 degrees		F 1152
6.3	Notch Orientation	M8.12	<110> ± 2°	<110> ± 2°	<110> ± 2°	<110> ± 2°		
6.6.1	Edge Profile		C_y = 194 µm, A_x = 120 µm, D_y = 50 µm	C_y = 194 µm, A_x = 120 µm, D_y = 50 µm	C_y = 194 µm, A_x = 120 µm, D_y = 50 µm	C_y = 194 µm, A_x = 120 µm, D_y = 50 µm	This is the "blunt" edge specification generally preferred by I300I companies, especially heavy CMP users.	ASTM F 928, DIN 50441/2
6.6.2	Edge Surface Finish	M1	Polished	Polished	Polished	Polished	Identify test measurement method	
6.7	Thickness	M1	775 ± 25 µm	775 ± 25 µm	775 ± 25 µm	775 ± 25 µm		ASTM F 533, ASTM F 1530, JIS H0611, DIN 50441/1
6.7.1	Thickness Variation (9-Point TTV)	M1	≤ 10 µm	≤ 10 µm	≤ 10 µm	NS		ASTM F 533, JIS H0611, DIN 50441/1
6.72	Thickness Variation (GBIR)		NS	NS	NS	≤ 5 µm	Full Scan	ASTM F 1530
6.9	Surface Orientation	M8.12	(100) ± 2°	(100) ± 2°	(100) ± 2°	(100) ± 2°	Use tighter tolerance for Implant work	ASTM F 26, JEIDA 18, DIN 50433
6.10	Bow		NS	NS	NS	NS		
6.11	Warp		≤ 100 µm	≤ 100 µm	≤ 100 µm	≤ 50 µm	Keep loose	ASTM F 1390, F 1451
6.12	Sori		NS	NS	NS	NS		
6.13	Flatness/Global		NS	NS	NS	NS		
6.14a	Flatness/Site (for lithography tests)		NS	NS	NS	SFQR ≤ 0.25 µm (90% of sites on wafer)	25 mm x 25 mm, site center at wafer center; Partial sites NOT included (see figure)	ASTM F 1530
6.14b	Flatness/Site (for wafer characterization)		NS	NS	NS	SFQR ≤ 0.25 µm (90% of sites on wafer)	25 mm x 25 mm, site corners at wafer center; Partial sites included (see figure)	ASTM F 1530

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ITEM		**SEMI Standard**	**MECHANICAL WAFER**	**FURNACE WAFER**	**PARTICLE WAFER**	**LITHOGRAPHY WAFER**	**COMMENTS**	**TEST METHOD**
Per SEMI M18; missing = "NS"		Unless otherwise noted, all specs are **M28-97** (exceptions to standards are shaded) "(R)" = Report sampled/typical value; "NS" = Not Specified						Test methods are negotiable. (Methods listed are not all verified appropriate)
7. FRONT SURFACE CHEMISTRY								
7.1	Surface Metal Contamination							
	Sodium		NS	$\leq 5 \times 10^{10}/cm^2$	NS	NS		ASTM F 1617
	Aluminum		NS	$\leq 1 \times 10^{11}/cm^2$	NS	NS		ASTM F 1617
	Potassium		NS	$\leq 2.5 \times 10^{10}/cm^2$	NS	NS	Fast diffusing metal per NTRS-97	
	Chromium		NS	$\leq 2.5 \times 10^{10}/cm^2$	NS	NS		ASTM F 1526
	Iron		NS	$\leq 2.5 \times 10^{10}/cm^2$	NS	NS		ASTM F 1526
	Nickel		NS	$\leq 2.5 \times 10^{10}/cm^2$	NS	NS		ASTM F 1526
	Copper		NS	$\leq 2.5 \times 10^{10}/cm^2$	NS	NS		ASTM F 1526
	Zinc		NS	$\leq 2.5 \times 10^{10}/cm^2$	NS	NS		ASTM F 1526
	Calcium		NS	$\leq 2.5 \times 10^{10}/cm^2$	NS	NS	Fast diffusing metal per NTRS-97	
7.2	Surface Organics		NS	NS	NS	NS		
8. FRONT SURFACE CRITERIA								
8.1A	Scratches (macro)		NS	none	none	none	Tencor SP-1 Wide and Narrow channels with sensitivity ≤ 0.1 µm PSL equivalent (or technical equivalent)	ASTM F 523, JIS H 614
8.1B	Scratches (micro)		NS	≤ 10 mm (total length)	≤ 10 mm (total length)	≤ 10 mm (total length)	Tencor SP-1 Wide and Narrow channels with sensitivity ≤ 0.1 µm PSL equivalent (or technical equivalent)	ASTM F 523, JIS H 614
8.2	Pits		NS	NS	none	NS		
8.3	Haze		NS	NS	Goal < 0.05ppm	NS	Tencor SP-1 Wide channel (or technical equivalent)	
8.4	Localized Light Scatterers (Particles ONLY preferred)	NTRS-97	NS	≤ 100 @ ≥ 0.12 µm PSE	≤ 20 @ ≥ 0.12 µm PSE	≤ 100 @ ≥ 0.12 µm PSE	Tencor SP-1 Wide channel (or technical equivalent)	NOTE 1: Supplier capability limited. NOTE 2: NTRS-97 uses 0.12 µm for 0.25 µm technology node
8.6	Edge Chips		NS	none	none	none		ASTM F 523, JIS H 614, JEIDA 24
8.7-8.16	OTHER		NS	NS	NS	NS		
9. BACK SURFACE CRITERIA								
9.1	Edge Chips		NS	none	≤ 3	≤ 3		ASTM F 523
9.2-9.5	OTHER		NS	NS	NS	NS		
9.6	Roughness		NS	NS	NS	NS		
9.7	Brightness (CMP polish preferred)		≥ 80% Gloss Reading	≥ 80% Gloss Reading	≥ 80% Gloss Reading	≥ 80% Gloss Reading	With a 60 ° Angle of Incidence, Gloss Value is Referenced to a Mirror Polished Silicon Wafer.	ASTM D523, JIS Z8741
9.X	Localized Light Scatterers		NS	≤ 100 @ ≥ 0.25 µm	≤ 100 @ ≥ 0.25 µm	≤ 100 @ ≥ 0.25 µm	Report test method	
9.YA	Scratches (Macro)		NS	none	none	none	Visual Inspection	ASTM F 523, JIS H 614
9.YB	Scratches (Micro)		NS	≤ 25 mm (total length)	≤ 25 mm (total length)	≤ 25 mm (total length)	Visual Inspection	ASTM F 523, JIS H 614
I300I Wafer Type Code			"3"	"J"	"7"	"B"		

3 WAFER ID CODES

I300I Laser ID Mark

SEMI M12-type mark

10 characters + 2 checksum characters
Positions 1-4 (alphanumeric) are supplier lot ID
Position 5 (alphanumeric) is I300I wafer type code (see below)
Position 6 (alphanumeric) and 7-8 (numeric) are supplier lot sequence number
Position 9-10 (alpha) are SEMI initials for supplier
Position 11-12 are SEMI M12 checksum

Mark is placed according to M28 (frontside; left of notch (w/ notch down))
ID mark character bottoms should be towards notch

I300I Wafer Type Codes

Chemical Control (CC)

1=one or more chemical characteristics specified (e.g., bulk iron, surface metals, resistivity)
0=no chemical characteristics specified

Flatness Control (FC)

1=lithographic flatness specified
0=lithographic flatness not specified

Particle Control (PC)

1=particle counts specified
0=particle counts not specified

Test Wafer (TW)

1=wafer is suitable for process tests
0=wafer is not suitable for process tests; OK for mechanical tests and dummy/filler use

Dopant Type (DT) or Structure

1=p-type doping (polished)
0=epitaxial (p/p-, p/p+, p/p++)

I300Ispecial1 = "W" = n-type
I300Ispecial2 = "X"
I300Ispecial3 = "Y"
I300Ispecial4 = "Z"

I300I wafer type code = ALPHANUM[CC*16 + FC*8 + PC*4 + TW*2 + DT]
Where ALPHANUM = "0123456789ABCDEFGHIJKLMNOPQRSTUV"
--OR--
I300I wafer type code = I300Ispecial

NOTE:
TW = Mechanical wafer
TW+CC = Furnace wafer
TW+PC = Particle wafer
TW+FC = Lithography wafer
TW+CC+PC+FC = Circuit wafer

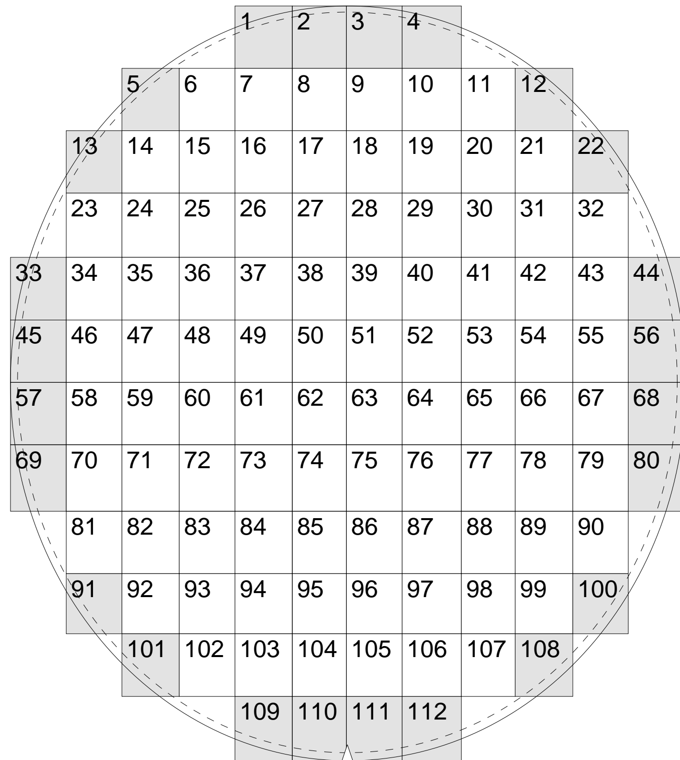
I300I Wafer Code Values

I300I wafer code values						
CC	FC	PC	TW	DT	CODE	
0	0	0	0	0	0	
0	0	0	0	1	1	
0	0	0	1	0	2	
0	0	0	1	1	3	=Mechanical wafer (p-type)
0	0	1	0	0	4	
0	0	1	0	1	5	
0	0	1	1	0	6	
0	0	1	1	1	7	=Particle wafer (p-type)
0	1	0	0	0	8	
0	1	0	0	1	9	
0	1	0	1	0	A	
0	1	0	1	1	B	=Lithography wafer (p-type)
0	1	1	0	0	C	
0	1	1	0	1	D	
0	1	1	1	0	E	
1	1	1	1	1	F	
1	0	0	0	0	G	
1	0	0	0	1	H	
1	0	0	1	0	I	
1	0	0	1	1	J	=Furnace wafer (p-type)
1	0	1	0	0	K	
1	0	1	0	1	L	
1	0	1	1	0	M	
1	0	1	1	1	N	
1	1	0	0	0	O	
1	1	0	0	1	P	
1	1	0	1	0	Q	
1	1	0	1	1	R	
1	1	1	0	0	S	
1	1	1	0	1	T	
1	1	1	1	0	U	=Circuit wafer (epitaxial, p-type)
1	1	1	1	1	V	=Circuit wafer (polished, p-type)
I300ISpecial1					W	=n-type polished wafer
I300ISpecial2					X	
I300ISpecial3					Y	
I300ISpecial4					Z	

4 SITES 25 x 25 – FIGURES

Sites 25 x 25 – Corner

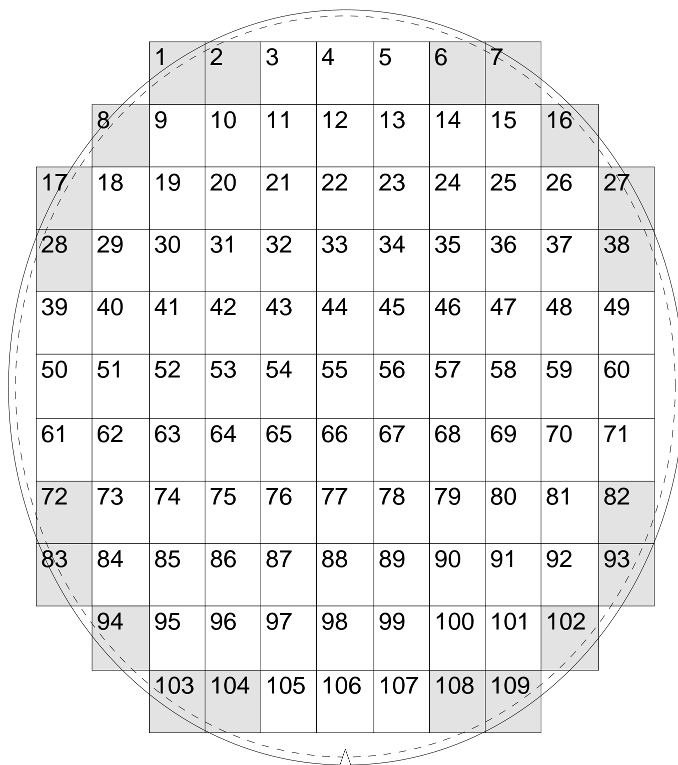
Diameter	300
xSize	25
ySize	25
xOffset	12.5
yOffset	12.5
EdgeXcl	3



Full	Partial	Total	%FQA Full
88	24	112	81.02

Sites 25 x 25 – Center

Diameter	300
xSize	25
ySize	25
xOffset	0
yOffset	0
EdgeXcl	3



Full	Partial	Total	%FQA Full
89	20	109	81.94

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