

Hitachi

CG-4000

Process Type: Metrology & Inspection

Wafer Size: 300mm

Equipment Information:

Status of Equipment: crated
(Load Port C need repair)

Configuration:

Hitachi CG-4000; 3LP
Software V31

Options:

Signal Light Tower(with buzzer)
UL Safety Modification (S2-0200)
Circulator Input Voltage Modification
Automatic Beam Alignment on wafer
Optical magnification (x100 & x200)
AC208V input modification
Cable (15m) (for main unit thru power supply unit)
SE-Gun back-up power supply unit
Ion pump back-up power supply unit
SPM (pre-focus only)
Multi-point Measurement
Gap meas
Corner radius meas
Image Filing Function
Output function to DOS format FD
Recipe queue

ArF package (multi)

Image info additional function to MSR file

Waveform matching

Large

pixel $A \times B$

Image enhancement

Mag. Max $\times 400k$

Dry Pump I/F "F" (for IL70)

GEM300

DS/T-PC link connection

license 100nm Microscale

Grounded Arm

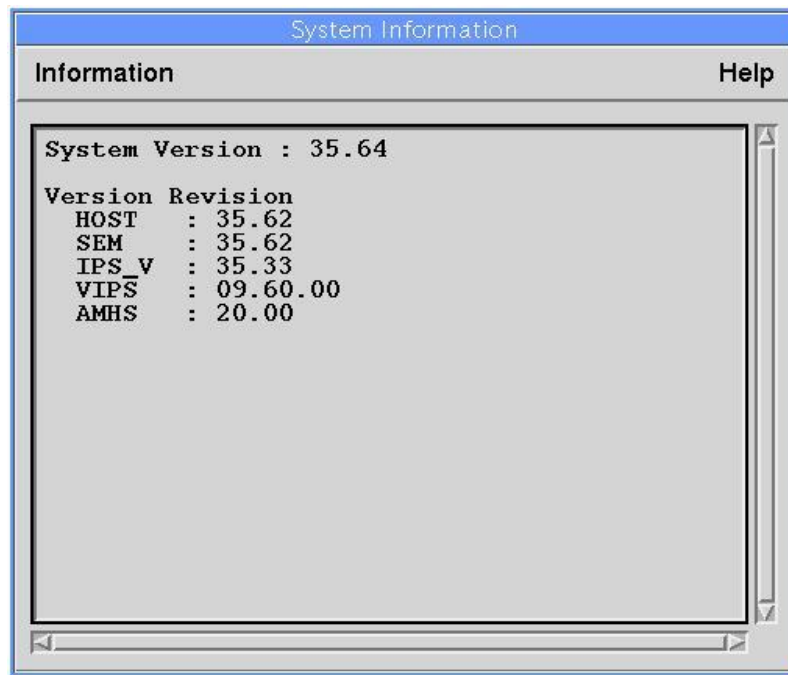
FFU hood

CG4000 Critical Gauge Scanning Electron Microscope Installation Report

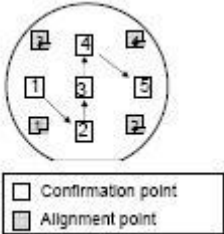


Instrument Model Number: CG4000

System Information



Performance Tests

No.	Test Item	Details	Specification	Result
1.	Inventory	Check all items according to packing list		Finished
2.	Vacuum check	Ion Pump Vacuum Levels IP1 0×10^{-7} IP2 0×10^{-7} IP3 6×10^{-7}	IP-1 $< 2.0 \times 10^{-7}$ Pa IP-2 $< 5.0 \times 10^{-6}$ Pa IP-3 $< 5.0 \times 10^{-5}$ Pa	Pass Pass Pass
3.	Operation check	All system functions work normally.		Refer to P-5
4.	Safety circuit Operation	All EMO's work normally.		Refer to P-6
5.	SEM image resolution	Sample: STP sample <u>Optical conditions:</u> Vacc: 800V Ip: 10pA Optical mode: Hi-Reso Measurement Magnification: 333kx Frame count: Optimum Number	1.8nm at accelerating voltage of 800V	Refer to P-8
6.	Contact hole observation	Hole size = $0.1 \sim 0.2\mu\text{m}$ or smallest hole that customer will observe. <u>Optical conditions:</u> Vacc: 800V Ip: 10pA Optical mode: Hi-Reso and H-DOF Measurement Magnification: 200kx Frame count: 128 frames	Bottom of the hole should be seen brightly and clearly.	Refer to P-9
7.	Stage stop accuracy	(1) Sample: Standard Hitachi wafer (or wafer with a resist pattern) (2) Measurement: After performing alignment at four SEM image points, move to the five chips in the direction of the arrows and measure the deviation of a given pattern in each chip (Measure once) 	Within $\pm 1\mu\text{m}$	Refer to P-10

8	Dynamic measurement reproducibility	(1) Sample: Standard Hitachi wafer Line patterns with a Poly-Si etching sample; 90nm wide or less (2) Optical conditions Accelerating voltage: 800V Probe current: Optimal value Magnification: 200kx Optical mode: Hi-Reso/Hi-DOF Frame count: 16 frames (3) Recipe settings Given 10 measurement points, measure 10 times per point Auto focusing: off site each time Auto focusing type: I-Diff Auto focusing magnification: 150kx (4) Measurement parameters: Hitachi conditions	Average reproducibility for 10 measurement points: $3\sigma \leq 0.3 \text{ nm}$ (excluding contamination components)	Refer to P-11
9.	Loading test	Successfully load/unload 200 wafers per load port without errors.	Minimum 200 times loading with no errors. (Each port A, B, C)	Refer to P-12
10.	Throughput	(1) Sample: Standard Hitachi wafer Line patterns with a maximum width of 90 nm (2) <u>Optical conditions</u>: Vacc: 800V Ip: Optimal value Magnification: 200kx Optical mode: Hi-Reso Frame count: Addressing: 4 frames Measurement: 8 frames (3) <u>Recipe settings</u> Measurement conditions: 1 site/chip, 20 chips/wafer Auto focusing: Performed during each measurement (the same spot as the measurement point) Auto focusing type: FAST2 Auto focusing magnification: 100kx (4) <u>Measurement method</u>: Transfer 5 wafers successively from a cassette (one of the wafers being patterned). For the LC-A side set a patterned wafer in the third slot, and measure time from the end of loading the 2nd wafer to the end of loading of the 3rd wafer. Similarly, on the LC-B side, place patterned wafer in the second slot, and measure time from end of loading the 1st wafer to the end of loading the 2nd wafer. Take the average time values of LC-A & LC-B to calculate the throughput. (5) Measurement parameters: Hitachi conditions	Continuous: 36wph With GEM communication option off	Refer to P-12

11.	X&Y Linearity	Using micro scale compare X and Y pitch measurement.	$\leq 0.25\%$ Error between average measured value and JQA value.	Refer to P-13
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CG4000 Series Operation Verification

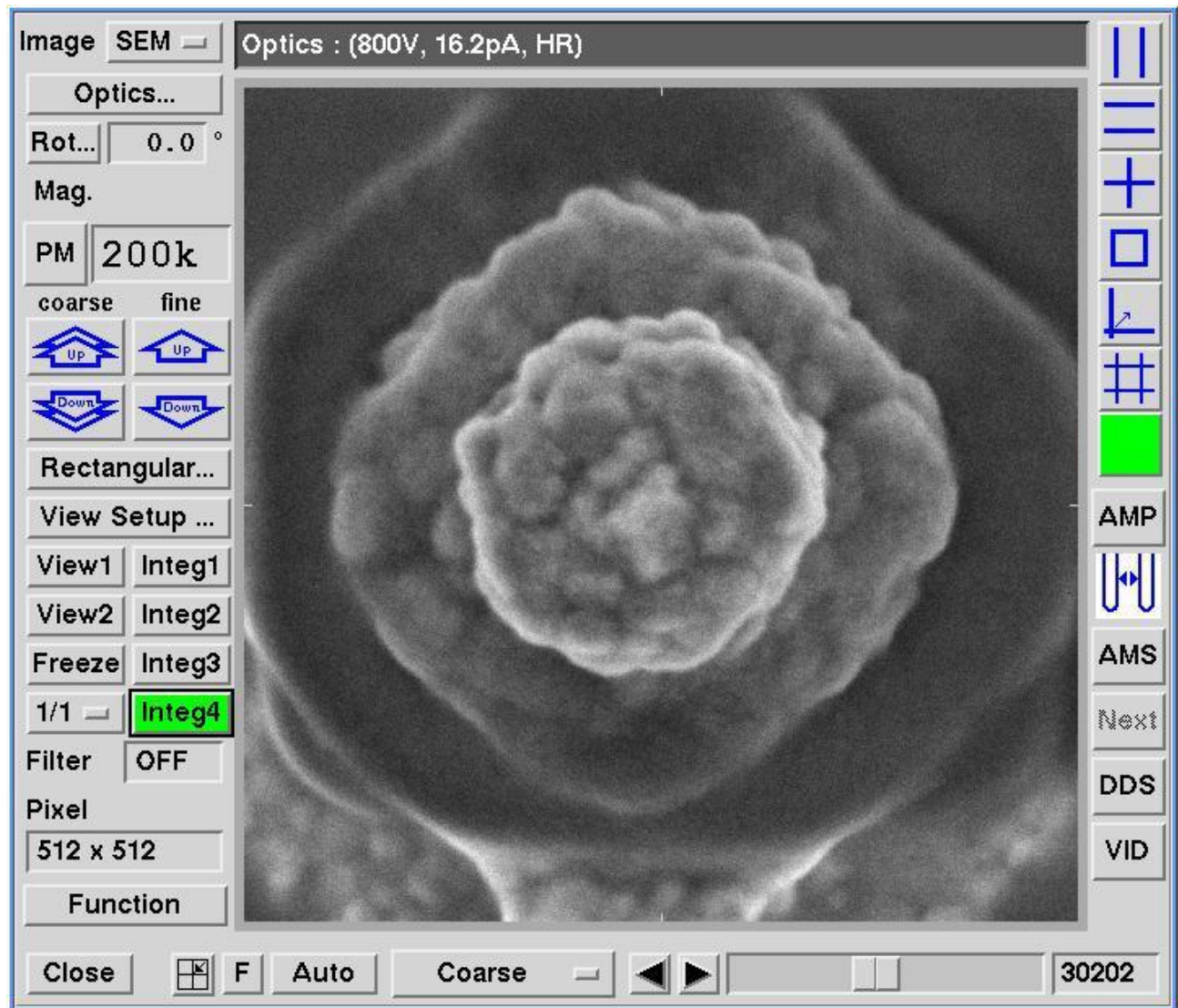
No.	Description/Specification	Result
<Specimen stage, Wafer loader>		
1.	Stage travel range X: 0 ~ 300mm Y: 0 ~ 300mm	Good
2.	Stage home position X: 0mm Y: 0mm	Good
3.	Wafer loading position X: 0mm Y: -6mm (Holder A)	Good
	X: 360mm Y: -6mm (Holder B)	Good
<Column>		
1.	The objective aperture moves smoothly and all four holes are centered.	Yes
2.	The heater for the objective aperture operates normally.	Yes
3.	The BLK and IPPA connectors are properly connected.	Yes
<Electron Gun>		
1.	The mechanical axis adjustment screws and knobs move smoothly.	Yes
2.	MV1 to 3 (manual valves) are closed (if baking was conducted during installation).	Yes
3.	The ion pump high-voltage connectors are not loose.	Good
4.	The ion pump vacuum meters read normally and do not fluctuate.	Yes
5.	After baking, the gun flange received additional tightening.	Yes
<Control System>		
1.	The accelerating voltage can be set up to 0.3 kV to 1.6 kV (in 10V increments).	Yes
2.	Electrical axis adjustments can be performed by means of Alignment 3 and Stigma X, Y.	Yes
3.	The knobs, trackball, switches, keyboard and mouse operate smoothly.	Yes
4.	Magnification switching and display can be performed correctly.	Yes
5.	Photographs are aligned properly in the FOV and data is displayed clearly.	Good
6.	Auto focusing and auto stigma operate properly.	Yes
7.	The correct date and time zone are set.	Yes
8.	The SEM turns off automatically during a Normal Shutdown.	Yes
<Evacuation system>		
1.	The Penning gauge meters read correctly and do not fluctuate.	Yes
2.	No abnormal noise during DP or RP operation.	Good
3.	Auto evacuation sequence operates normally.	Yes
4.	All valves close when Air pressure is below 550 kPa.	Good
<Mini-environment>		
1.	Mapping is performed normally on ports A, B and C.	Yes
2.	No abnormal noise during robot or opener operation.	Good
3.	The opener suction pad is clean and unscratched.	Good
4.	The wafer alignment chuck is free of debris and stains.	Yes
5.	The robot arms are clean and unscratched.	Yes
6.	The differential pressure systems indicates a minimum level of 0.8 Pa	Yes
7.	The system passes particle checks (Standard Hitachi specification: 15 wafers cycled, 2 particles per pass for particles 0.08 µm or larger).	Yes

	<Miscellaneous> - No external scratches (panels, etc) or unusual problems. - The Air, N2 and Vacuum are properly set: Air: 600±20kPa N2(L): 90±10kPa N2(H): 385±10kPa Vacuum:- 80kPa (non-adjustable) - No unusual problems with the input voltage (200, 208, 230V±10%) - Status LED's on display unit function properly when the system is running (except for BAKE). - The system is not multi-point grounded to anti-vibration fixtures. - Document accessories provided and ensure they function properly.	Good Good Good Yes Good Good
	<Safety Devices> - All power turns off when the EMERGENCY STOP switch is pressed. * The IP/GUN/FAPC backup supplies also turn off. - When the covers of the power supply unit are opened, the power is turned off (with the exception of the IP/GUN/FAPC backup supplies). - The power for the dry pumps turns off when the EVAC power supply is turned off (if the dry pumps are provided with a power supply unit). - The dry pumps stop when the EVAC power supply is turned off (if the dry pumps are provided with a DP I/F). - The EVAC power supply turns off when the power for the dry pumps is cut. - The robot stops when the mini-environment cover is opened.	Yes Good Yes Yes Yes Yes
	<Post-installation Checkup> - Column load plate fixture (bolts, spacers) are removed. - Stage fixture is removed. - OM Fixture is removed. - Turbo pumps 1, 2 and 3 fixtures are removed. - Wafer holder fixtures are removed. - AV3 valve fixtures are removed. - Opener fixtures are removed. - Mini-environment is aligned with jigs and secured. - System is wired correctly. - Plumbing work is done correctly. - Alignment sample and micro-scale are installed and are free of scratches and smudges. No leaks in the Air, N2 and Vacuum Lines. - No water leaks in the cooling water lines. - DP exhaust duct is connected to a customer provided exhaust duct. - The cables to the main unit are secured and fitted with dampeners.	Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Good Good Good Yes Yes

Final Items

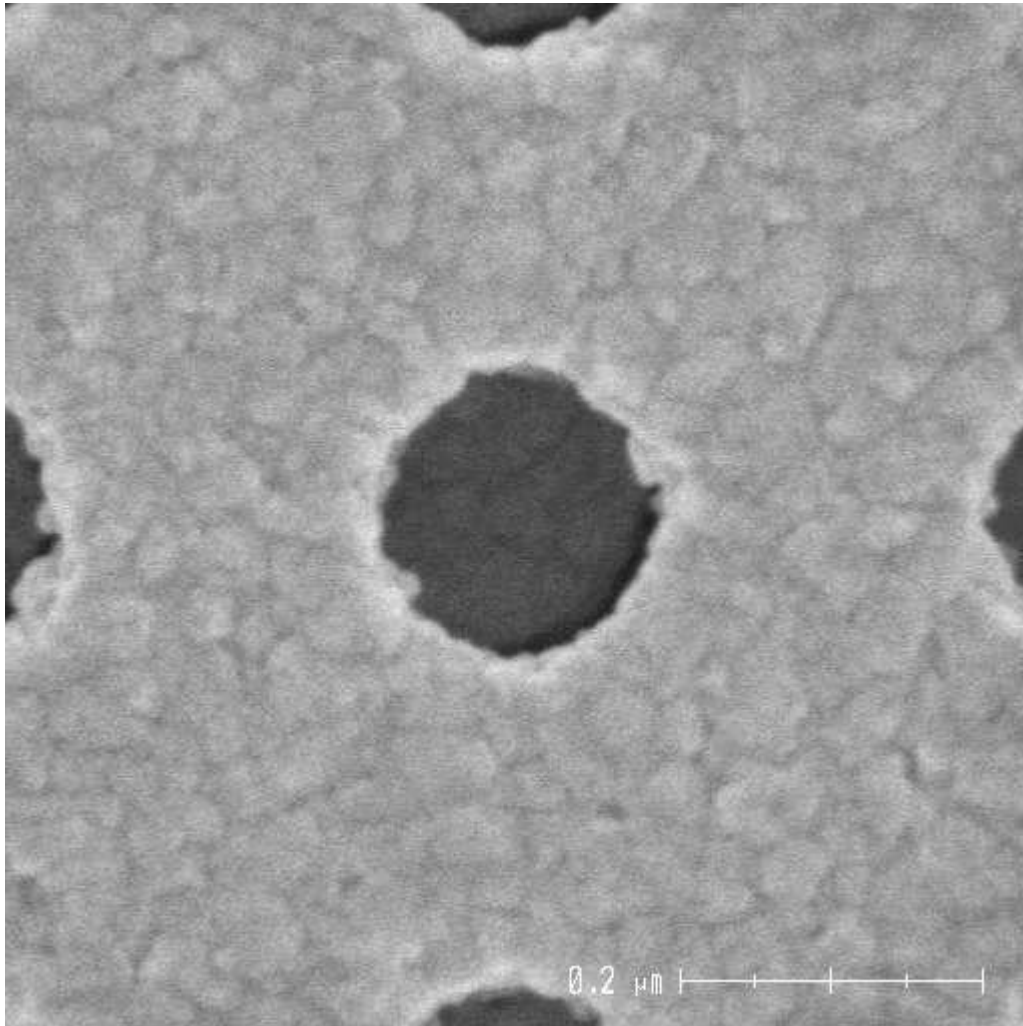
<i>Item</i>	<i>Description</i>	<i>Result</i>
Networking	Network system to customer network (if required).	
Particles	Verify the system passes particle checks (Standard Hitachi specification: 15 wafers cycled, 2 particles per pass for particles 0.08 μm or larger).	
Final Adjustments	Using a customer wafer (golden wafer if available), verify the following are within specification: ☐ Stage Offset Correction ☐ Stage Stop Accuracy ☐ OM-SEM Offset ☐ Image Shift Mapping* * If voltages other than 300V, 500V, 800V or 1600V are to be used.	
Machine-to-Machine Matching	If recipes are to be shared among multiple CD-SEMs, the following items must be adjusted according to the baseline system: ☐ Stage Offset Correct ☐ STC Correction ☐ OM-SEM, Rotation Correction ☐ OM height (focus) ☐ Z-sensor Offset Adjustment ☐ Measurement Data Correction	
System Backup	Perform a system backup to save adjustment and matching data.	
Customer Training	Brief the customer on the following: Safety Maintenance schedules Startup and Shutdown sequences. Basic Operations	N/A
JQA Report and Inventory Check Sheet	Embed JQA Certificate of Calibration page and inventory check files into document by dragging -and- dropping files into appropriate boxes on page 16.	N/A

Secondary Electron Resolution Image



Sample :
Acceleration Voltage: 800V
Magnification : ×200,000
Probe Current : 16pA (High Reso. Mode)

Contact Hole Observation



Sample: Standard sample
Accelerating Voltage : 800V
HR Magnification : $\times 200,000$

Stage Positioning Accuracy

Specification: Within $\pm 1\mu\text{m}$

Stage Correction2				
Chip	Diff X[μm]	Diff Y[μm]		
(11, 8)	0.05	0.15	Recording Apply Graph... Initialize Print Save Close	
(11, 9)	0.16	0.24		
(11, 10)	0.09	0.48		
(12, 3)	-0.65	-0.68		
(12, 4)	-0.30	-0.65		
(12, 5)	-0.15	-0.59		
(12, 6)	0.03	-0.55		
(12, 7)	0.08	-0.26		
(12, 8)	0.08	-0.06		
(12, 9)	0.13	-0.01		
Maximum	0.57	1.10		
Minimum	-1.02	-0.76		
Mean	-0.17	0.07		
3 Sigma	1.11	1.47		
Mean + 3 Sigma	1.28	1.54		

Dynamic Measurement Accuracy

Specification: 3σ (w/out trend) $\leq 0.3\text{nm}$

Note: Double click on table below to access for data input
Click once outside of the table to exit data entry mode

	Run										
MP	1	2	3	4	5	6	7	8	9	10	3σ
1	75.32	75.33	75.26	75.28	75.29	75.58	75.48	75.68	75.78	75.88	0.69
2	76.23	76.08	76.15	76.23	76.25	76.33	76.26	76.28	76.24	76.19	0.21
3	73.99	73.93	73.85	73.93	74.13	73.99	74.04	74.09	74.09	74.33	0.40
4	76.83	76.70	76.73	76.80	76.84	76.88	76.84	76.86	76.97	76.82	0.23
5	79.02	78.96	78.94	78.97	78.97	79.08	79.10	79.07	79.11	79.13	0.21
6	74.65	74.52	74.64	74.41	74.56	74.53	74.63	74.61	74.78	74.72	0.32
7	75.84	75.77	75.77	75.73	75.73	75.88	75.87	75.88	75.86	75.81	0.18
8	76.98	76.76	76.77	76.79	76.84	76.86	76.82	76.86	76.96	76.95	0.24
9	73.28	73.14	73.15	73.02	73.10	73.25	73.14	73.26	73.17	73.30	0.27
10	78.59	78.44	78.48	78.53	78.53	78.48	78.59	78.62	78.59	78.62	0.19
										AVG 3σ	0.29
	Run (without trend)										
MP	1	2	3	4	5	6	7	8	9	10	3σ
1	75.32	75.31	75.22	75.22	75.21	75.48	75.36	75.54	75.62	75.70	0.53
2	76.23	76.06	76.11	76.17	76.17	76.23	76.14	76.14	76.08	76.01	0.22
3	73.99	73.91	73.81	73.87	74.05	73.89	73.92	73.95	73.93	74.15	0.29
4	76.83	76.68	76.69	76.74	76.76	76.78	76.72	76.72	76.81	76.64	0.18
5	79.02	78.94	78.90	78.91	78.89	78.98	78.98	78.93	78.95	78.95	0.12
6	74.65	74.50	74.60	74.35	74.48	74.43	74.51	74.47	74.62	74.54	0.27
7	75.84	75.75	75.73	75.67	75.65	75.78	75.75	75.74	75.70	75.63	0.19
8	76.98	76.74	76.73	76.73	76.76	76.76	76.70	76.72	76.80	76.77	0.24
9	73.28	73.12	73.11	72.96	73.02	73.15	73.02	73.12	73.01	73.12	0.28
10	78.59	78.42	78.44	78.47	78.45	78.38	78.47	78.48	78.43	78.44	0.17
										AVG 3σ (w/o trend)	0.30
		1	2								

Loading Test

Specification: 334 times loading with no error (for each port A and B)

LoaderTester				
Repeat	30	times for Port-A		
	0	Port-B		
	0	Port-C		
	0	Port-D		
Total count of	Port			
	A	B	C	D
Recipe run	30	0	0	0
Wafer unload	206	0	0	0
Unload time		21:26:41		
Unload Lap time		00:01:02		
Stop		Close		

LoaderTester				
Repeat	0	times for Port-A		
	8	Port-B		
	0	Port-C		
	0	Port-D		
Total count of	Port			
	A	B	C	D
Recipe run	0	8	0	0
Wafer unload	0	200	0	0
Unload time		21:55:12		
Unload Lap time		00:02:45		
Stop		Close		

* LP-C Out of Service

Results: 200 times loading without errors

Throughput

Specification: 36 wafers / hour (Continuous)

Must Average Load Port A time and Load Port B time to obtain the Specification



Results:

$$A: 3600 \text{ (s)} / 98 \text{ (s)} = 36.7 \text{ wafers / hour}$$

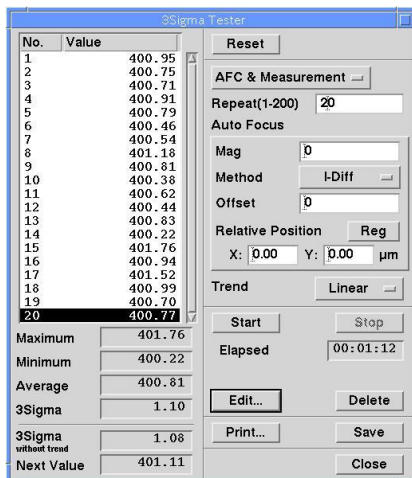
$$B: 3600 \text{ (s)} / 96 \text{ (s)} = 37.5 \text{ wafers / hour}$$

$$\text{Average} = 37.1 \text{ wafers / hour}$$

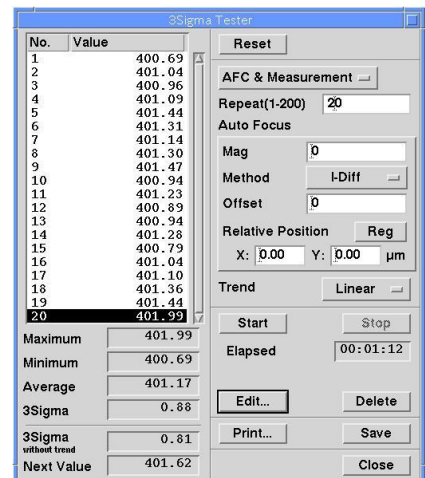
X&Y Linearity

Specification: Delta between X & Y must be less than $\pm 0.25\%$

Final data is determined after customer testing.



800HR



NOTE: No CLP fitted; Hitachi standard wafer used.

Software Options

