REFERENCES

Ansari, S. A. and Baig, R. (1998). "**PC-based Vibration Analyser for Condition Monitoring of Process Machinery**", IEEE Transactions on Instrumentation and Measurement, Volume 47 No. 2 April, pp. 378-383.

Baccigalupi, A.; Bernieri, A.; and Pietrosanto, A. (1997). "**Digital-Signal-Processor-Based Measurement System for On-line Fault detection**", IEEE Transactions on Instrumentation and Measurement, Volume 46 No. 3 June, pp. 731-736.

Boonyachai, S. (1981). "**A Statistical Approach for Analysing the Quality Problem in a Sanitaryware Manufacturing System**", Asian Institute of Technology.

Chetty, G. (1996). "**Neural Network Based Signal Processing Scheme for Automatic Tool Wear Recognition**", Proceedings of the International Symposium on Signal Processing and Its Applications, Volume 2, pp. 533-536.

Chow, Tommy W.S. (1996). "**Condition Monitoring of Electric Machine Using Third-order Spectrum Analysis**", Conference Record - IAS Annual Meeting, Volume 1, pp. 679-686.

Farnum R.N. (1994). "**Statistical Quality Control and Improvement**", 1st edition, Duxbury Press, USA.

Fuang-arom, A. (1990). "**Statistical Methods for Quality Improvement in a Gypsum Board Manufacturing Process**", Asian Institute of Technology.

Gong, L. and Tang, K. (1997). "**Monitoring Machine Operations Using On-line sensors**", European Journal of Operational Research, Volume 96 No. 3 February 1, pp. 479-492.

Gupta, K.N. (1997). "**Vibration - A Tool for Machine Diagnostics and Condition Monitoring**", Sadhana - Acedemy Proceedings in Engineering Sciences, Volume 22 No. 3 June, pp. 393-410.

Harry, M.J. (1998). "**Six Sigma: A Breakthrough Strategy for Profitability**", Quality Progress, May, pp. 60-64.

Hoehn, W. (1995). "**Robust Designs through Design to Six Sigma Manufacturability**", IEEE International Engineering Management Conference, pp. 241-246.

Hoerl, R.W. (1998). "**Six Sigma and the Future of the Quality Profession**", Quality progress, June, pp. 35-41.

Holroyd, T.J. (1997). "**Acoustic Emission - An NDT Technique Evolving into a Versatile Industrial Monitoring Method**", Measurement & Control, Volume 30 No. 5 June, pp. 141-145.

Javed, M.A. and Littlefair, G. (1993). "**Intelligent Condition Monitoring System using Acoustic Emission**", Intelligent Engineering Systems through Artificial Neural networks, Volume 3, pp. 775-780.

Jenning, A.D. and Drake, P.R. (1997). "**Machine Tool Condition Monitoring Using Statistical Quality Control Charts**", International Journal of Machine Tools and Manufacture, Volume 37 No. 9 September, pp. 1243-1249.

Juran, J.M. and Gryna, F.M. (1993). "**Quality Planning and Analysis: From Product Development through Use**", McGraw-Hill, USA.

Kiemele, M.J., Schmidt, S.R., and Berdine, R.J. (1997). "**Basic Statistics: Tools for Continuous Improvement**", 4th edition, Air Academy Press, USA.

Li, S. and Elbestawi, M.A. (1996). "**Fuzzy Clustering for Automated Tool Condition Monitoring in Machining**", Mechanical Systems & Signal Processing, Volume 10 No. 5 September, pp. 533-550.

Long, A.; Isbeli, C.; Kirkham, C.; and Taylor O. (1999). "**Machine Level Diagnosis Tools for Condition Monitoring**", Key Engineering Materials, Volume 167, pp. 217-223.

Lowes, S. and Shippen, J. (1996). "**Investigation into the Transferability of Neural Network for Condition Monitoring**", Insight: Non-destructive Testing and Condition Monitoring, Volume 38 No. 8 August, pp. 566-569.

MaAlister, W.R. (1998). "**Continuous Process Monitoring Leads to Reduced Scrap and Shorter Cycle Time**", Die casting Engineer, Volume 42 No. 4 July-August.

McCormick, A.C. and Nandi, A.K. (1997). " **Classification of the Rotating Machine Condition Using Artificial Neural networks**", Journal of Mechanical Engineering Science, Volume 211, No. 6, pp. 439-450.

Module Handout of Chulalongkorn University and Warwick Manufacturing Group. (1999). "**Quality Management and Techniques**", Chulalongkorn University, Thailand.

Montgomery, D.C. (1997). "**Introduction to Statistical Quality Control**", 3rd edition, John Wiley & Sons, Inc., USA.

Murray, A. and Penman, J. (1997). "**Extracting Useful Higher Order Features for Condition Monitoring Using Artificial Neural Networks**", IEEE Transactions on Signal Processing, Volume 45 No. 11 November, pp. 2821-2828.

Normand, J.F. and Draper, R.E. (1997). "**Resolution of Insulation Related Manufacturing Problems Using the Six Sigma Methodology and Tools**", Proceedings of the Electrical/Electronics Insulation Conference, pp. 769-774.

Parekhji, R.A.; Venkatesh, G.; and Sherlekar, S.D. (1996). "**Monitoring Machine Based Synthesis Techniques for Concurrent Error Detection in Finite State Machines**", Journal of Electronic Testing: Theory and Applications, Volume 8 No. 2 April, pp. 179-201.

Pornpitakpong, K. (1997). "**0% HFM and LFM out of control in TSPC**".

Redinius, D. (1998). "**Six Sigma Design Guidelines**", March, pp. 1-18.

Reference Manual (1995). "**Statistical Process Control (SPC)**", 2nd edition, USA.

Scobbo, J.J. (1998). "**Designing Engineering Resins for Six Sigma Performance**", Special Areas Annual Technical Conference, Volume 3.

Sick, Bernhard (1998). "**On-line Tool Wear Monitoring in Turning Using Time-Delay Neural Networks**", IEEE International Conference on Acoustic, Speech, and Signal Processing - Proceedings, Volume 1, pp. 445-448.

Spoerre, J.K. (1997). "**Application of the Cascade Correlation Algorithm (CCA) to Bearing Fault Classification Problems**", Computers in Industry, Volume 32 No. 3 March, pp. 295-304.

Tesara, B.B. (1987). "**Control Charts and Quality Related Statistical Applications in Industry**", Asian Institute of Technology.

Turmel, Jeff and Gartz, Larry (1997). "**Designing in Quality Improvement: A Systematic Approach to Designing for Six Sigma**", Annual Quality Congress Transactions, pp. 391-398.

Venkatesan, G.T.; West, D.; Buckley, K.M.; Tewfik, A.H.; and Kaveh, M. (1997). "**Automatic Fault Monitoring Using Acoustic Emissions**", IEEE International Conference on Acoustics, Speech, and Signal Processing - Proceedings, volume 3, pp. 1893-1896.

Walpole, R.E. and Myers, R.H. (1993). "**Probability and Statistics for Engineers and Scientists**", 5th edition, Macmillan, USA.

Wieser, R.; Kral, C.; Pirker, F.; and Schagginger, M. (1997). "**Condition Monitoring of Inverter Fed Induction Machines by Means of State Variable Observations**", IEEE Conference Publication, No. 444, pp. 336-340.

Wu, Z. (1998). "**Adaptive Acceptance Control Chart for Tool Wear**", International Journal of Production Research, Volume 36 No. 6 June, pp. 1571-1586.

Zhang, S.; Ganesan, R.; and Xistris, G.D. (1996). "**Self-organising Neural Networks for Automated Machinery Monitoring Systems**", Mechanical System & Signal Processing, Volume 10 No. 5 September, pp. 517-532.

APPENDICES

Appendix A

Head Gimbal Assembly

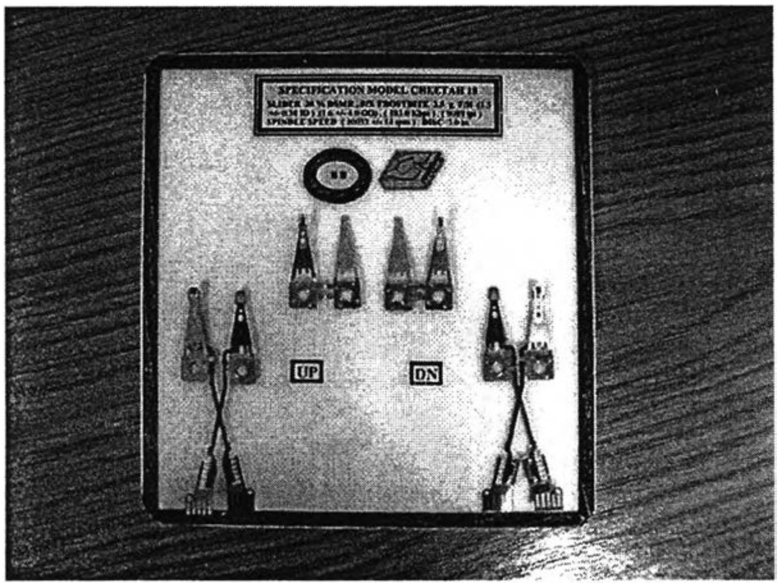
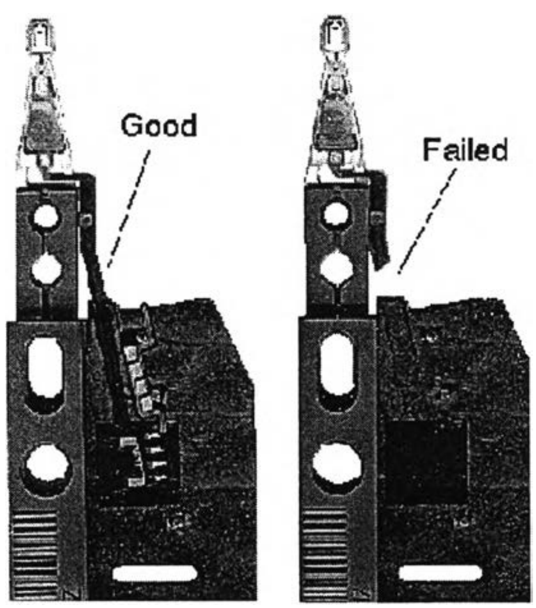
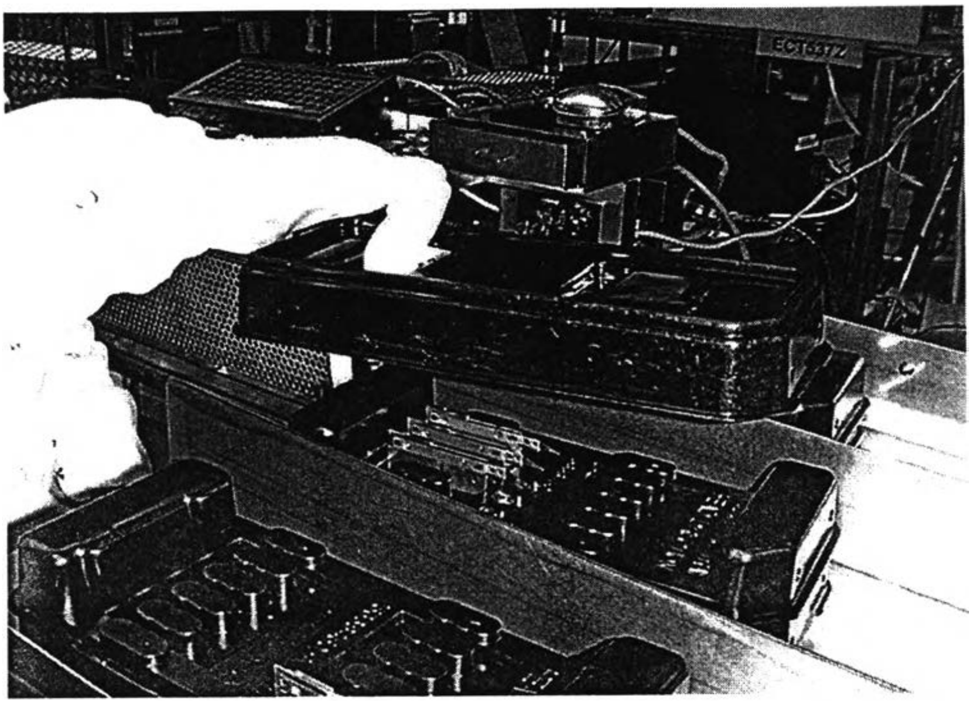


Figure of HGAs



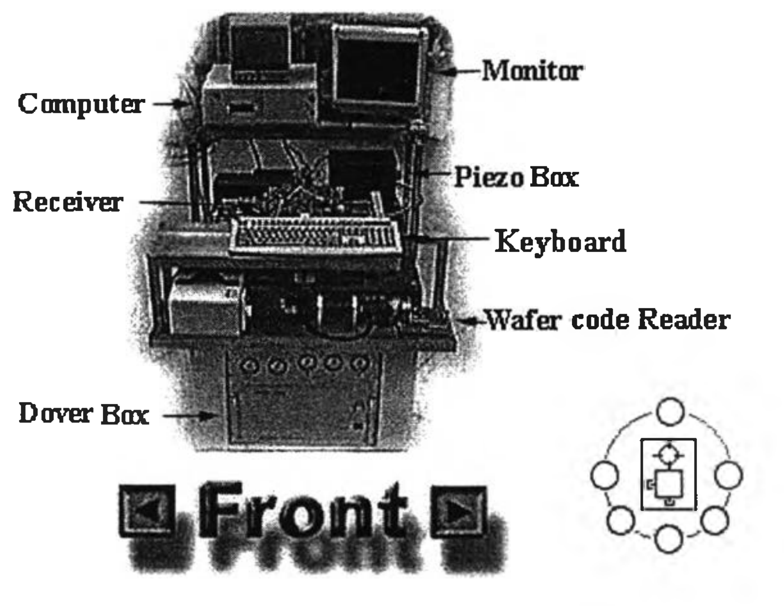
HGAs on Integrated Arm Technology (IAT) arms



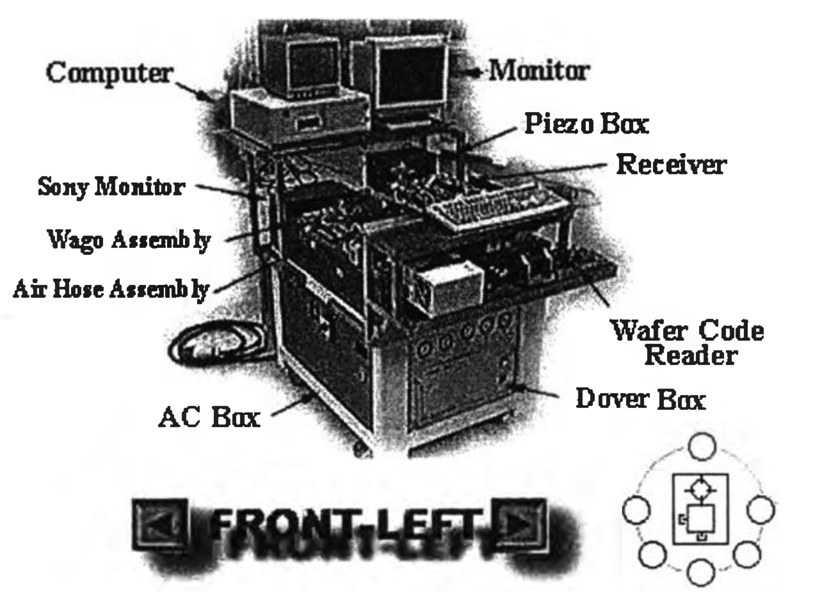
HGAs in the tray

Appendix B

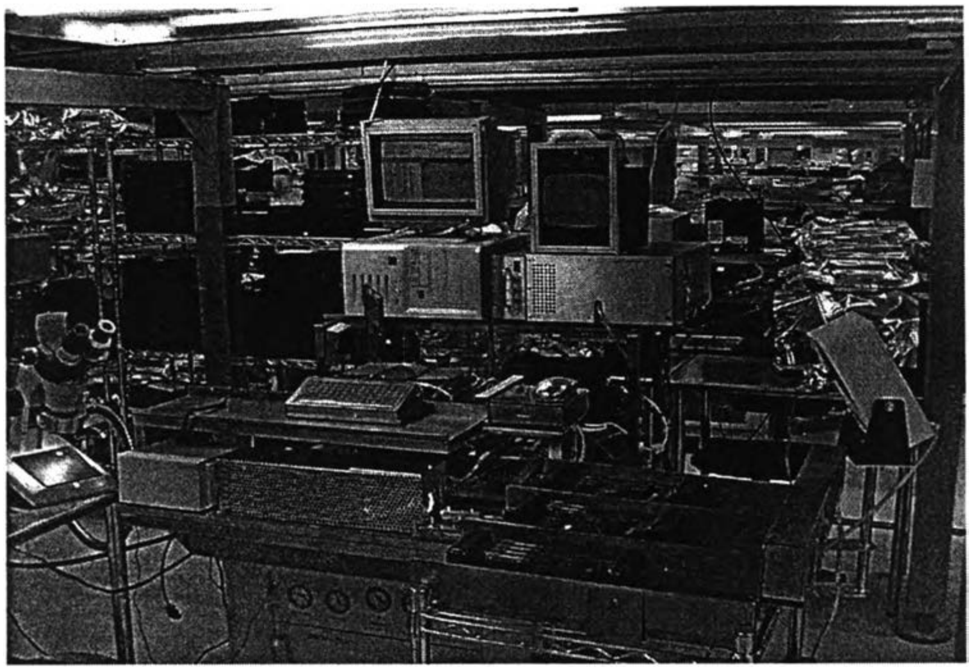
Electrical Tester



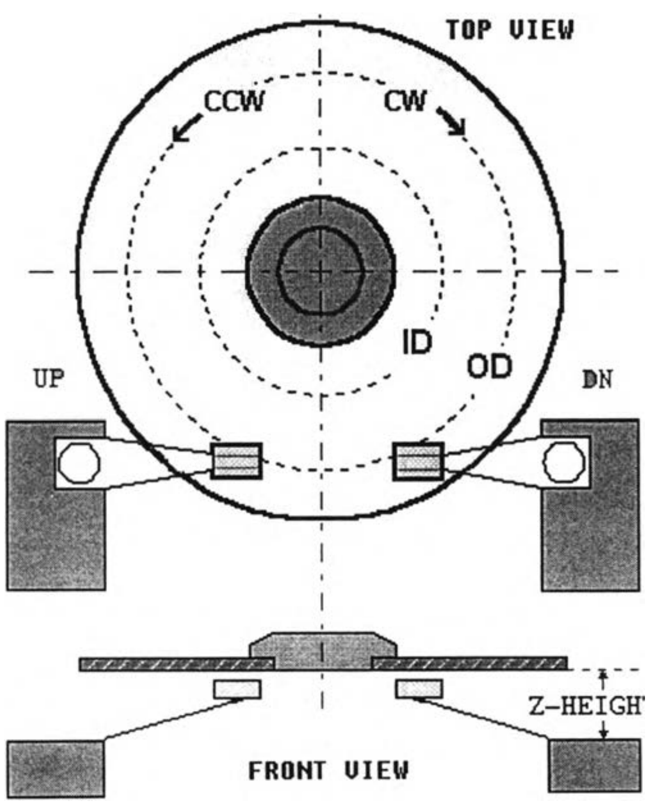
Electrical tester in front view



Electrical tester in front-left view



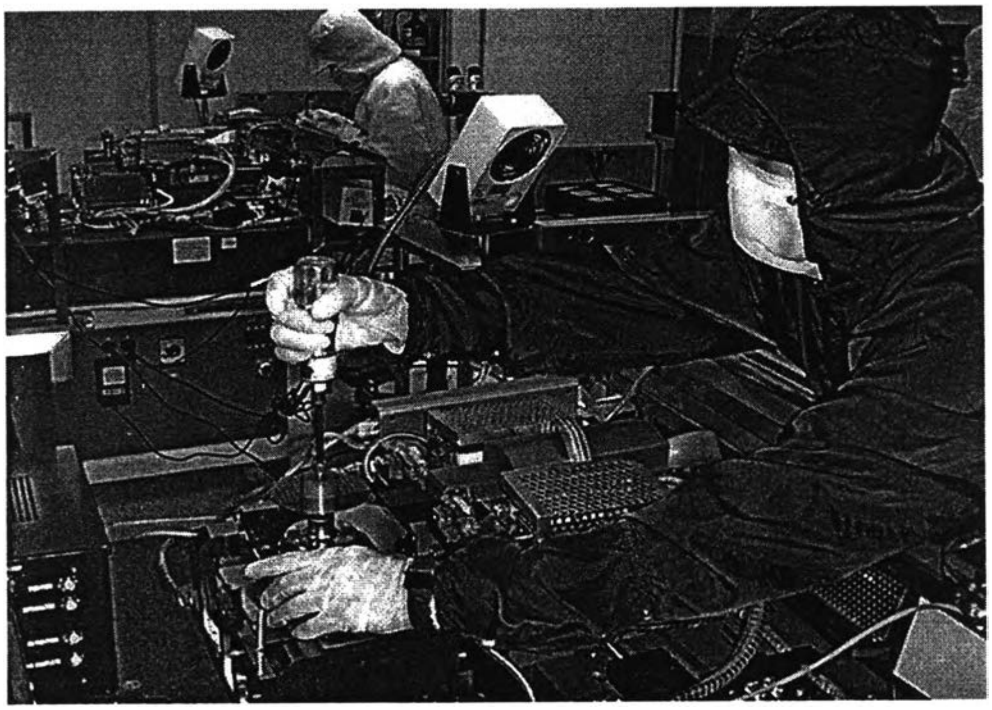
Electrical tester in cleanroom



Tester configuration

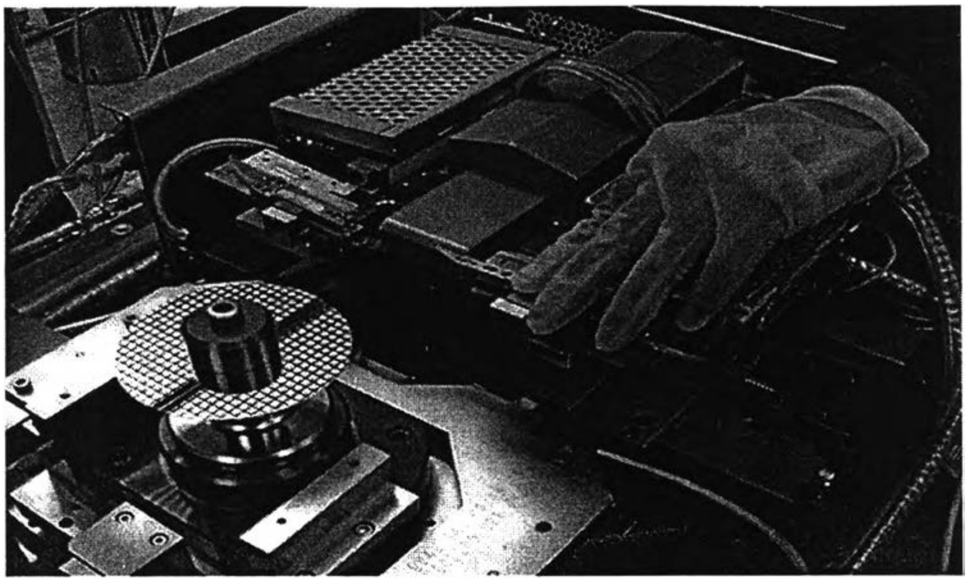
Appendix C

Processes of Performing TSPC

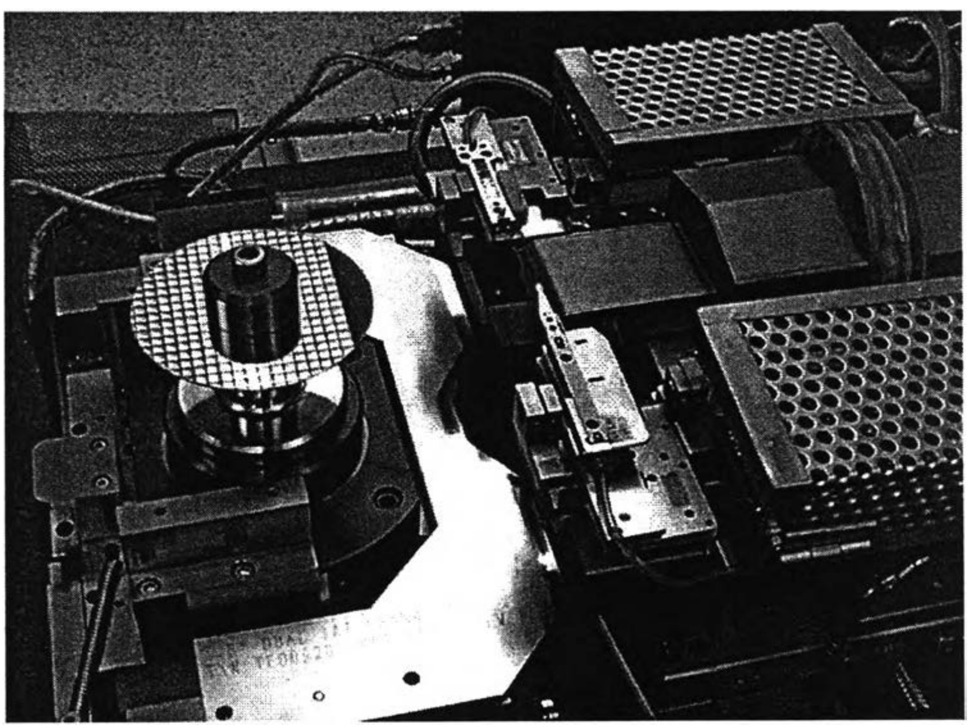


Changing disc

Placing factoring part and then calculating for factor



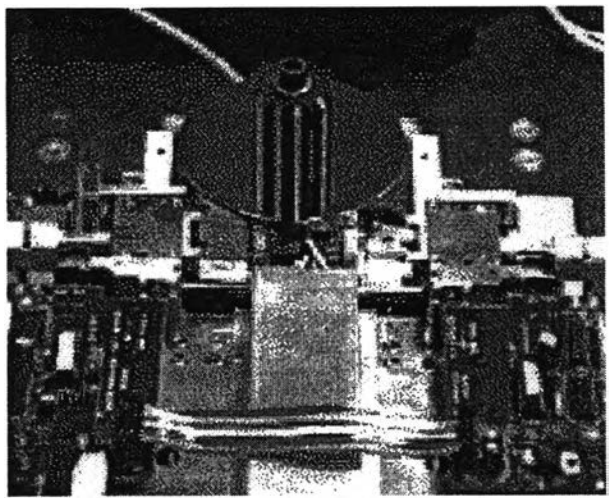
Placing TSPC part to run TSPC

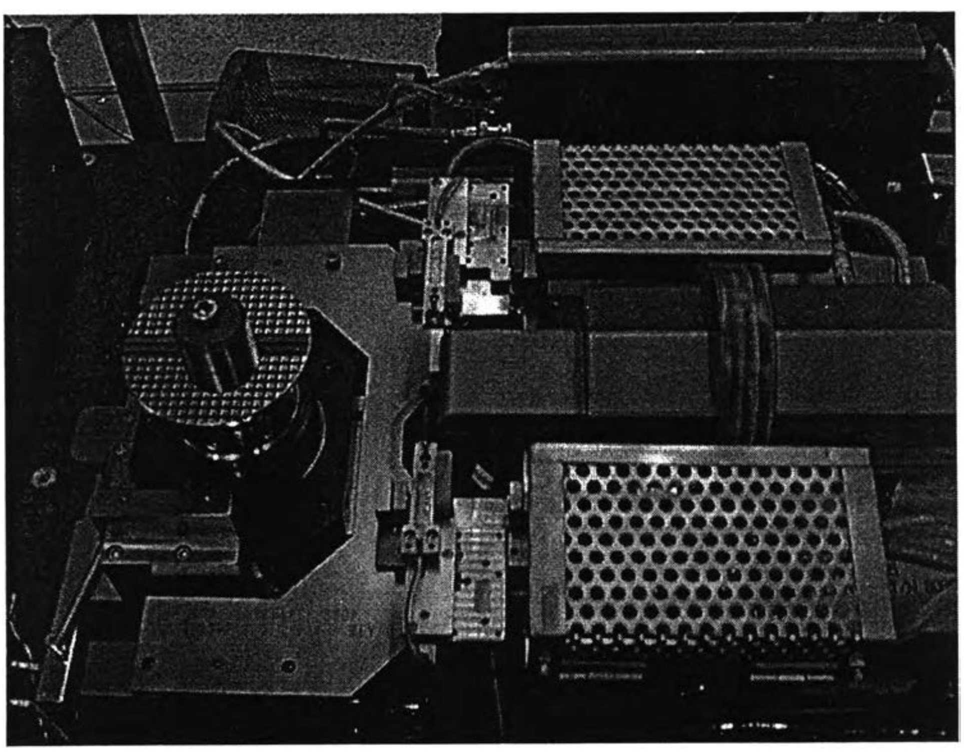


HGA on the tester

Appendix D

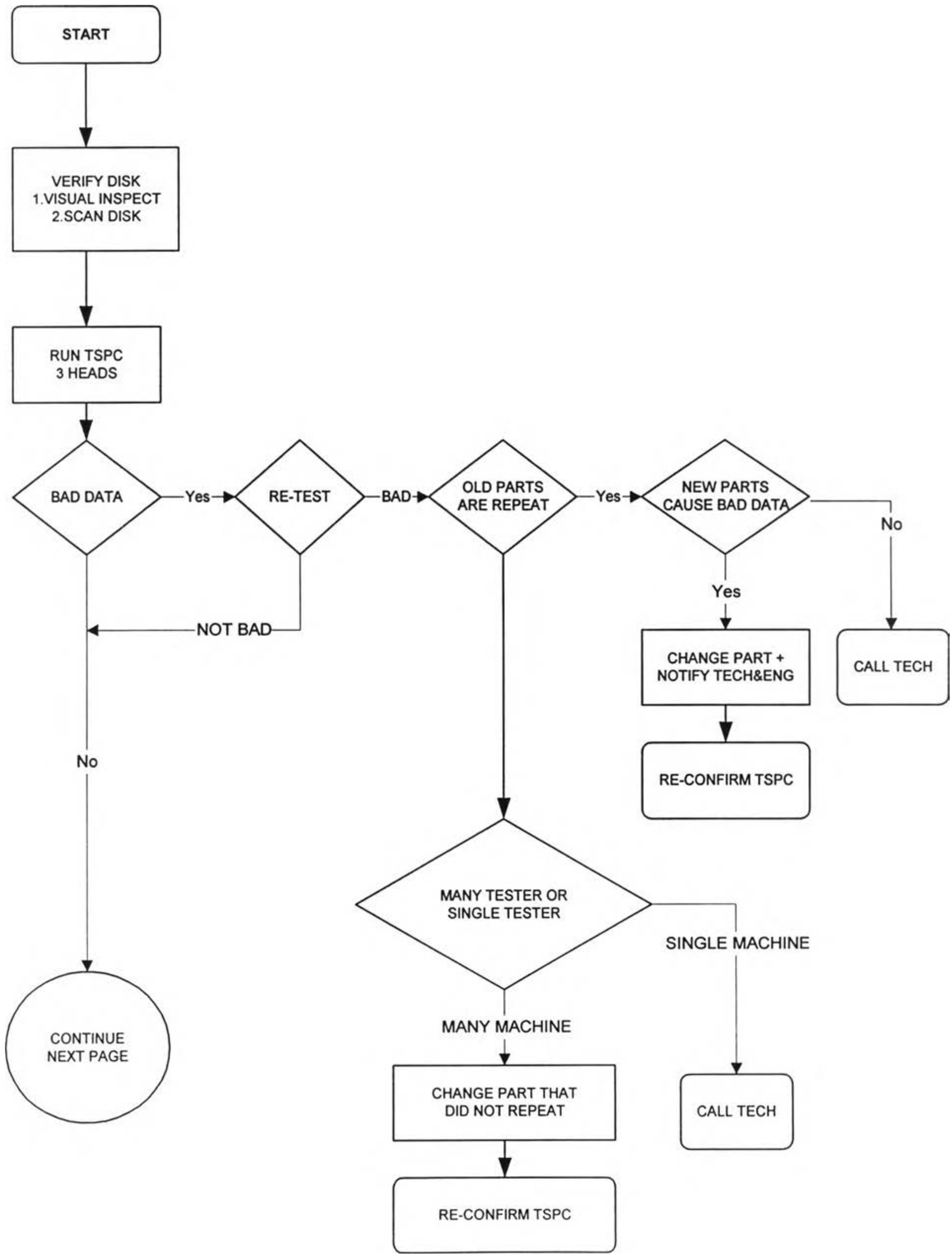
Media / Disc

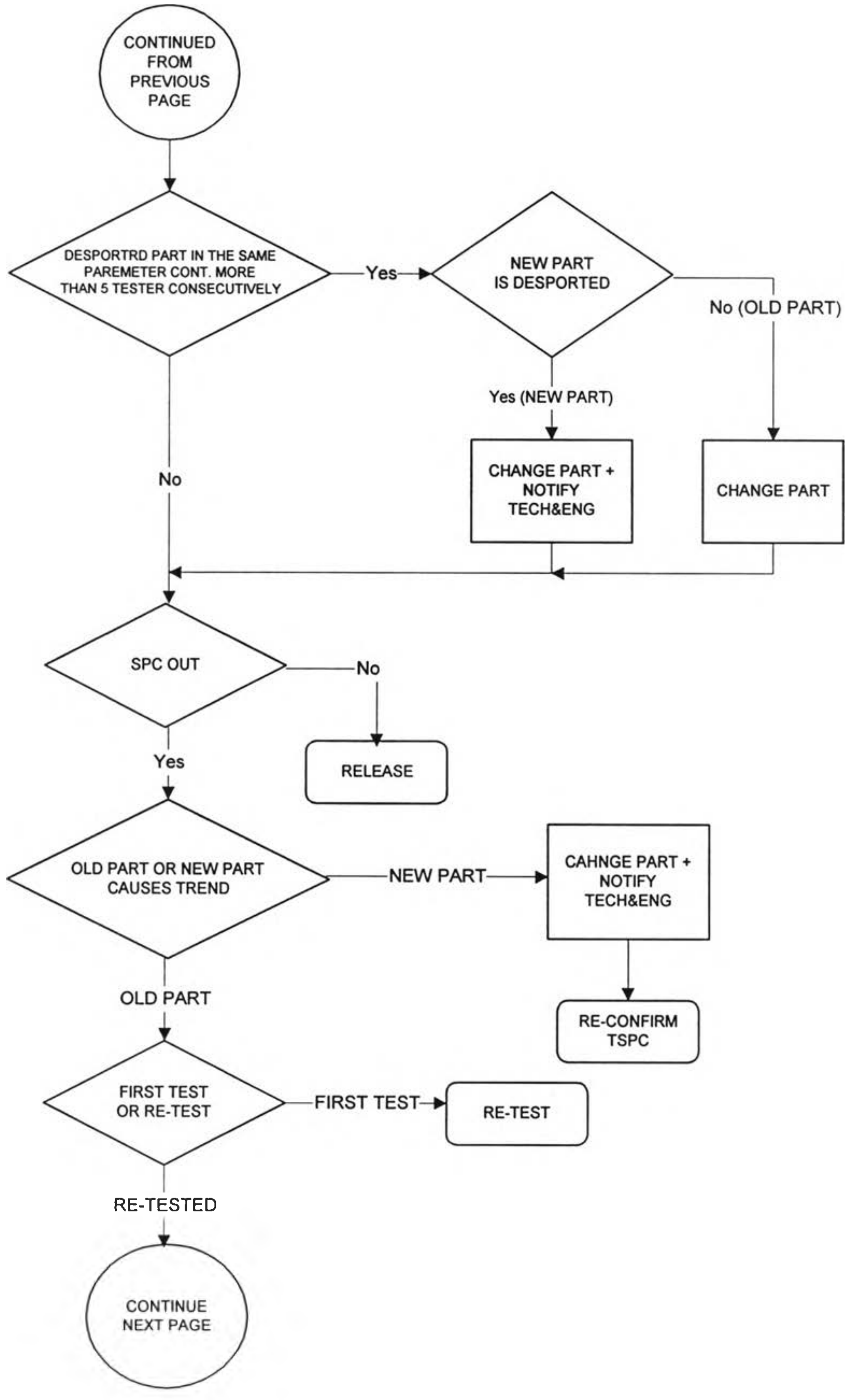


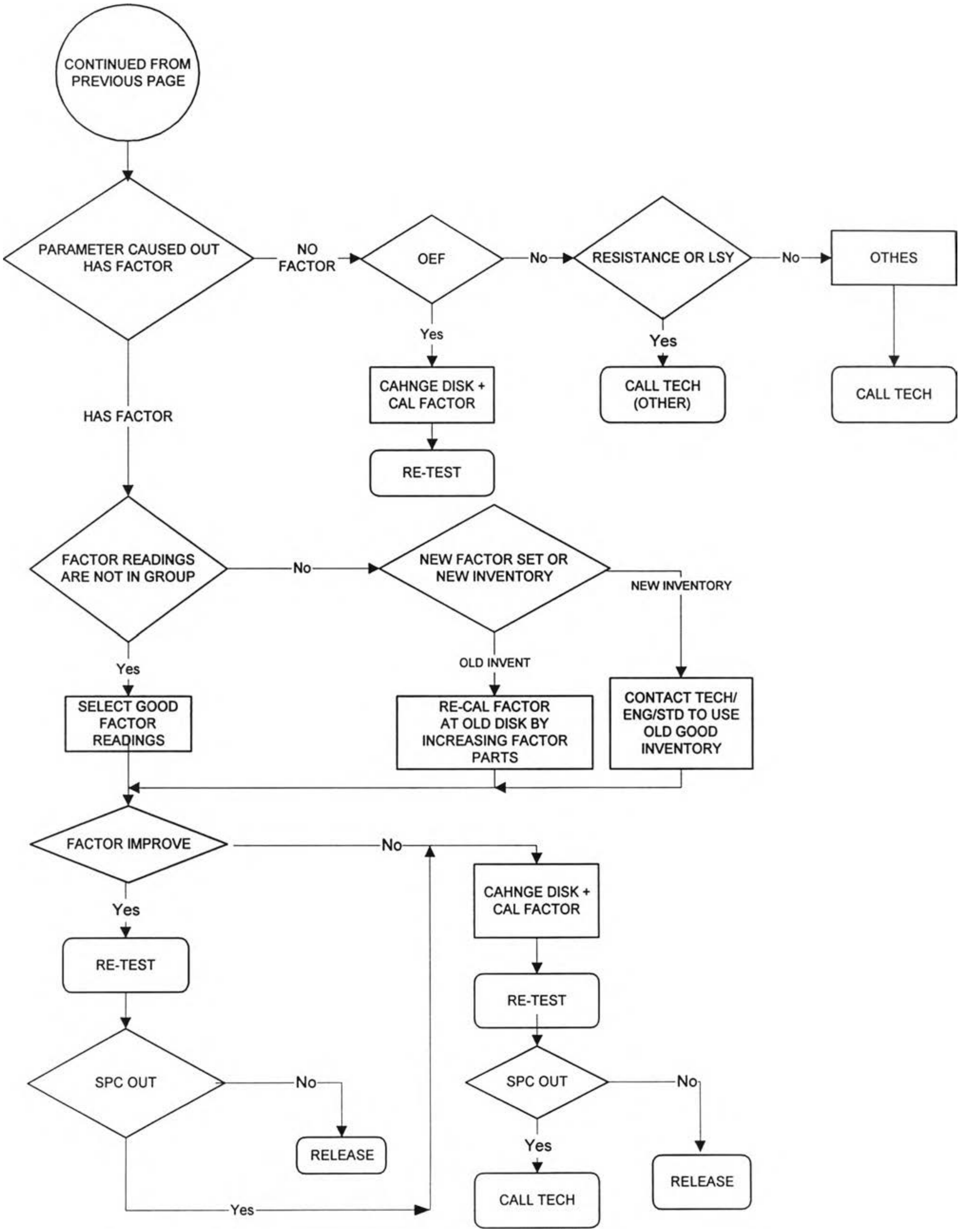


Appendix E

Corrective Action Instruction for TTOs

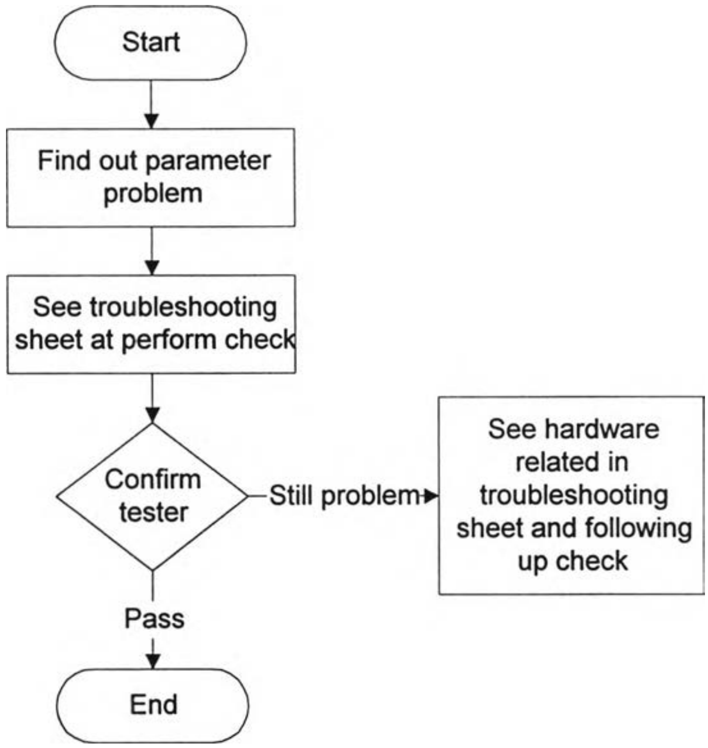



CONTINUED FROM PREVIOUS PAGE
DESPORTRD PART IN THE SAME PAREMETER CONT. MORE THAN 5 TESTER CONSECUTIVELY
Yes
NEW PART IS DESPORTED
No (OLD PART)
Yes (NEW PART)
CHANGE PART + NOTIFY TECH&ENG
CHANGE PART
No
SPC OUT
No
RELEASE
Yes
OLD PART OR NEW PART CAUSES TREND
NEW PART
CAHNGE PART + NOTIFY TECH&ENG
RE-CONFIRM TSPC
OLD PART
FIRST TEST OR RE-TEST
FIRST TEST
RE-TEST
RE-TESTED
CONTINUE NEXT PAGE


CONTINUED FROM PREVIOUS PAGE
PARAMETER CAUSED OUT HAS FACTOR
NO FACTOR
OEF
No
RESISTANCE OR LSY
No
OTHES
Yes
CAHNGE DISK + CAL FACTOR
RE-TEST
Yes
CALL TECH (OTHER)
CALL TECH
HAS FACTOR
FACTOR READINGS ARE NOT IN GROUP
No
NEW FACTOR SET OR NEW INVENTORY
NEW INVENTORY
OLD INVENT
Yes
SELECT GOOD FACTOR READINGS
RE-CAL FACTOR AT OLD DISK BY INCREASING FACTOR PARTS
CONTACT TECH/ ENG/STD TO USE OLD GOOD INVENTORY
FACTOR IMPROVE
No
Yes
RE-TEST
SPC OUT
No
RELEASE
Yes
CAHNGE DISK + CAL FACTOR
RE-TEST
SPC OUT
No
Yes
CALL TECH
RELEASE

Appendix F

Tester Troubleshooting Guide



Troubleshooting Guide for MR Tester Mean Offsets (Rev.4)

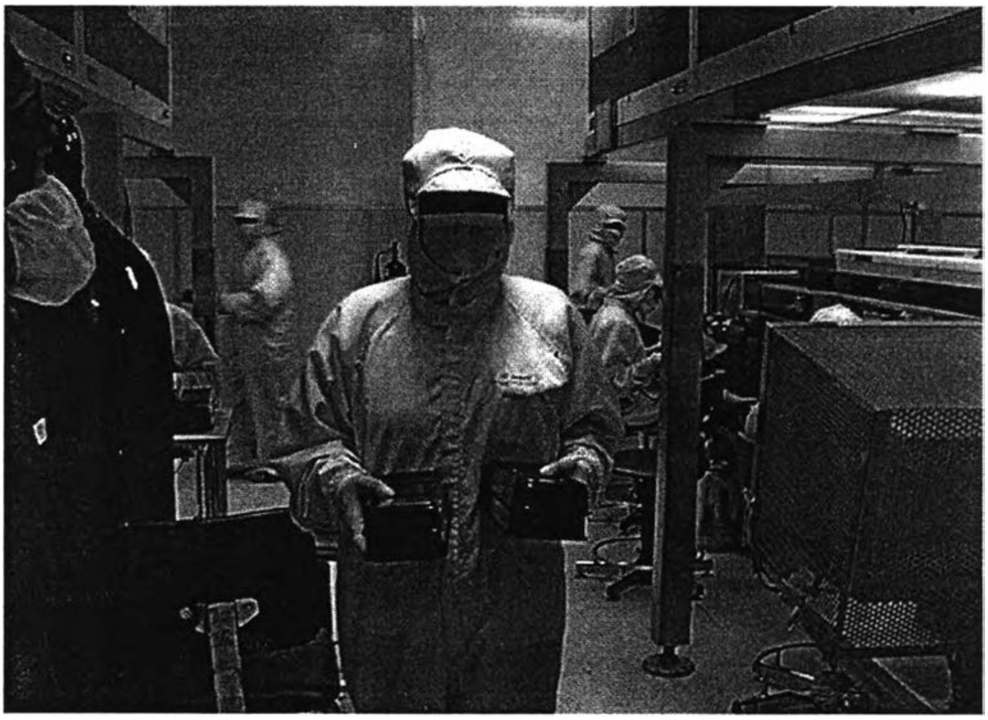
PERFORM CHECK TESTER.

Before following metrices. Must be perform below as:
Make sure Media,Housing,Cable, Pogo pin,Nest,Ground are in good condition.
Make sure PRODUCT setup.
Make sure the constant register are in correction.

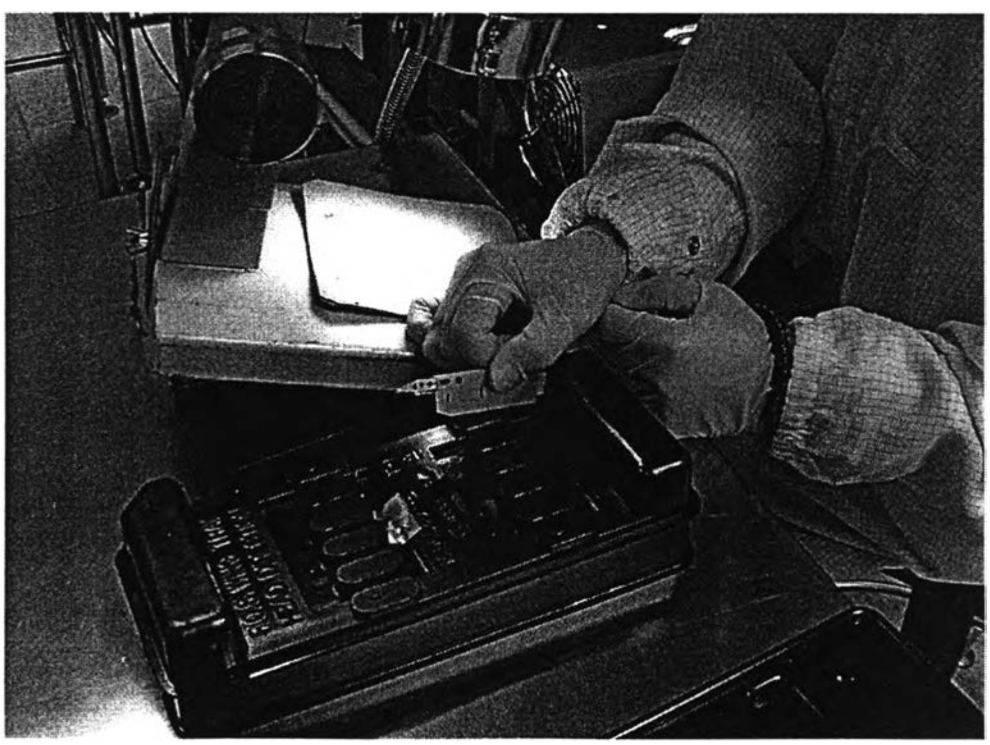
Related Hardware	PARAMETER GROUP																
	BASE LI POP	DIGITAL AN	MARGIN PRED	MR POLARITY	MR RESISTANC	OFF TRK/POSITION ERR		OVER WRITE	PTP AMP			PULSE WIDT	SGAW	TRK SCAN	TRK SCAN SL		VITERBI MAG
						OAG OEF PEA	OFF		HF,LF LFR LFC	LSY	LSC			RW1 POS/NEG RW1 POS/NEG WRD	RWS RWD	DPL DNL K_TRK_SYM	MAXTPSLR MAXDW3070	
Vibration	3rd					2nd	2nd				1st			2nd	2nd	2nd	2nd	2nd
-Air cushion																		
-Air stage											2nd							
-Spindle bracket																		
Piezo	2nd			1st														
-Cal. Volt. Ref.						5th	3rd							3rd	3rd	3rd	3rd	5th
-Convole																		
-Alignment														5th	5th	5th	5th	
-Trkscan move(HTB)		2nd				1st	1st							1st	1st	1st	1st	1st
Spindle																		
-Spindle Runout											3rd							
-Spindle speed	1st																	
-Air spindle																		
Stage																		
-Z-hight										2nd			5th					
-Home Position x,y							4th			3rd								
Noise																		
-Noise(floor)	4th							1st				4th						
-Noise(Profile Htb)																		
R/W control bd.		1st		2nd	1st	3rd			2nd	4th		2nd	1st					3rd
-Bias current																		
-Write current																		
Preamp Bd.					2nd				1st	5th		1st	2nd					
-Read chain cal.																		
Matrix filter													3nd					
Magnetic field										1st								
-Clamb block																		
-Nest																		
-Disk adaptor																		
Dover box																		
x,y Phase balance														4th	4th	4th	4th	
Ewr box																		
Processor bd.																		
Control bd.																		
PPPw bd.		3rd						3rd	3rd			3rd	4th					
Synth bd.																		
Difference bd.																		
Tsd. bd.																		
Sn/ow bd.								2nd										
Analog Dist bd.																		
Channel chip Reg bd.						6th												6th

Appendix G

Handling Factoring Parts and TSPC Parts



Carrying TSPC parts to the tester



Holding TSPC part to be run on the tester

Appendix H

TSPC Corrective Action Code

- Retest issue corrective action codes
  - A1: TSPC show bad, will retest without Action
  - A2: TSPC show out, will retest without Action
- TSPC heads issue corrective action codes
  - H1: TSPC head desported, will change TSPC head
  - H2: TSPC head BAD, will change TSPC head
  - H3: TSPC bad assigned value, will change head and alert Technician/Engineer
  - H4: No spare part, will use other TSPC group to confirm tester
- Disk issue corrective action codes
  - D1: Disk bad on factored parameter, will change disk
  - D2: Disk bad on parameter OEF, will change disk
  - D3: Disk evaluate, no corrective action
  - D4: Disk re-used, will change disk
  - D5: Disk new model, will change disk if have new disk
- Factor part issue corrective action code
  - F1: Factor degraded or desported, will re-calibrate factor parts with old factor
  - F2: Factor degraded or desported, will re-calibrate factor parts with more factor
  - F3: Factor bad without spare, wait for new factor
  - F4: Change factor set or change factor inventory, will feedback to Technician/ Engineer
  - F5: Factor evaluate, no corrective action
- TSPC software error corrective action codes
  - E1: TSPC software calculate error, will re-install software
  - E2: TSPC data loss
  - E3: TSPC evaluate, no corrective action
- Tester issue corrective action codes
  - T1: Tester bad on factored parameter, will check tester by Troubleshooting Guide
  - T2: Tester bad on parameter OEF, will check tester by Troubleshooting Guide
  - T3: Tester bad on parameter RCR / RHR / WRR, will check Tester by Troubleshooting Guide
  - T4: Tester bad on parameter LSY, will check tester by Troubleshooting Guide

Appendix I

Repeatability

1st test order	2nd test order	3rd test order	4th test order
6	2	4	3
1	5	2	6
4	4	1	2
5	6	3	5
3	1	5	4
2	3	6	1
5th test order	**6th test order**	**7th test order**	**8th test order**
2	2	4	6
6	6	1	1
3	4	5	5
4	5	3	4
5	1	2	3
1	3	6	2

Repeatability test order by head number

	Part#1	Part#2	Part#3	Part#4	Part#5	Part#6
1						
2						
3						
4						
5						
6						
7						
8						
Mean						
Std.Dev.						
S_{pooled} =			Grand Mean =			
COV =						

Repeatability test data analysis table

Appendix J

Gage R&R

TEST PARAMETER CAPABILITY

PRODUCT	TOTAL PARAMETERS	CAPABLE PARAMETERS	%CAPABLE TEST	% CONTRIBUTION GR&R															
				FUNCTIONAL TEST									BIT ERROR RATE TEST						
				HFA_AVG	HFA_AVG (OD)	LFA_AVG	OVW_AVG	PW_UINCH	RD_WDT	WD_RD_OFF	MR_RES	WRITER_RES	OTC_AVG	OTC_AVG (OD)	OTC_OFF	OTC_EFL	OTC_EFL (OD)	PE_AVG	PE_EFL
CUDA 18XL	24	6	25%	4.2	[illegible]		[illegible]	7.0	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
DURANGO	16	3	19%			[illegible]	[illegible]		[illegible]				[illegible]		4.8	[illegible]		[illegible]	
U10	15	5	33%	4.6			[illegible]	[illegible]	3.1	6.9	[illegible]	[illegible]							[illegible]
U8	25	9	36%	5.7			[illegible]	[illegible]	5.0		[illegible]	7.6	[illegible]		3.5	[illegible]			
VAIL	15	7	47%			[illegible]	6.6	5.6	6.3	[illegible]	[illegible]	[illegible]							[illegible]

GAGE R&R PROCESS: 30 PARTS RUN 3 TIMES ACROSS 3 TESTERS USING COMMON DISC SURFACE

- GAGE IS GOOD (% CONTRIBUTION ≤ 2)
- GAGE IS ACCEPTABLE (% CONTRIBUTION ≤ 7.7)
- GAGE IS UNACCEPTABLE (% CONTRIBUTION > 7.7)

Gage R&R for LFA

Gage R&R Study - ANOVA Method

Gage name: VAIL GR&R STUDY
Date of study: 03/13/2000
Reported by: SURAPORN S.
Tolerance:
Misc:

Two-Way ANOVA Table With Interaction

Source	DF	SS	MS	F	P
NO	30	30912536	1030418	842.551	0.00000
TSTR_PART_NU	4	54824	13706	11.207	0.00000
TSTR_PART_NU*NO	120	146757	1223	3.143	0.00000
Repeatability	155	60313	389		
Total	309	31174430			

Gage R&R

Source	VarComp	StdDev	5.15*Sigma
Total Gage R&R	1007	31.739	163.46
Repeatability	389	19.726	101.59
Reproducibility	618	24.865	128.05
TSTR_PART_NU	201	14.189	73.08
TSTR_PART_NU*NO	417	20.419	105.16
Part-To-Part	102919	320.811	1652.17
Total Variation	103927	322.377	1660.24

Source	%Contribution	%Study Var
Total Gage R&R	0.97	9.85
Repeatability	0.37	6.12
Reproducibility	0.59	7.71
TSTR_PART_NU	0.19	4.40
TSTR_PART_NU*NO	0.40	6.33
Part-To-Part	99.03	99.51
Total Variation	100.00	100.00

Number of Distinct Categories = 14

Gage R&R for OVW

Gage R&R Study - ANOVA Method

Gage name: VAIL GR&R STUDY
Date of study: 03/13/2000
Reported by: SURAPORN S.
Tolerance:
Misc:

Two-Way ANOVA Table With Interaction

Source	DF	SS	MS	F	P
NO	30	1006.54	33.5513	274.758	0.00000
TSTR_PART_NU	4	39.01	9.7513	79.855	0.00000
TSTR_PART_NU*NO	120	14.65	0.1221	2.888	0.00000
Repeatability	155	6.55	0.0423		
Total	309	1066.75			

Gage R&R

Source	VarComp	StdDev	5.15*Sigma
Total Gage R&R	0.2375	0.48735	2.50985
Repeatability	0.0423	0.20564	1.05906
Reproducibility	0.1952	0.44184	2.27546
TSTR_PART_NU	0.1553	0.39409	2.02958
TSTR_PART_NU*NO	0.0399	0.19978	1.02886
Part-To-Part	3.3429	1.82836	9.41608
Total Variation	3.5804	1.89220	9.74484

Source	%Contribution	%Study Var
Total Gage R&R	6.63	25.76
Repeatability	1.18	10.87
Reproducibility	5.45	23.35
TSTR_PART_NU	4.34	20.83
TSTR_PART_NU*NO	1.11	10.56
Part-To-Part	93.37	96.63
Total Variation	100.00	100.00

Number of Distinct Categories = 5

Appendix K

Raw Data of Same Wafer Quad Analysis for LFA

Wafer List	Input(Time1)	Time 1	Input(Time2)	Time 2
PLCPA4	681	1251.28	135	1212.56
PLCP7K	402	1257.71	117	1308.4
PLCPE1	418	1306.49	115	1258.53
PLCOTM	350	1310.82	116	1246.64
PLCPFS	550	1292.86	156	1322.26
PLCPLW	635	1363.16	299	1308.31
OLCM2Y	423	1280.72	1782	1273.66
PLCP8G	230	1448.31	89	1421.91
PLCP0X	286	1321.99	377	1324.98
PLCP6S	759	1306.37	157	1302
PLCPE4	204	1185.13	375	1151.12
PLCPJA	80	1306.31	125	1286.84
PLCPD7	212	1403.34	117	1376.5
PLCPET	287	1249.23	285	1302.28
PLCPCA	1019	1290.13	106	1378.43
PLCPBX	257	1235.05	622	1235.15
PLCPFG	111	1177.11	137	1185.34
PLCP9W	333	1239.59	296	1272.97
OLCM2X	70	1296.83	1980	1205.29
PLCP3E	67	1343.31	2499	1313.4
PLCPB1	48	1300	73	1268.56
PLCOW1	150	1404.75	1797	1291.4
PLCOW0	182	1380.31	1970	1263.07
OLCLU7	183	1250.3	1331	1239.74
PLCOUP	61	1370.86	1286	1312.4
PLCOW3	84	1319.69	1925	1277.62
PLCO4Q	89	1362.25	2409	1394.52
PLCOFA	32	1440.34	1365	1295.68
PLCOPP	112	1385.04	1037	1323.67
PLCPCA	1025	1288.56	142	1366.49
PLCOUQ	158	1375.7	1388	1347.3
PLCOEM	203	1317.93	1114	1324.58
PLCOMJ	73	1460.86	1930	1377.63
PLCOMP	134	1311.39	1335	1277.67
PLCPLW	700	1357.61	299	1308.31
PLCPLX	556	1383.24	222	1443.61
PLCO66	117	1481.1	2322	1381.53
PLCOOI	185	1379.49	1219	1315.42
PLCOEL	149	1307.31	1639	1301.35
PLCOYD	290	1293.85	709	1302.64
PLCP9B	40	1282.26	199	1398.22

PLCO85	58	1375.36	1979	1397.12
PLCPCB	610	1351.53	117	1263.76
PLCP54	43	1319.23	1622	1331.02
PLCO99	98	1374.95	1716	1366.71
PLCO4S	58	1344.39	914	1330.57
PLCOOJ	252	1402.35	1692	1327.85
PLCOOW	243	1409.22	1298	1271.37
PLCOW2	211	1283.94	1858	1253.46
PLCPC9	28	1187.85	285	1309.46
OLCNQM	62	1178.4	716	1171.25
PLCOG5	127	1443.41	2446	1401.02
PLCPC8	107	1325.98	276	1374.11
PLCONM	48	1441.19	912	1450.58
PLCP9Z	204	1273.49	410	1230.81
OLCLU7	186	1251.32	1323	1240.16
PLCO99	82	1387.19	1750	1367.14
PLCPLW	694	1359.92	299	1308.31
PLCP6S	788	1304.41	157	1302
PLCPC8	97	1334.22	276	1374.11
OLCNQM	56	1170.78	711	1170.24
PLCOVO	151	1362.61	2103	1283.57
PLCORA	123	1296.54	2307	1303.71
PLCP98	318	1383.88	564	1400.44
PLCPDI	283	1302.7	789	1297.17
PLCPJ8	121	1355.3	406	1343.32
OLCM2Y	438	1261.44	1788	1272.36
PLCPE0	226	1349.72	267	1326.49
PLCPCL	71	1233.76	678	1277.62
PLCPFV	173	1288.33	658	1292.4
PLCP6S	776	1303.13	157	1302
PLCPA0	41	1392.9	666	1425.2
PLCPET	286	1236.38	285	1302.28
PLCP6T	85	1290.59	941	1335.94
PLCP6U	60	1310.86	31	1277.89
PLCPB2	143	1177.86	390	1256.61
PLCPD4	179	1448.15	656	1399.93
PLCP0X	323	1322.01	396	1326.7
PLCPCB	611	1347.69	117	1263.76
PLCPBL	47	1314.85	78	1204.56
PLCPGY	36	1167.69	587	1216.89
PLCPCA	858	1284.09	143	1367.18
PLCP6S	699	1308.54	114	1268.28
PLCPCB	518	1354.66	96	1267.38
PLCPLX	477	1375.96	215	1445.59
PLCP9W	272	1231.26	365	1266.68
PLCP9Z	145	1268.13	415	1229.07
PLCPLW	678	1358.2	259	1300.12

PLCPDO	199	1217.61	868	1200.4
PLCPE7	115	1181.31	360	1231.82
PLCPDP	93	1272.43	1071	1262.05
PLCP5U	117	1266.51	503	1233.33
PLCP82	92	1355.74	2289	1417.2
PLCPBW	161	1260.96	840	1235.14
PLCPDR	164	1312.58	549	1262.85
PLCP75	54	1376.13	2369	1378.45
PLCPDQ	65	1251.35	781	1261.46
PLCPE4	236	1181.38	374	1157.45
PLCPBY	33	1199.46	434	1251.41
PLCPBX	276	1226.45	672	1231.98

Appendix L

Raw Data of Same Wafer Quad Analysis for OVW

Wafer List	Input(Time1)	Time 1	Input(Time2)	Time 2
PLCOEJ	309	-31.54	1668	-32.31
PLCOMO	93	-34.85	1390	-33.29
PLCP8C	282	-33.93	1196	-33.86
PLCPCB	597	-31.89	110	-32.29
PLCPLX	549	-31.45	222	-32.35
PLCO5F	131	-31.94	1910	-32.74
PLCO5M	66	-33.39	1855	-32.5
PLCOFE	113	-31.63	2073	-30.75
PLCOEM	203	-32.68	1146	-32.03
PLCNRB	211	-33.4	1884	-32.67
OLCMAZ	184	-33.23	1225	-32.27
PLCOG5	117	-33.63	2470	-33.62
PLCOV4	420	-30.3	1710	-30.43
PLCOS0	104	-33.96	1449	-33.76
PLCPD4	183	-33.76	721	-33.51
PLCPDO	221	-31.96	881	-31.98
PLCOII	82	-31.94	1733	-32.26
PLCOM3	66	-30.03	2759	-31.34
PLCPFS	626	-33.72	161	-33.67
PLCOZQ	71	-33.63	1133	-33.2
PLCPB2	152	-31.02	410	-31.63
PLCPE6	188	-33.57	95	-33.13
PLCPGI	94	-32.64	153	-32.37
PLCOW2	212	-31.76	1850	-31.11
PLCOUQ	175	-30.67	1443	-29.73
PLCPGW	85	-32.15	770	-32.75
PLCP8C	211	-33.93	1147	-33.93
PLCOEJ	288	-31.25	1650	-32.32
PLCON1	140	-32.47	1678	-33.13
PLCO3N	86	-31.79	2271	-31.92
PLCP2A	76	-31.29	1109	-30.75
PLCPE0	235	-34.73	311	-33.9
PLCOFE	94	-31.59	2090	-30.72
PLCOMO	83	-34.95	1418	-33.33
PLCOQO	91	-31.96	1677	-32.56
PLCPD4	157	-33.85	721	-33.51
PLCOVR	75	-31.51	2533	-32.14
PLCOEI	149	-33.3	1378	-33.01
PLCOV4	402	-30.22	1727	-30.41
PLCPD7	214	-32.3	117	-30.39

PLCPFS	605	-33.7	161	-33.67
PLCPCN	118	-31.41	738	-31.92
PLCOCI	117	-31.58	2188	-30.75
PLCPFV	181	-31.75	768	-32.55
PLCPJW	63	-32	1314	-33.2
PLCNRB	200	-33.17	1806	-32.68
PLCOUQ	151	-30.4	1425	-29.74
PLCOYD	276	-32.87	686	-32.53
PLCO5F	128	-31.48	1788	-32.68
PLCO5H	120	-29.88	2175	-30.24
PLCOEM	201	-32.53	1146	-32.03
PLCP0M	74	-32.81	855	-32.53
PLCPGW	68	-31.73	770	-32.75
PLCPA4	809	-32.17	135	-31.82
PLCOOJ	242	-33.04	1681	-31.85
PLCPB2	143	-30.75	417	-31.66
PLCPGI	84	-32.43	153	-32.37
PLCOW0	200	-32.42	1909	-32.83
PLCOII	77	-31.6	1675	-32.22
PLCP8I	79	-30.74	352	-33.1
OLCLU7	203	-34.91	1264	-34.1
PLCOYF	138	-32	1099	-31.85
PLCOZQ	68	-33.18	1115	-33.2
PLCOV7	174	-30.71	1225	-30.35
PLCOMQ	227	-33.43	2144	-33.03
PLCOPM	34	-33.2	989	-32.46
PLCPGG	99	-33.45	120	-33.51
PLCOTN	66	-33.1	772	-33.01
PLCOUD	184	-32.45	1630	-31.97
PLCPHZ	107	-35.19	153	-34.22
PLCOEL	157	-32.34	1572	-32.24
PLCOMI	90	-31.24	2213	-32.69
PLCP0C	56	-30.37	1233	-31.75
PLCOM3	72	-30.2	2732	-31.3
PLCOQG	61	-31.28	1387	-30.41
PLCOHL	70	-33.79	2505	-33.44
PLCOOX	60	-30.27	1380	-30.1
PLCP98	514	-32.68	571	-32.54
PLCP6S	781	-34.09	157	-34.74
PLCPC8	89	-32.75	276	-34.23
PLCO3L	95	-33.02	2709	-32.26
PLCOW0	202	-32.68	1954	-32.87
PLCOW2	208	-31.8	1780	-31.09
PLCPE0	267	-34.48	311	-33.9
PLCOW3	105	-31.95	1879	-31.45
PLCO99	101	-30.99	1658	-31.55
PLCOPP	131	-31.4	1100	-30.99

PLCP9Z	202	-32.96	431	-32.36
PLCPCL	113	-32.68	661	-32.46
PLCP0C	58	-30.93	1213	-31.77
PLCPEV	27	-31.88	177	-32.34
OLCM2Y	497	-31.77	1763	-31.45
OLCMAW	99	-33.24	66	-33.5
PLCPCA	1045	-32.44	143	-34.13
PLCPJ8	189	-34.25	422	-33.93
PLCNYM	70	-32.32	179	-31.45
PLCPCB	590	-32	117	-32.19
PLCOMP	125	-33.34	1268	-32.96
PLCOOJ	236	-33.28	1646	-31.85
OLCMAW	80	-33.11	66	-33.5
PLCOG6	119	-32.87	3447	-33.94
PLCO3L	98	-32.64	2798	-32.26
PLCOW3	96	-31.78	1898	-31.48
PLCO4S	51	-32.39	884	-33.8
PLCOMJ	78	-33.74	1971	-31.92
OLCM2Y	488	-31.77	1762	-31.38
PLCOW0	205	-32.63	1935	-32.88
PLCP2B	310	-30.28	1065	-31.02
PLCP6S	797	-34.06	157	-34.74
PLCPDI	353	-32.53	789	-32.29
PLCPJ8	181	-34.13	380	-33.91
PLCO99	98	-30.7	1702	-31.57
PLCPLW	708	-33.14	299	-33.1
PLCO66	124	-31.72	2391	-32.37
PLCP0W	49	-32.85	85	-31.94
PLCPCA	1041	-32.41	143	-34.13
PLCOW2	213	-31.73	1810	-31.12
PLCPC8	105	-32.43	276	-34.23
PLCPDH	51	-33.07	68	-32.28
PLCONM	46	-34.74	962	-33.86
PLCOW1	186	-32.99	1649	-32.74
PLCP6U	75	-34.96	36	-34.28
PLCO85	67	-33.13	1995	-32.97
PLCOUO	27	-31.65	863	-30.47
PLCP98	541	-32.6	577	-32.52
PLCPCL	115	-32.62	672	-32.48
PLCO4M	25	-31.97	2639	-33.29
PLCO3K	204	-32.44	2548	-33.31
PLCO99	67	-31.51	1725	-31.57
PLCP5J	507	-33.1	1179	-33.47
PLCOC6	493	-32.3	1567	-32.1
PLCOKY	124	-31.37	2105	-30.73
PLCO8H	107	-32.05	2894	-32.89
PLCP8T	550	-34.77	1237	-33.91

PLCNUY	399	-32.9	903	-32.96
PLCOM0	531	-31.44	2628	-32.94
PLCP4P	792	-33.2	1063	-33.44
PLCP7T	84	-35.16	875	-34.53
PLCP4Q	363	-32.7	1049	-33.01
PLCP55	338	-32.4	1453	-33.67
PLCO8J	163	-31.29	2520	-31.53
PLCOHG	464	-32.43	2413	-32.79
PLCO72	28	-34.02	1955	-35.02
PLCP8S	710	-34.07	1097	-33.99
PLCO9B	320	-31.77	1464	-32.25
PLCOT7	327	-33.4	881	-33.7

Appendix M

Raw Data of Normality Test for LFA

Wafer List	Input(Own)	Mean(Own)	Std(Own)	Yield(Own)
PLCOYC	136	1360.28	198.35	99.26
PLCP1P	107	1519.7	221.82	99.07
PLCOV4	103	1157	187.56	98.06
PLCOD7	90	1332.5	157.44	100
PLCP2B	87	1376.86	207.14	98.85
PLCOOI	73	1410.24	138.42	100
PLCOOW	65	1440.09	155.46	100
PLCO4O	62	1379.11	125.6	100
PLCOCA	60	1398.83	223.8	98.33
PLCOMQ	59	1448.28	159.71	100
PLCOV6	59	1260.45	189.35	100
PLCOEU	52	1321.27	187.94	100
PLCOVO	50	1351.33	132.12	100
PLCON1	48	1359.85	188.01	100
PLCOUD	44	1334.08	153.83	100
PLCOYE	40	1422.06	190.53	100
PLCO8H	38	1529.41	209.17	100
PLCOE4	36	1196.34	303.75	94.44
PLCOHJ	36	1497.97	178.23	100
PLCOYD	35	1261.44	200.33	100
PLCP1O	35	1522.13	297.6	100
PLCO66	33	1443.48	187.83	100
PLCORA	33	1317.86	155.56	100
PLCOS2	32	1516.19	175.3	100
PLCOZO	32	1430.6	158.59	100
PLCOG6	31	1399.13	145.17	100
PLCONX	29	1397.09	205.84	100
PLCO4U	27	1480.04	294.39	96.3
PLCOEK	27	1388.84	100	100
PLCON2	27	1537.02	174.69	100
PLCOOL	27	1496.78	156.1	100
PLCOLU	26	1483.55	157.9	100
PLCOFD	25	1318.22	209.54	100
PLCOPR	23	1434.36	143.64	100
PLCO8L	22	1503.33	138.52	100
PLCOW2	20	1332.45	186.95	100
PLCP8F	20	1334.76	223.68	100
PLCON0	18	1283.33	224.83	100
PLCPJL	18	1338.18	230.52	100

Appendix N

Raw Data of Normality Test for OVW

Wafer List	Input(Own)	Mean(Own)	Std(Own)	Yield(Own)
PLCP8C	77	-34.25	1.23	100
PLCPA4	64	-33.23	1.38	100
PLCOEJ	63	-31.14	1.96	95.24
PLCOFE	47	-32.03	1.8	97.87
PLCPFV	47	-31.93	1.51	100
PLCPD4	45	-34.52	0.92	100
PLCOCI	41	-31.97	1.57	97.56
PLCOVR	41	-31.68	3.68	97.56
PLCO3N	40	-31.77	1.27	100
PLCPCN	40	-31.55	0.95	100
PLCOEI	38	-33.44	1.12	100
PLCPHZ	38	-35.01	0.78	100
PLCOQO	36	-32.14	1.7	97.22
PLCP0M	35	-33.15	2.24	100
PLCO5H	34	-29.96	1.51	91.18
PLCOS0	34	-34.16	0.88	100
PLCOUQ	34	-31.9	0.77	100
PLCNRB	30	-33.18	1.31	100
PLCOHL	30	-33.67	1.51	100
PLCOV4	30	-30.83	0.82	100
PLCOYD	27	-33.84	1.58	100
PLCOYF	27	-32.72	1.49	100
PLCPD7	27	-33.52	0.99	100
PLCOEM	26	-32.93	1.25	100
PLCOOJ	25	-33.88	1.23	100
PLCONN	24	-34.13	1.89	100
PLCOTN	23	-32.89	1.04	100
PLCOUD	22	-31.87	1.76	95.45
PLCPE0	21	-34.11	0.97	100
PLCPGI	21	-32.83	1.36	100
PLCOZQ	19	-33.42	1.08	100
PLCPJW	19	-31.87	1.1	100
PLCOV7	18	-30.67	0.96	100
PLCPGG	18	-34.02	1.24	100
PLCOII	17	-31.64	2.51	88.24
PLCP2A	17	-31.45	1.97	94.12
PLCPB2	16	-31.81	0.97	100
PLCON1	15	-32.55	2.06	93.33
PLCOMI	14	-31.6	1.36	100

Appendix O

Raw Data of Hypothesis Testing When SPC is In Control

Vail on LFA: In control, no significant difference on any pairs of comparison

➔ **Own tester & SD**

Wafer List	Input (Own)	Mean (Own)	Input (SD)	Mean (SD)
PLCPJ8	59	1354.45	33	1406.99
PLCPE0	37	1327.85	42	1311.96
PLCPFV	24	1254.72	94	1299.13
PLCPA0	20	1408.43	22	1438.56
PLCPA4	18	1190.78	39	1212.6
PLCPGY	18	1166.19	32	1215.17
OLCM2Y	17	1280.71	46	1250.83

➔ **Own tester & DS**

Wafer List	Input (Own)	Mean (Own)	Input (DS)	Mean (DS)
PLCPDI	99	1316.73	273	1291.19
PLCP98	78	1375.53	474	1404.96
PLCPJ8	59	1354.45	141	1391.98
PLCP0X	54	1363.48	290	1312.7
PLCPET	53	1225.67	272	1246.26
PLCPIV	45	1407.25	117	1429.26
PLCP87	41	1434.92	73	1332.06
PLCPCP	38	1297.01	129	1370.86
PLCPE0	37	1327.85	247	1364.87
PLCPCR	35	1285.76	92	1234.92
PLCP6T	33	1282.73	84	1298.49
PLCPCF	33	1347.66	92	1321
PLCP6S	30	1359.95	786	1303.91
PLCPFV	24	1254.72	194	1301.62
PLCPA0	20	1408.43	61	1437.96
PLCPA4	18	1190.78	818	1254.76
PLCPCB	18	1382.83	612	1348.86
PLCPGY	18	1166.19	31	1203
OLCM2Y	17	1280.71	491	1269.51

→ **Own tester & DD**

Wafer List	Input (Own)	Mean (Own)	Input (DD)	Mean (DD)
PLCPDI	99	1316.73	789	1297.17
PLCP98	78	1375.53	577	1401.04
PLCPJ8	59	1354.45	389	1340.6
PLCP0X	54	1363.48	396	1326.7
PLCPET	53	1225.67	285	1302.28
PLCPE0	37	1327.85	269	1338.34
PLCP6T	33	1282.73	941	1335.94
PLCP6S	30	1359.95	157	1302
PLCPB2	30	1058.01	413	1261.08
PLCPFV	24	1254.72	674	1296.21
PLCPA0	20	1408.43	675	1426.68
PLCPA4	18	1190.78	96	1212.54
PLCPCB	18	1382.83	117	1263.76
PLCPGY	18	1166.19	578	1216.05
OLCM2Y	17	1280.71	1786	1273.04

→ **DS & DD**

Wafer List	Input (DS)	Mean (DS)	Input (DD)	Mean (DD)
PLCPDI	273	1291.19	789	1297.17
PLCP98	474	1404.96	577	1401.04
PLCPJ8	141	1391.98	389	1340.6
PLCP0X	290	1312.7	396	1326.7
PLCPET	272	1246.26	285	1302.28
PLCPE0	247	1364.87	269	1338.34
PLCP6T	84	1298.49	941	1335.94
PLCP6S	786	1303.91	157	1302
PLCPB2	139	1210.78	413	1261.08
PLCPFV	194	1301.62	674	1296.21
PLCPA0	61	1437.96	675	1426.68
PLCPA4	818	1254.76	96	1212.54
PLCPCB	612	1348.86	117	1263.76
PLCPGY	31	1203	578	1216.05
OLCM2Y	491	1269.51	1786	1273.04
PLCPCL	113	1264.62	639	1279.49
PLCP0W	54	1361.43	83	1288.15
PLCPDH	53	1272.86	65	1217.87

Vail on LFA: In control, significant difference at least one pair of comparison

➔ **Own tester & DS**

Wafer List	Input (Own)	Mean (Own)	Input (DS)	Mean (DS)
PLCPCA	97	1246.7	959	1294.41
PLCPCW	44	1307.57	56	1383.61
PLCPAJ	42	1276.37	115	1333.52
PLCPHA	34	1245.6	107	1265.1
PLCPIT	33	1346.86	140	1468.98
PLCP6S	30	1214.75	786	1309.45
PLCPCX	30	1220.86	42	1233.86
PLCPHB	30	1258.84	108	1364.4
PLCPCB	27	1298.57	603	1352.12
PLCP44	24	1325.22	91	1370.93
PLCPDO	24	1199.98	217	1227.97
PLCPLX	23	1342.76	558	1381.29
PLCPIL	21	1385.96	135	1332.99
PLCPDQ	20	1241.88	65	1268.96

➔ **Own tester & DD**

Wafer List	Input (Own)	Mean (Own)	Input (DD)	Mean (DD)
PLCPCA	97	1246.7	143	1367.18
PLCP6S	30	1214.75	157	1302
PLCPCB	27	1298.57	117	1263.76
PLCPDO	24	1199.98	910	1200.16
PLCPLX	23	1342.76	207	1444.95
PLCPDQ	20	1241.88	822	1258.1

➔ **DS & DD**

Wafer List	Input (DS)	Mean (DS)	Input (DD)	Mean (DD)
PLCPCA	959	1294.41	143	1367.18
PLCP6S	786	1309.45	157	1302
PLCPCB	603	1352.12	117	1263.76
PLCPDO	217	1227.97	910	1200.16
PLCPLX	558	1381.29	207	1444.95
PLCPDQ	65	1268.96	822	1258.1
PLCPE6	194	1146.04	141	1042.68

Appendix P

Raw Data of Hypothesis Testing When SPC is Out of Control

Vail on LFA: Out of control, significant difference at least one pair of comparison

➔ Own tester & SD

Wafer List	Input (Own)	Mean (Own)	Input (SD)	Mean (SD)
PLCOOT	53	1349.91	43	1161.77
PLCO70	52	1327.94	24	1343.05
PLCO5C	40	1389.95	35	1461.89
PLCO4M	38	1143.43	22	1094.49
PLCO4Q	37	1322.21	25	1282.74
PLCO4O	33	1296.32	17	1397.04
PLCO5J	33	1194.86	27	1222.62
PLCO7V	31	1294.76	91	1234.02
PLCOCI	31	1364.79	81	1353.58
PLCO4R	27	1142.41	23	1110.36
PLCOII	26	1349.57	35	1289.44
PLCO85	25	1365.59	30	1327.59
PLCOG4	24	1248.67	67	1164.47
PLCOKS	23	1262.64	132	1223.03
PLCO3M	20	1509.02	24	1290.11
PLCO54	19	1214.05	109	1396.75
PLCOG6	19	1119.54	159	1258.94
PLCOLV	19	1361.19	71	1321.08
PLCOC8	18	1266.83	84	1164.27
PLCOGL	18	1263.58	34	1283.42
PLCON0	18	1247	24	1130.22
PLCOQD	17	1342.76	62	1128.16

➔ Own tester & DS

Wafer List	Input (Own)	Mean (Own)	Input (DS)	Mean (DS)
PLCOIJ	63	1228.63	789	1349.86
PLCOOT	53	1349.91	575	1394.07
PLCO4M	38	1143.43	553	1267
PLCO4Q	37	1322.21	189	1424.26
PLCO4O	33	1296.32	116	1427.1
PLCO5J	33	1194.86	274	1283.35
PLCO7V	31	1294.76	296	1342.54
PLCOCI	31	1364.79	101	1402.51
PLCOII	26	1349.57	120	1325.56
PLCO85	25	1365.59	130	1472.3
PLCOG4	24	1248.67	223	1399.69
PLCON3	23	1309.97	101	1424.41

PLCO9B	21	1254.23	50	1391.68
PLCOR0	19	1348.82	327	1339.02
PLCOC8	18	1266.83	77	1362.67
PLCOGL	18	1263.58	108	1363.66
PLCOM5	18	1294.86	117	1343.8
PLCON0	18	1247	121	1279.8
PLCOQD	17	1342.76	67	1321.55

→ **Own tester & DD**

Wafer List	Input (Own)	Mean (Own)	Input (DD)	Mean (DD)
PLCOIJ	63	1228.63	611	1338.54
PLCOOT	53	1349.91	1185	1425.61
PLCO70	52	1327.94	1426	1381.01
PLCO5C	40	1389.95	2139	1474.78
PLCO4M	38	1143.43	2200	1293.09
PLCO4Q	37	1322.21	2330	1393.48
PLCOM4	37	1182.7	772	1198.48
PLCO4O	33	1296.32	2338	1378.55
PLCO5J	33	1194.86	2672	1316.84
PLCO7V	31	1294.76	2041	1360.24
PLCOCI	31	1364.79	2195	1409.94
PLCO4R	27	1142.41	1950	1410.85
PLCOII	26	1349.57	1704	1334.03
PLCO85	25	1365.59	1894	1392.86
PLCOG4	24	1248.67	2044	1319.35
PLCOKS	23	1262.64	2617	1439.32
PLCON3	23	1309.97	1584	1319.9
PLCO9B	21	1254.23	1742	1390.43
PLCO3M	20	1509.02	2188	1478.24
PLCO54	19	1214.05	2808	1504.07
PLCOFD	19	1252.14	1782	1310.4
PLCOG6	19	1119.54	3302	1361.02
PLCOLV	19	1361.19	2567	1452.1
PLCOR0	19	1348.82	1340	1281.24
PLCOC8	18	1266.83	1774	1351.24
PLCOGL	18	1263.58	1365	1320.51
PLCOM5	18	1294.86	1078	1239.49
PLCON0	18	1247	1599	1247.04
PLCOQD	17	1342.76	1073	1273.73

➔ **DS & DD**

Wafer List	Input (DS)	Mean (DS)	Input (DD)	Mean (DD)
PLCOIJ	789	1349.86	611	1338.54
PLCOOT	575	1394.07	1185	1425.61
PLCO70	580	1403.14	1426	1381.01
PLCO5C	144	1514.17	2139	1474.78
PLCO4M	553	1267	2200	1293.09
PLCO4Q	189	1424.26	2330	1393.48
PLCOM4	505	1192.7	772	1198.48
PLCO4O	116	1427.1	2338	1378.55
PLCO5J	274	1283.35	2672	1316.84
PLCO7V	296	1342.54	2041	1360.24
PLCOCI	101	1402.51	2195	1409.94
PLCO4R	93	1487.48	1950	1410.85
PLCOII	120	1325.56	1704	1334.03
PLCO85	130	1472.3	1894	1392.86
PLCOG4	223	1399.69	2044	1319.35
PLCO8J	87	1604.62	2669	1589.83
PLCOKS	269	1408.74	2617	1439.32
PLCON3	101	1424.41	1584	1319.9
PLCO9B	50	1391.68	1742	1390.43
PLCO3M	135	1510.15	2188	1478.24
PLCO54	70	1424.37	2808	1504.07
PLCO5F	128	1558.97	1953	1493.67
PLCOFD	255	1192.09	1782	1310.4
PLCOG6	152	1366.74	3302	1361.02
PLCOLV	106	1542.37	2567	1452.1
PLCOR0	327	1339.02	1340	1281.24
PLCOC8	77	1362.67	1774	1351.24
PLCOGL	108	1363.66	1365	1320.51
PLCOM5	117	1343.8	1078	1239.49
PLCON0	121	1279.8	1599	1247.04
PLCO3U	89	1531.01	1987	1476.95
PLCOQD	67	1321.55	1073	1273.73
PLCO7S	61	1320.19	817	1316.21
PLCOLB	541	1550.27	1551	1567.48
PLCOCH	103	1459.6	2229	1415.02
PLCON1	101	1419.34	1746	1354.74
PLCONQ	197	1372.48	1652	1342.92
PLCOHH	133	1360.18	2549	1312.51
PLCOQU	118	1423.92	1649	1372.5
PLCO5K	100	1284.45	1540	1260.87
PLCOB9	121	1409.32	1533	1290.34
PLCO7F	145	1512.51	1227	1469.17
PLCOQV	129	1421.79	2120	1397.28
PLCOK3	208	1393.47	2036	1474.33

Vail on LFA: Out of control, no significant difference on any pairs of comparison

→ **Own tester & SD**

Wafer List	Input (Own)	Mean (Own)	Input (SD)	Mean (SD)
PLCOEJ	89	1331.38	46	1452.75
PLCNRB	56	1218.47	36	1197.57
PLCOMI	25	1257.37	92	1440.21
PLCOCI	24	1483.1	91	1398.94
PLCOEL	24	1260.27	31	1313.54
PLCOS0	24	1366.44	44	1406.81
PLCO5H	22	1278.85	21	1363.14
PLCOG5	19	1423.37	27	1404.07

→ **Own tester & DS**

Wafer List	Input (Own)	Mean (Own)	Input (DS)	Mean (DS)
PLCOEJ	89	1331.38	262	1369.21
PLCNRB	56	1218.47	180	1232.66
PLCPHZ	40	1278.96	82	1296.74
PLCPCN	31	1327.78	125	1326.4
PLCOUQ	27	1333.89	160	1390.4
PLCPE0	26	1345.17	258	1361.54
PLCOMI	25	1257.37	79	1308.91
PLCOCI	24	1483.1	130	1471.55
PLCOEI	24	1350.96	166	1404.13
PLCOEL	24	1260.27	147	1329.03
PLCOS0	24	1366.44	102	1399.65
PLCP2A	23	1409.04	102	1392.72
PLCO5H	22	1278.85	127	1293.88
PLCOOX	22	1253.39	49	1336.84
PLCPA4	22	1327.83	814	1251.37
PLCPGG	22	1329.17	94	1324.17
PLCOW2	21	1244.21	206	1281.3
PLCOEM	20	1344.41	210	1323.14
PLCOG5	19	1423.37	121	1449
PLCO5M	18	1445.53	78	1360.62
PLCONN	18	1548.35	130	1536.91
PLCPGI	17	1223.31	93	1279.83

→ **Own tester & DD**

Wafer List	Input (Own)	Mean (Own)	Input (DD)	Mean (DD)
PLCOEJ	89	1331.38	1657	1369.75
PLCNRB	56	1218.47	1854	1219.05
PLCPHZ	40	1278.96	153	1167.58
PLCPCN	31	1327.78	738	1282.79
PLCOUQ	27	1333.89	1443	1349.86
PLCPE0	26	1345.17	311	1334.77
PLCOMI	25	1257.37	2179	1376.42
PLCOCI	24	1483.1	2163	1402.79
PLCOEI	24	1350.96	1378	1348.19
PLCOEL	24	1260.27	1608	1301.12
PLCOS0	24	1366.44	1445	1423.45
PLCP2A	23	1409.04	1109	1311.19
PLCO5H	22	1278.85	2207	1299.96
PLCOOX	22	1253.39	1424	1306.02
PLCPA4	22	1327.83	135	1212.56
PLCPGG	22	1329.17	120	1331.24
PLCOW2	21	1244.21	1852	1253.14
PLCOEM	20	1344.41	1146	1326
PLCOG5	19	1423.37	2481	1401.56
PLCO5M	18	1445.53	1873	1327.21
PLCONN	18	1548.35	1398	1440.95
PLCPGI	17	1223.31	153	1211.49

→ **DS & DD**

Wafer List	Input (DS)	Mean (DS)	Input (DD)	Mean (DD)
PLCOEJ	262	1369.21	1657	1369.75
PLCNRB	180	1232.66	1854	1219.05
PLCPHZ	82	1296.74	153	1167.58
PLCPCN	125	1326.4	738	1282.79
PLCOUQ	160	1390.4	1443	1349.86
PLCPE0	258	1361.54	311	1334.77
PLCOMI	79	1308.91	2179	1376.42
PLCOCI	130	1471.55	2163	1402.79
PLCOEI	166	1404.13	1378	1348.19
PLCOEL	147	1329.03	1608	1301.12
PLCOS0	102	1399.65	1445	1423.45
PLCP2A	102	1392.72	1109	1311.19
PLCO5H	127	1293.88	2207	1299.96
PLCOOX	49	1336.84	1424	1306.02
PLCPA4	814	1251.37	135	1212.56
PLCPGG	94	1324.17	120	1331.24
PLCOW2	206	1281.3	1852	1253.14
PLCOEM	210	1323.14	1146	1326
PLCOG5	121	1449	2481	1401.56
PLCO5M	78	1360.62	1873	1327.21

PLCONN	130	1536.91	1398	1440.95
PLCPGI	93	1279.83	153	1211.49
PLCOOJ	252	1402.64	1679	1326.67
PLCPJW	84	1385.06	1314	1346.58
PLCO8K	52	1530.95	1273	1437.19
PLCOMQ	229	1414.6	2132	1283.16
PLCOYF	143	1372.74	1099	1377.83
PLCOTN	67	1406.55	778	1311.67
PLCPFS	632	1299.95	161	1326.41
PLCPGW	84	1244.46	770	1264.93

Appendix Q

Raw Data of 2-way ANOVA for LFA

Wafer List	Input (Own)	Mean (Own)	Input (DS)	Mean (DS)
PLCOIJ	63	1228.63	789	1349.86
PLCOOT	53	1349.91	575	1394.07
PLCO4M	38	1143.43	553	1267
PLCO4Q	37	1322.21	189	1424.26
PLCO4O	33	1296.32	116	1427.1
PLCO5J	33	1194.86	274	1283.35
PLCO7V	31	1294.76	296	1342.54
PLCOCI	31	1364.79	101	1402.51
PLCOII	26	1349.57	120	1325.56
PLCO85	25	1365.59	130	1472.3
PLCOG4	24	1248.67	223	1399.69
PLCON3	23	1309.97	101	1424.41
PLCO9B	21	1254.23	50	1391.68
PLCOR0	19	1348.82	327	1339.02
PLCOC8	18	1266.83	77	1362.67
PLCOGL	18	1263.58	108	1363.66
PLCOM5	18	1294.86	117	1343.8
PLCON0	18	1247	121	1279.8
PLCOQD	17	1342.76	67	1321.55

Appendix R

Raw Data of 2-way ANOVA for OVW

Wafer List	Input (Own)	Mean (Own)	Input (DS)	Mean (DS)
PLCP8C	77	-34.25	240	-33.77
PLCPA4	64	-33.23	772	-32.13
PLCOEJ	63	-31.14	288	-31.56
PLCOFE	47	-32.03	94	-31.18
PLCPFV	47	-31.93	171	-31.65
PLCPD4	45	-34.52	158	-33.49
PLCOCI	41	-31.97	113	-31.8
PLCOVR	41	-31.68	78	-30.99
PLCO3N	40	-31.77	102	-31.76
PLCPCN	40	-31.55	116	-31.49
PLCOEI	38	-33.44	152	-33.27
PLCPHZ	38	-35.01	84	-35.19
PLCOQO	36	-32.14	101	-31.84
PLCP0M	35	-33.15	68	-32.33
PLCO5H	34	-29.96	115	-29.85
PLCOS0	34	-34.16	92	-33.59
PLCOUQ	34	-31.9	153	-30.33
PLCNRB	30	-33.18	206	-33.23
PLCOHL	30	-33.67	51	-33.71
PLCOV4	30	-30.83	413	-30.22
PLCOYD	27	-33.84	285	-32.79
PLCOYF	27	-32.72	131	-31.98
PLCPD7	27	-33.52	226	-32.16
PLCOEM	26	-32.93	204	-32.54
PLCOOJ	25	-33.88	243	-33.01
PLCONN	24	-34.13	124	-33.26
PLCOTN	23	-32.89	58	-33.01
PLCOUD	22	-31.87	177	-32.34
PLCPE0	21	-34.11	263	-34.52
PLCPGI	21	-32.83	89	-32.41
PLCOZQ	19	-33.42	69	-33.21
PLCPJW	19	-31.87	81	-32.2
PLCOV7	18	-30.67	174	-30.73
PLCPGG	18	-34.02	98	-33.36
PLCOII	17	-31.64	84	-31.72
PLCP2A	13	-31.45	108	-31.09

BIOGRAPHY

Achareeya Rakmitr was born on October 15th, 1975 in Bangkok, Thailand. She graduated from Sirindhorn International Institute of Technology, Thammasat University in 1998 with a Bachelor Degree in Industrial Engineering.