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APPENDICES

APPENDIX A

Hard Disk Drive Process Description

Hard Disk Drive Process Description

1. Auto Motor to Base assembly

The AMTB machine will assemble the motor, crash stop, bottom VCM components and screw at the base.

2. Auto Media Installer

The auto media installer will pick up the media and disk clamp and place and screw them on to the base and to append the media including media bias to prevent the media balance plate to sway when the motor is rotating.

3. Auto Wire Balance

Is the step that the balance value of the drive will be checked with the auto wire balance machine? If the balance value is more than the specification, the wire will be input into the disk clamp for the drive balance and check the balance again before sending to the next station.

4. Auto Head Stack assembly

Is the procedure before installing the head stack and Top VCM by using the AHSA and there will be a lift of the HSA from the HSA Tray and TVCM to place in the drive.

5. FCC station

Operator will use the EDR to screw at the TVCM and Flex connector to append to the base.

6. Slow Spin Merge

The SSM machine will input the transfer comb into the area between HGA and unplug the shipping comb before merging the HSA to parking zone area of the media by slowly spinning the motor.

7. Auto Top Cover

Is the final procedure of the HDA assembly process in the assembly line and the ATC machine will place and locate the top cover in line with the base and screw to fasten the top-cover with the base?

8. Servo Writer

The HDS machine will write the servo transmission code onto the media plate. Each STW can write the code onto each drives simultaneously for 9-12 sets per each time.

9. Seal Install

The operator will place the seal onto the specified location and then placing the drive onto the machine to firmly press on the seal.

10. Leak test

Every drive will be assessed its tolerance against leakage and pressure with the leak tester by letting the air flow passes the breather filter.

Manufacturing procedure as below:

1. Line controller

The line controller to serve as a load station and function to initial the line and load the work (MBA) on to the pallet. Besides, it functions as collecting the rejected work from various work cells.

2. Work cell # 1 Disk spacer install

The disk spacer tools will assembly the disks and spacer on the motor hub Function to pick up the media and spacer onto the work (MBA)

3. Work cell # 2 Biases / Clamp install

The bias / clamp tool will be used for automatic installation of the disk clamp onto the disk stack biasing the disk, and tighten the clamp screwed to a defect value of the disk clamp. The disk clamp will be fed into the work cell by an operator via the tray.

Function to pick up the disk clamp and bias the media and screw it simultaneously to derive the defection value as of the specification. Defecting as specified by inputting the disk clamp. The personnel will have to place the tray for the disk clamp onto the material work cell.

4. Work cell # 3 Balance Verify & Filter install

The Balance Verify & Filter tool supports a dual Function operation. It's a test cell that will ascertain the shacking forces that result from imbalance of the media. It will also accommodate the manual Installation of (2) filter into the base. Measure the imbalance value. After that, the officer will fix 2 filters at the base of the job with the imbalance value that that meets the specification.

5. Work cell # 4 Ramp Install

The ramp tool support a dual function installation operation It will be used for automatic installation of the ramp into the motor base. It will also accommodate the automatic inspection of the Ramp Gap between the media edges and the Ramp edges. The Ramp will be presented to the equipment by an Operator via tray

Function as picking up the ramp and screw to get the pre-defined value. After that, the range between the media rim and the ramp edge will be measured and compared to the specification. To input the ramp, the personnel must place the tray for the ramp onto the material work cell.

6. Work cell # 5 HSA / VCM install

The HS A / VCM tool will use for automatic installation of the HS A and VCM onto the base .The HS A and via Tray VCM will be fed into work cell by operator.

Function to pick up the HS A and VCM to put on the base and then fasten the screw to get the pre-defined value. To input the HAS/VCM, the personnel will have to input the HAS and VCM tray onto the material work cell.

7. Work cell # 6 Fasten VCM / FCC screw

The fasten VCM / FCC screw will be used for tightening the VCM / FCC screw Function to fasten the screw of the VCM and FCC to be firmly fixed.

8. Work cell # 7 Latch / Interposer install

The Latch / Interposer will be used for automatic Installation of the Latch and Interposer onto a base. The Latch and Interposer will be fed into work cell by operator via tray.

Function to pick up the latch and the interposer and then place onto the motor- base. To input the latch and interposer, the personnel will place the tray for the latch/interposer onto the material work cell.

9 Work cell # 8 HSA Merge / ODCS Install

The HAS Merge / ODCS tool will be used for automatically merging the previously installed HSA with the Ramp. It will also automatically install OD crash stop. This is a two station work cell the Site of the assembly processes and the second an Inspection station. The crash stop will be fed by a sweep feeder.

Function to slide the HAS into the ramp and feed the ODCS. The machine consists of 2 parts. The first part function as the job assembly and the second part, which is the next step of the first, will measure the range between the edge of the first head and the second head

Work cell # 9 Top cover install

Is the assembly process of the top cover onto the base? The machine will locate and position the top cover to align with the base and fasten the screw to append the top cover with the base.

Servo Writer

The HDS will write the servo code onto the media by each STW will write the code onto 9-12 drives simultaneously.

Seal Install

The operator will input the seal on the location. After that, the machine will press on the seal so as it is firmly attached.

Leak test

Every dive will be checked the leakage and pressure tolerance with the leak tester by letting the air flow through the breather filter.

Appendix B

Training Class Content

Applied Just-in-Time technique to production line

Just in time is one of the techniques using in Lean Manufacturing to improve the return on investment of a business by eliminating waste and its associated costs. From the analysis of typical machine productivity carefully, there are a number of time wasting events become apparent, these include the time taken by the operator to load/unload the item being processed, transfer the part program to the motion controller, the operator to make the machine operate, the down time of the machine and etc.

To minimize the unit cost with high quality standard product, Just-In-Time production system is the effective system to achieve the key customer satisfaction. JIT is capable to support high volume ramp up as seasonal selling target and to control inventory level with Pull system.

Statistical Process Control (SPC)

Statistical Process Control (SPC) is a powerful collection of problem-solving tools useful in achieving process stability and improving capability through the reduction of variability. SPC can be applied to any process. Its seven basic tools, often called "the magnificent seven," are Histogram, Check sheet, Pareto chart, Cause-and-effect diagram, Process flow charting, Scatter diagram and Control chart.

Control charts are the simplest type of on-line statistical process control (SPC). A major objective of control chart is to quickly detect the occurrence of assignable causes of process shifts so that investigation of the process and corrective action may be undertaken before many nonconforming units are manufactured. Control charts may also be used to estimate the parameters of a production process, and, through this information useful in improving the process. The control chart is an effective tool in reducing variability as much as possible.

Design/re-design and machine adjustment

Technology led the process change, go to market faster, improve quality and increase competitive advantage. New machine design and adjustment required to reduce the processing time to market and increase competitive advantage with automation system.

The purpose of the Design for Assembly/ Manufacturing Analysis (DFA/MA) is twofold, firstly to reduce costs of manufactured products by simplification, making the product easier to produce. Secondly, reduction in the cost and time to design and develop products by reducing the number of design changes as the product goes into production.
Design for assembly/ Manufacturing Analysis benefits:

- Reduced parts count, thus lower work in progress (WIP), design, sourcing, stock and production control costs
- Systematic component costing and process selection
- Lower component and assembly costs
- Reliable and efficient assembly processes
- Standardization of components, assembly sequence and methods across a range of related products
- Encourages concurrent engineering
- Lower level of engineering change
- Reduced time to market
- Improved product quality and reliability
- Education and training

APPENDIX C

Interview Contents

Section 1: How would you think the employees would rate the following General Issues about ABC Company?

- The employees of our company fully understand the aims and goals of our company.
- The employees of our company understand that our company values human resources more than other resources.
- The employees of our company obtain sufficient information on company policies and programs.
- The employees of our company agree that our company is managed well.
- The employees of our company agree that two-way communication in our company works properly.
- The employees of our company observe that everybody in our company is enthusiastic to express new ideas.
- The employees of our company think that the most competent people are promoted in our company.
- The employees of our company know that compensation and benefits or our company are good or better compared to other companies in the same industry.

Section 2: How would you think about the opinions of the employees about Job, Advancement, and Work Place?

- In our organization the employees are well informed about information related to their job (Changes result…)
- In our organization the employees think there are enough resources (instrument, spare parts, and persons) to do their jobs.
- In our organization the employees think that their jobs challenge them to use their skills, knowledge, and ability.
- In our organization the employees see that their jobs provide them with chances for outstanding and measurable performance.

- In our organization the employees feel better and work more effectively in teams.
- In our organization the employees are willing to share knowledge and work with each other.
- In our organization the employees feel to be treated with respects and courtesy by the others at the company.
- In our organization the employees believe the company offers good chances for their continued growth and advancement/promotions.

Section 3: The following statements deal with Training and Development

- Adequate training in job skills is provided to enable me to understand my current work and to do effectively.
- In our company there are enough training courses for me to increase my suitability for a better job.
- In our company schedules of training courses are convenient for me to participate in.
- Schedules of my work/job allow me to follow courses and class outside company for my long term advancement.
- Problem-solving training courses are sufficiently provided to me to my job.

APPENDIX D

Hard Disk Drive Component

Harddisk

- ฮาร์ดดิสก์ ทำมาจากแผ่นจานแม่เหล็กกลม ๆ ที่เคลือบสารแม่เหล็กไว้สำหรับเก็บข้อมูล (Platter) ซ้อนกันหลาย ๆ ชั้นขึ้นอยู่กับความจุ
- จานแม่เหล็กนี้จะติดกับมอเตอร์ที่ทำหน้าที่หมุนแผ่นจานแม่เหล็กนี้ โดย จะมีแขนที่มีหัวอ่าน ข้อมูลติดอยู่ตรงปลาย (actuator) ทำหน้าที่อ่านข้อมูลจาก จานแม่เหล็กที่หมุนอยู่ ด้วยความ เร็วคงที่
- ความเร็วของฮาร์ดดิสก์ เช่น ฮาร์ดดิสก์แบบ 5,400 รอบ , 7,200 รอบ หรือ 10,000 รอบ ก็คือความเร็วของการหมุนจานแม่เหล็ก

การทำงานของ Harddisk

- ใช้ "หัวอัด (Head)" เพื่อใช้อัด หรือ บันทึกรวมทั้ง อ่านข้อมูล จากผิวหน้า ของ platter
- Head นี้ จะต่ออยู่กับ แขน หรือ arm เพื่อยื่น Head ไปยังพื้นผิว ของ Platter โดย แต่ละ Platter จะประกบด้วย Head และ Arm นี้ทั้งบนและล่าง ดังนั้น หากฮาร์ดดิสก์หนึ่งๆ ประกอบไปด้วย 5 Platter จึงประกอบไปด้วย Head และ Arm อย่างละ 10 ตัว
- Head อ่านข้อมูล โดยอาศัย การสัมผัส กับสนามแม่เหล็ก ซึ่งจะมี คลื่นแม่เหล็ก ส่งข้อมูล ออกมา บริเวณใต้ Head
- เมื่อ ต้องการบันทึก Head จะใช้สนามแม่เหล็ก ไปเปลี่ยน ค่าแม่เหล็กไฟฟ้า บริเวณ Platter ให้เปลี่ยนแปลง ตาม ซึ่งจะมี การบันทึก ข้อมูล เก็บไว้ ที่ track และ sector
- หากระบบ ปฏิบัติการ ต้องการไฟล์ จาก track หรือ sector ไหน มันก็จะ ส่งคำขอ ไปที่ hard drive เพื่อดึงเอา ข้อมูลนั้นมา

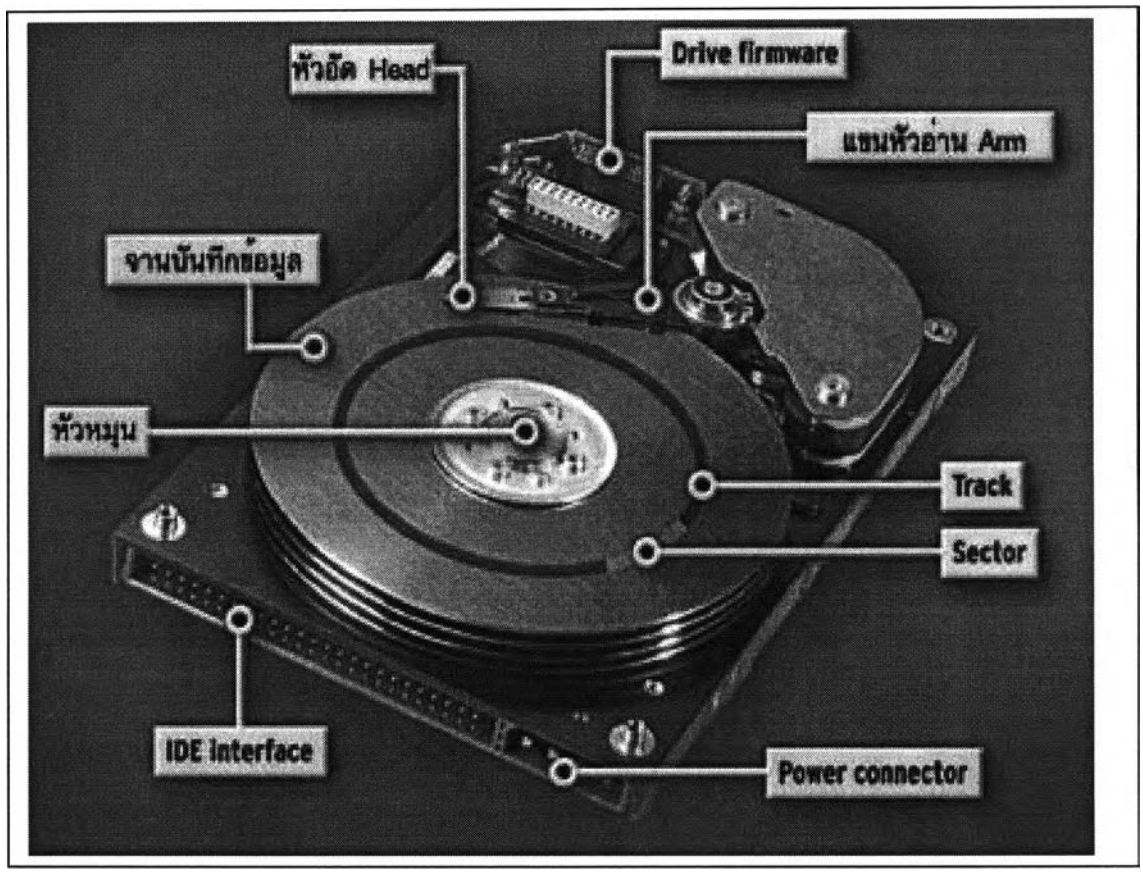
Hard Disk Access Time

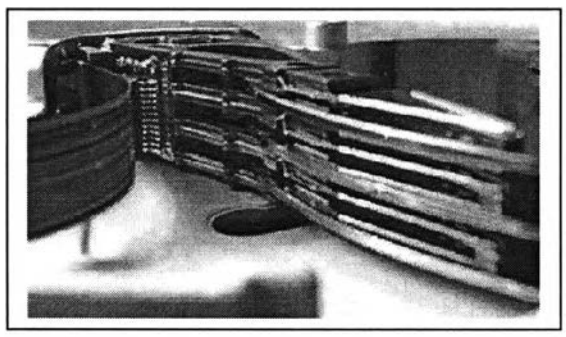
Access Time คือ เวลาตั้งแต่คอมพิวเตอร์เริ่มค้นหาข้อมูล จนกระทั่งได้รับข้อมูลตามต้องการ ประกอบด้วย

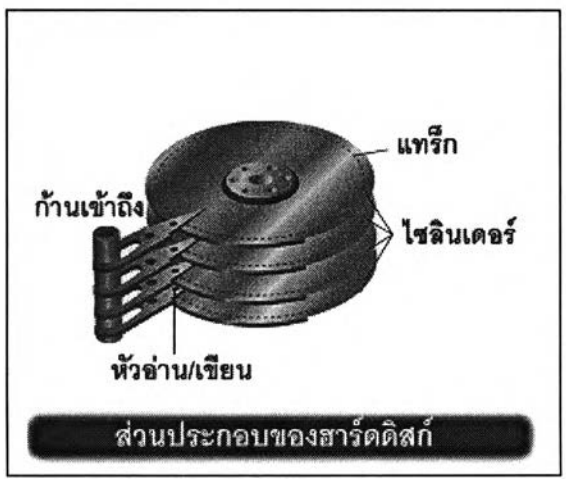
- ระยะเวลาค้นหา (Seek Time) หัวอ่านวิ่งผ่านไปยัง cylinder ที่ต้องการ
- การเลือกหัวอ่าน/บันทึก (R/W Head Switching) เลือกแทรคที่ต้องการ
- ความล่าช้าในการหมุน (Rotational Delay) ข้อมูลหมุนมาตรงกับ Head
- การเคลื่อนย้ายข้อมูล (Transfer Rate) จากแผ่นไปหน่วยความจำ

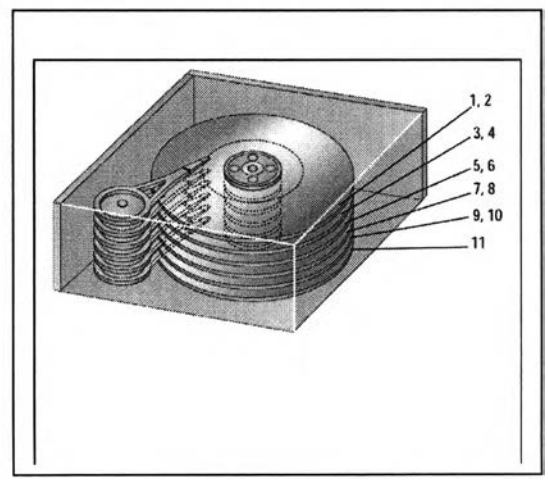
Hard Disk Components

- Spindle หัวหมุน ใช้ motor
- Access Arm แขนหัวอ่าน
- Read/Write Head หัวอ่าน/บันทึก
- Control Unit ตัวควบคุมการทำงาน
- *Magnetic Disk (จานแม่เหล็ก)*


หัวอัด Head
Drive firmware
แขนหัวอ่าน Arm
จานบันทึกข้อมูล
หัวหมุน
Track
Sector
IDE interface
Power connector




แทร็ก
ก้านเข้าถึง
ไซลินเดอร์
หัวอ่าน/เขียน
ส่วนประกอบของฮาร์ดดิสก์


1, 2
3, 4
5, 6
7, 8
9, 10
11

APPENDIX E

Check List

Example 1: Check List for New Process Implementation

AGS / Paralellism and Flatness / Centering.

Tool ID : _____ Module :_____ Date Perform :_____
Tooling Tech : _____ Product :_____

1. Comb bent Error ☐ OK ☐ Not OK.
2. Center pin engage ☐ OK ☐ Not OK.

	New value	Ref Value		
3. Comb origin			☐ With in tolerance	☐ Without tolerance
4. Z- height encoder			☐ With in tolerance	☐ Without tolerance
5. Z- height Sensor			☐ With in tolerance	☐ Without tolerance
6. Comb latch (landing)			☐ With in tolerance	☐ Without tolerance
7. Push pin origin			☐ With in tolerance	☐ Without tolerance
8. Push pin latch.			☐ With in tolerance	☐ Without tolerance

9. Push pin height check ☐ Too high. ☐ Too low. ☐ OK..Pass.

* For parameter with out tolerance please repeat untill with in tolerance and record final value below.

Parameter	New Value	Ref value.	New Value	Ref value.	New Value	Ref value
3. Comb origin						
4. Z- height encoder						
5. Z- height Sensor						
6. Comb latch (landing)						
7. Push pin origin						
8. Push pin latch.						
9. Push pin height check						

9. Flatness of load comb._____um
10. Paralellism of load comb. _____um.
11. Check when tower move down transfer comb not hit HSA. ☐ OK ☐ Not OK.
12. Check latch pusher. ☐ OK ☐ Not OK.

13Media height sensor check..

Media Height Sensor Check (bring tower to get ready position)

	1st reading	2rd reading	3nd rading
1X			
2X			
3X			

Example 2: Check List for New Process Implementation

Station.	OK	NOT OK	Other (fixing)
1.AMTB (Automotor To Base)			
1.1 Turn table time less than 0.8 sec. (monitor display, RT)			
1.2 Operating time less than 16.0 sec. (monitor display, CT)			
1.3 Obsorber condition good.			
1.4 Repeat 3 drives operating without obstruction.			
2. AMI (Auto Media Install)			
2.1 Tool operating order is correct as below step - Turn drive in. - Pick up media - Pick up disk clamp and install screw. - Install media to drive. - Install disk clamp and drive screw. - Turn drive out.			
2.2 Time operating less than 17.0 sec.			
2.3 Drive elevator working on good condition.			
2.4 Repeat 3 drives operating without obstruction.			
3. AWB (Auto Wire Balance)			
3.1 Confirm gauge reading within spec.			
3.2 Check sampling rate setting is 10%			
3.3 Operating time less than 16.0 sec.			
3.4 Repeat 3 drives operating without obstruction.			
4. AHSA (Auto HSA Install)			
4.1 Check all equipments of tool			
4.2 Repeat 3 drives operating without obstruction.			
4.3 Operating time less than 17.3 sec.			
5.SSM (Slow Spin Merge)			
5.1 Check time tower move up and move down, 1.5 sec of each.			
5.2 Operating time less than 16.5 sec.			
5.3 Calibrate tool.			
5.4 Repeat 3 drives operating without obstruction.			
6. ATC (Auto Top Cover)			
6.1 Turn table time less than 0.8 sec. (monitor display, RT)			
6.2 Operating time less than 16.0 sec. (monitor display, CT)			
6.3 Obsorber condition good.			
6.4 Repeat 3 drives operating without obstruction.			

ตารางการตรวจเช็ค ( ) Machine ( ) Facility ( ) Accessories **ประจำวัน** ( ) **อื่น ๆ จุดควบคุม**

ชื่อเครื่องจักร : **รหัส :** **แผนก :** **ส่วน :** **ฝ่าย :** **ประจำเดือน :**

จุดปฏิบัติงาน :

รายการที่ตรวจสอบ	หัวข้อที่ตรวจสอบ	อุปกรณ์/สิ่งที่ใช้ตรวจสอบ	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
บันทึกการตรวจสอบ.....																																	
รายชื่อพนักงานดูแลเครื่องจักร		เวลาที่เครื่องจักรเสีย																															
.....		พนักงานตรวจเช็ค																															

ตรวจสอบโดย...../.....ผู้ควบคุมเครื่องจักร

หัวหน้าหน่วย / หัวหน้าแผนก

ตรวจสอบโดย.....พนักงานซ่อมบำรุง

...../...../.....

หมายเหตุ 1. สัญลักษณ์ / = ปกติ สัญลักษณ์ X = ไม่ปกติ สัญลักษณ์ S = เครื่องจักรไม่ได้ทำงาน

สัญลักษณ์ S/ = เครื่องจักรทำงานงานครึ่งวัน

2. ทำการตรวจสอบก่อนลงมือปฏิบัติงานทุกวัน

3. ส่งคืนแผนกซ่อมบำรุงทุกวันที่ 1 ของเดือน หลังการตรวจเช็ค

FO-MAM-007 : R1 31/10/48

Checking Table ( ) Machine ( ) Facility ( ) Accessories daily ( ) Other

Machine Name : Auto Motor To Base (AMTB) Code : **Department : Tooling** **Section : Online prod.** **Site : Factory** **Month :**

LOCATION : PRODUCTION LINE

CHECKED POINT	ITEM	INSTRUMENT/ CHECKING TOOL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Screw feeder	check condition good/bad	Naked eye																											
Bit driver	check condition good/bad	Naked eye																											
Screw presentor	check alignment	Set up gauge																											
Screw vacuum	Test vacuum	Screw																											
Bit to finder value	Value in specification	Tool data																											
Turn table	check condition good/bad	Naked eye																											
Absorber	check condition good/bad	Naked eye																											
Latch lock	check condition good/bad	Naked eye																											
Motor bar	check alignment	Set up gauge																											
Wiring	check condition good/bad	Naked eye																											
Operating	No obstruction	Screw/base/motor																											
Record.....																													
Reponsible Technician		Time machine down																											
.....		Technician																											

To check up by...../.....Controller
Leader / Supervisor

To check up by.....Tooling maintenance
...../...../.....

Remarks 1. Mark = Normal Mark **X** = Abnormal Mark **S** = Don't use
2. Check before start work everyday
3. Return to maintenance every first of month

Checking Table ( ) Machine ( ) Facility ( ) Accessories daily ( ) Other

Machine Name : Auto Media Install (AMI) **Code :** **Department : Tooling** **Section : Online prod.** **Site : Factory** **Month :**

LOCATION : PRODUCTION LINE

CHECKED POINT	ITEM	INSTRUMENT/ CHECKING TOOL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Screw feeder	check condition good/bad	Naked eye																										
Bit driver	check condition good/bad	Naked eye																										
Screw pick up	check condition good/bad	Naked eye																										
Disk clamp post	check condition good/bad	Naked eye																										
Media caddy holder	check condition good/bad	Naked eye																										
Media pick up	check condition good/bad	Naked eye																										
Screw driving alignment	Alignment	Set up gauge																										
Drive clamping	check condition good/bad	Naked eye																										
Drive elevator	check alignment	Set up gauge																										
Wiring	check condition good/bad	Naked eye																										
Operating	No obstruction	Screw/base/media																										
Record.....																												
Reponsible Technician		Time machine down																										
		Technician																										

To check up by...../.....Controller
Leader / Supervisor

To check up by.....Tooling maintenance
...../...../.....

Remarks 1. Mark = Normal Mark **X** = Abnormal Mark **S** = Don'
2. Check before start work everyday
3. Return to maintenance every first of month

Checking Table ( ) Machine ( ) Facility ( ) Accessories daily ( ) Other

Machine Name : Auto Wire Balance (AWB) **Code :** **Department : Tooling** **Section : Online prod.** **Site : Factory** **Month :**

LOCATION : PRODUCTION LINE

CHECKED POINT	ITEM	INSTRUMENT/ CHECKING TOOL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Accelerometer	check condition good/bad	Naked eye																										
Pogo pin	check condition good/bad	Naked eye																										
Pogo pin alignment	check condition good/bad	Naked eye																										
Wire pick up	check condition good/bad	Naked eye																										
Size wire checking	check condition good/bad	Naked eye																										
Reading accuracy	Master drive reading	Master drives																										
Drive clamping	Alignment	Set up gauge																										
Spin board	check condition good/bad	Naked eye																										
Wiring	check condition good/bad	Naked eye																										
Operating	No obstruction	H.D.A(without HAS)																										
Record.....																												
Reponsible Technician		Time machine down																										
.....		Technician																										

To check up by...../.....Controller
Leader / Supervisor

To check up by.....Tooling maintenance
...../...../.....

Remarks 1. Mark = Normal Mark **X** = Abnormal Mark **S** = Don'
2. Check before start work everyday
3. Return to maintenance every first of month

Checking Table ( ) Machine ( ) Facility ( ) Accessories daily ( ) Other

Machine Name : Auto Wire Balance (AWB) **Code :** **Department : Tooling** **Section : Online prod.** **Site : Factory** **Month :**

LOCATION : PRODUCTION LINE

CHECKED POINT	ITEM	INSTRUMENT/ CHECKING TOOL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Head stack pick up	Alignment	Set up gauge																										
Head stack vacuum	check condition good/bad	Naked eye																										
Head stack gripper	Alignment	Set up gauge																										
Top VCM gripper	Alignment	Set up gauge																										
Vision system	Head stack detection	Automatic program																										
Turn table	check condition good/bad	Naked eye																										
Drive clamping	Alignment	Set up gauge																										
Scaning system	Barcode accuracy reading	Automatic program																										
Wiring	check condition good/bad	Naked eye																										
Operating	No obstruction	H.D.A/Head stack																										
Record.....																												
Reponsible Technician		Time machine down																										
		Technician																										

To check up by...../.....Controller
Leader / Supervisor

To check up by.....Tooling maintenance
...../...../.....

Remarks 1. Mark = Normal Mark **X** = Abnormal Mark **S** = Don'
2. Check before start work everyday
3. Return to maintenance every first of month

APPENDIX F

Severity, Occurrence, and Detection Criteria for Design FMEA

Severity Evaluation Criteria

Effect	Criteria: Severity of Effect	Rank
Hazardous - without warning	Very high severity ranking when a potential failure mode affects safe vehicle operation and/or involves noncompliance with government regulation without warning	10
Hazardous - with warning	Very high severity ranking when a potential failure mode affects safe vehicle operation and/or involves noncompliance with government regulation with warning	9
Very High	Vehicle/item inoperable, with loss of primary function.	8
High	Vehicle/item operable, but at reduced level of performance. Customer dissatisfied.	7
Moderate	Vehicle/item operable, but Comfort/ Convience item(s) inoperable. Customer experiences discomfort.	6
Low	Vehicle/item operable, but Comfort/ Convience item(s) operable at reduced level of performance. Customer experiences some dissatisfaction.	5
Very Low	Fit & finish/Squeak & Rattle item does not conform. Defect noticed by average customers.	4
Minor	Fit & finish/Squeak & Rattle item does not conform. Defect noticed by most customers.	3
Very Minor	Fit & finish/Squeak & Rattle item does not conform. Defect noticed by discriminating customers.	2
None	No effect.	1*

***Note:** *Zero (0) rankings for Severity, Occurrence or Detection are not allowed*

Suggested Occurrence Evaluation Criteria			
Rank	CPK	Failure Rates	Probability of Failure
10	≥ 0.33	> 1 in 2	**Very High:** Failure almost inevitable
9	≥ 0.33	1 in 3	
8	≥ 0.51	1 in 8	**High:** Repeated failures
7	≥ 0.67	1 in 20	
6	≥ 0.83	1 in 80	
5	≥ 1.00	1 in 400	**Moderate:** Occasional failures
4	≥ 1.17	1 in 2000	
3	≥ 1.33	1 in 15 000	**Low:** Relatively few failures
2	≥ 1.50	1 in 150 000	
1*	≥ 1.67	≤ 1 in 1 500 000	**Remote:** Failure is unlikely

***Note:** *Zero (0) rankings for Severity, Occurrence or Detection are not allowed*

Suggested Detection Eval. Criteria		
Detection	Criteria	Rank
Absolute Uncertainty	Design Control will not and/or cannot detect a potential cause/ mechanism and subsequent failure mode; or there is no Design Control.	10
Very Remote	Very Remote chance the Design Control will detect a potential cause/mechanism and subsequent failure mode.	9
Remote	Remote chance the Design Control will detect a potential cause/ mechanism and subsequent failure mode.	8
Very Low	Very Low chance the Design Control will detect a potential cause/ mechanism and subsequent failure mode.	7
Low	Low chance the Design Control will detect a potential cause/mechanism and subsequent failure mode.	6
Moderate	Moderate chance the Design Control will detect a potential cause/mechanism and subsequent failure mode.	5
Moderately High	Moderately High chance the Design Control will detect a potential cause/mechanism and subsequent failure mode.	4
High	High chance the Design Control will detect a potential cause/mechanism and subsequent failure mode.	3
Very High	Very High chance the Design Control will detect a potential cause/mechanism and subsequent failure mode.	2
Almost Certain	Design Controls will almost certainly detect a potential cause/mechanism and subsequent failure mode.	1*

***Note:** *Zero (0) rankings for Severity, Occurrence or Detection are not allowed*

Guidelines For Auditing FMEA'S per QS 9000:
(Source: Potential Failure Mode and Effects Analysis (FMEA) Reference Manual (AIAG): (Feb, 1996))

1. Is there evidence that a cross-functional team was used to develop the FMEA?
2. Is the FMEA header completely filled out with a tracking number, the component or (sub) system name, design responsible activity, preparer's name, model year and vehicle (if known), the initial FMEA due date, the date the original FMEA was compiled, the latest revision date and names/departments of team member?
3. Is the FMEA that is being audited the latest revision level?
4. **Function** – Has the component or (sub) system been identified? Has the nomenclature found on the engineering drawing been used? Has the function of the part been identified?
5. **Potential Failure Mode** – Is there at least one failure mode listed for every function?
6. **Potential Effects of Failure** – Are the effects of the failure defined and are they defined in terms of what the internal or vehicle level external customer might notice?
7. **Severity** – Is the severity (or seriousness) of the potential effect of the failure rated? (See Definitions provided above.)
8. **Classification** – Are the significant and critical characteristics identified in this column? (blanks are allowed) (See Special Characteristics model on other side)
9. **Potential Causes/Mechanisms of Failure** – Is there at least one potential cause of failure listed for every failure mode?
10. **Occurrence** – has an occurrence ranking been assigned to each of the potential causes/mechanisms of failure? (See Definitions provided above.)
11. **Current Design Controls** – Is there listed a prevention, design validation/verification (DV) or other activities which will maximize design adequacy of the failure mode and or cause mechanism?
12. **Detection** – Is there a detection ranking that assesses the ability of the design controls to detect a potential cause/mechanism or the ability of the design controls to detect the subsequent failure mode before the component or (sub) system is released for production. (See Definitions provided above.)
13. **RPN** – Has the RPN been calculated by multiplying S x O x D?
14. **Recommended Actions** – Have actions been identified for potential significant and critical characteristics and to lower the risk of the higher RPN failure modes? Has "none" been entered in the column if no actions are recommended?
15. **Responsibility** – Has an individual, SBU and target completion date been entered in columns where an action has been recommended? (Blanks are OK when no action is recommended)
16. **Actions Taken** – Has a brief description of the actual action and effective date been entered after the action has been taken? (Blanks are OK when no action is recommended)
17. Resulting severity, occurrence, detection and RPN – Have the new severity, occurrence, detection and RPN numbers been entered after an action has been completed and verified?
18. Has the design responsible engineer implemented or adequately addressed the recommended action?

BIOGRAPHY

Ms. Jintana Lersvisalsin has a B.E. from Rangsit University in Computer Engineering. She works in IT manufacturing business as a Process Engineer and Product Engineer for 4 and half years, concurrent working in her own business as a role of Sales and Marketing Manager in IT service sector. At this time, she decided to continue her study in Engineering Management and Manufacturing jointly offered by Chulalongkorn University and Warwick at the Regional Centre for Manufacturing Systems Engineering. She was enrolled as a part-time student and graduated in the academic year 2005.