Faculty of Manufacturing Engineering

INVESTIGATION ON VISION LEAD OVER REJECTION FOR D-PAK PACKAGE AT TESTING OPERATION USING SEVEN QUALITY CONTROL TOOLS

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Master of Manufacturing Engineering

2017

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A thesis submitted
In fulfillment of the requirements for the degree of
Master of Manufacturing Engineering (Manufacturing System Engineering)

Faculty of Manufacturing Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2017

DECLARATION

I declare that this thesis entitle "Investigation on Vision Lead over Rejection for D-pak Package at Testing Operation Using Seven Quality Tools" is the result of my own research except as cited in the reference. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ……..

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Date : 08.06.2017

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality as a fulfillment for the award of Master of Manufacturing Engineering (Manufacturing Systems).

Signature : .....

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Date : 08.06.2017

DEDICATION

I dedicate this work to my beloved wife Mrs. Punitha Rajinram, my daughter Sohbitha and my son Thirishaant who has encouraged me all the way and whose encouragement has made sure that I give it all it takes to finish that which I have started. Thank you. My love for you all can never be quantified.

ABSTRACT

In semiconductor industries, it as a common problem for the manufacture to falsely reject good product, part or component in their production lines due to error measurement of their vision inspection system. This scenario is very costly to the manufacturers in term of cycle time, scrap and delivery time. As a matter of fact, this problem can affect the credulity of the manufacturer from the customer's perspective. Therefore, this project attempt to investigate the root cause of the falsely reject products which is known as over rejection for a semiconductor's manufacturer in Melaka. Specifically, this project looked at over rejection for a lead to a integrated circuit device. Through this research, the root cause of the over rejection that are spring back soft 3D vision pedestal material, worn out pickup head and dirty 3D vision system mirror have been identified using Seven Quality Control tools. Counter measure to overcome those issues that are replacing vision pedestal material with a harder material, introduce the use of jig and clean the vision mirror using elastic or bended cotton stick have been implemented to reduce or eliminate the above mentioned problem. After implementing the counter measure, over rejection due to soft vision pedestal material has been totally eliminated. Whereas, the problem due to worn out pickup head and dirty vision system mirror have been significantly reduced to 65.7% and 61.5% respectively. In fact the vision lead reject has been tremendously declined from being top 13 to the top 2 the lowest reject in overall reject detected at testing operation of the production line.

ABSTRAK

Dalam industri semikonduktor, pelbagai masalah pembuatan sering dihadapi oleh pengeluar seperti rejek palsu terhadap produk atau komponen yang baik dalam pengeluaran mereka berpunca daripada kesilapan pengukuran sistem pemeriksaan mereka. Senario ini sangat merugikan kepada pengeluar dalam konteks jangka masa penghasilan atau pembuatan, pembuangan rejek dan masa penghantaran. Masalah ini boleh mejejaskan percayaan terhadap pengilang dan perspektif pelanggan terhadap mereka. Oleh itu, projek ini telah diusahakan untuk menyiasat punca berlakunya rejek palsu terhadap produk untuk pengilang semikonduktor di Melaka. Projek ini dikhususkan untuk focus pada reject palsu pada kaki peranti litar bersepadu. Melalui kajian ini, punca rejek palsu yang dikenal pasti adalah berpunca dari pada bahan lembut di gunakan dalam pembuatan 'pedestal', penghausan pada batang rod yang gunakan untuk pergerakkan unit atau komponen dan kotor pada cermin sistem 3D. 'Seven Quality Control (7QC) Tool' digunakan untuk mengatasi isu-isu seperti yang menggantikan dengan bahan yang lebih keras dalam pembuatan 'pedesta'l, memperkenalkan penggunaan 'jig' dan membersihkan cermin peralatan dengan menggunakan kayu kapas yanag elastik atau mudah dilenturkan, telah dilaksanakan untuk mengurangkan atau menghapuskan masalah tersebut. Selepas melaksanakan langkah menangani, rejek berpunca daripada bahan pedestal yang lembut telah dihapuskan. Manakala, masalah disebabkan oleh penghausan batang rod dan kotor pada cermin sistem 3D telah dikurangkan kepada 65.7% dan 61.5% masing-masing. Setelah mengatasi isu- isu yang dikenal pasti, ia membawa peningkatatn daripada tangga yang ke-13 kepada tangga ke-2 peratus rejek yang paling kurang di antara rejek yang dikesan pada operasi ujian dalam pengeluarannya.

ACKNOWLEDGEMENTS

I would like to express my gratitude to my supervisor Mr.Nik Mohd Farid Bin Che Zainal Abidin for useful comment, remark and engagement through the learning process of this master thesis. The door of Mr. Nik Mohd Faris always opens for me whenever I had trouble spot or question on writing my thesis. He consistently allows this paper to be my work, but steered me in the right direction whenever he thought I need it. Secondly,I would like to express my gratitude to the Infineon Technologies Malacca, Malaysia company management to allow me to perform my master project on the company and compile the relevant data for my project. Finally, I express my very profound to my wife Punitha Rajinram and to my beloved children Sohbitha Sevasothy and Thirishaant Sevasothy for providing me with the unfailing support and continues encouragement throughout the years of study and writing this thesis.

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CHAPTER 1

INTRODUCTION

1.0 Background

The traditional method of quality inspection is through manual inspection on the product by the operator in which defected units are being shorted out. If the operator fails to detect the defected unit, it may end up being delivered to the customers. If this happen, once the customers encounter the defected unit, they may claim the supplier for the defective products. Furthermore, this may affect the credibility of the supplier in the eye of the customers. In fact, this issue this will financially affect the organization due to the cost of product recall that requires re-inspection or re-scanning process to the returned products. In fact, the company may have to pay compensations to the customers for delay of delivery of the products (Jain and Meenu, 2013).

Among disadvantages of manual inspection process are:

1. Slow down the manufacturing process which will affect the delivery time.
2. Increases the cost of manufacturing for long term due to the need to employ number operators to perform this process before to delivery to customer.
3. Difficult be a world class manufacturing company in which the world class manufacturing company must be very competitive against other manufacturing company.

The use of semi-automated or fully automated vision system in production line can further increase the competitiveness of the company in terms of quality product and processing time. The machine vision or vision system is like a computer with eyes that can identify, inspect and communicate critical information to eliminate costly errors, improve productivity and enhance customer satisfaction through the consistent delivery of quality products.The terms of vision system is defined as a products or partin machine vision and imaging that consists of either camera, sensor, software, board, lighting or lenses. The vision system is used to perform the online inspection with high speed, high accuracy and high consistency. Any deviation quality of the production or manufacturing can be detected immediately.

The images of unit captured will be saved in the image gallery and it will be used in every topic related to vision functions that you can think of, including industrial inspection, life sciences, image processing and vision software, autonomous vehicles, drones, aerospace imaging, medical imaging, embedded vision, and much more.

1.1 Background Of Study

This project is to investigate the vision lead over rejection root cause in order to reduce the vision lead over rejection on the testing process in the module 2 at Power Malacca (POM) department of Infineon Technology Malacca Malaysia. The vision lead is an important inspection electronic semiconductor industrial. The term of vision lead refers to bent lead inspection on the electronic component or device produce such as the pitch reject, stand-off reject, stand-off variance reject and lead sweep reject. All the types and patterns of bent lead will be discussed in detail on the next chapter on this topic. These types of electronic semiconductor component are used in automotive industry on the control module such as safety systems and car security system.

This vision system is fixed at handler or testing machine to perform activities such testing, scanning, marking and packing (TSMP) process or testing, scanning and packing (TSP) process. The system uses a 3D vision lead module. The vision system equipment is use in Module 2 on POM department at Infineon Technologies is manufactured and design by Vitrox Technology Corporation Berhad. Vitrox Technology designs and manufactures aninnovative, leading-edge and cost-effective automated vision inspection equipment and system-on-chip embedded electronics devices for the semiconductor and electronics packaging industries. Vitrox core products are its Machine Vision System (MVS), Automated Board Inspection (ABI) and Electronics Communication System (ECS).

1.2 Problem Statement

The vision system is used in the Infineon Technologies Malacca manufacturing due to following reasons:

1. It is more productive, due to reduction of the inspection time and production cycle time.
2. It is more effective on bent lead detection compared to the manual inspection using human. This is because it is very accurate and uses the imaging application.
3. It eliminates the need for operators to inspect hence reducing the manufacturing cost.

The 3D lead vision system is used to detect and sort out the bent lead defect unit to the lot. This is to ensure the good quality of the product sent to the customers. The vision system inspection is more effective to the manufacturing process. However, it also has weakness in which it can accidentally reject good units, which is known as over rejection during the inspection process. The vision lead reject is one of the higher losses in the testing process which will effect to the overall testing process yield. This is due to the vision lead reject cannot be retest due to there is no retest working procedure

implementation in the POM testing process. According to the work procedure at Module 2 (M2) POM testing process, all the fail or reject unit are not allowed tobe retested to recover the losses. This is implemented to avoid the quality issue of the unit send to customer. This entire vision lead over rejection unit will be scrapped due to zero retest procedure at testing operation.

This project will focus on the reducing the vision lead over rejection on the testing operation at Power Malacca (POM) department. The vision lead over rejection happens due to the main 2 main factor:

1. The lead inspection is not accurate.
2. The 3D vision lead system did not detect the correct edge or the view of lead is not clear.

This entire vision reject is tolerated to scrap losses and low yield production. The scrap losses will increase the cost of manufacturing or cost per unit. When the cost per unit increases, it will cause the manufacturing cost of the product increases. This is will significantly affect the company in terms of its' credibility from the customers' perspective. To overcome this issue, the over rejection should be avoided or reduced in its processes. Furthermore, the high lead reject will cause the equipment/machine Overall Equipment Efficiency (OEE) drop due to the machine frequently stop because of the reject tube is full. In testing section, the maximum reject unit set in the reject tube for vision lead reject is 30 units. The 30 units is set to alert the machine operator to perform corrective action

This situation or scenario will cause the low yield lot increases up to 20 to 30 lots per week. The setting for the vision lead yield is 99.8%, in which the lot having the vision lead yield above 99.8% will be moved to the next process or operation., whereas the lot having vision yield below 99.8% will be placed on the problematic lot area for further

investigation and disposition to the effected lot. The manufacturing cycle time increases or effected due to the low yield lot because of the Deviation and Decision Management (DDM) lot procedure, where the low yield lot will be placed in the problematic lot area in production line for verification of reject unit and disposition of the lot. This is done due to ensure no defective unit is sent to customer. This scenario will increase the manufacturing cycle time and delay the delivery of the product to customer.

The vision over rejection scenario should be avoided or the machine must be stop immediately for correction action. This is because it is high speed handler or machine will tolerate to the high vision lead over rejection. This will cause the testing yield drop, where it impacts the profit of the company. The low yield production will cause bad impression to the customer toward the manufacturing quality and cannot be competitive with other same manufacturers.

1.3 Aim

The aim or goal of this project is to avoid or reduce the vision lead over rejection rate in order to improve the vision lead yield and reduce the Deviation and Decision Management (DDM) lot at the testing process. By reducing the vision lead over rejection, the company is able to reduce the number of Deviation and Decision Management lot (DDM) or problematic lot up to 40% to 50% of lot due to vision lead over rejection. This will help to achieve the demand of the customer because the produtcts can be delivered to customer on time.

1.4 Objective

To achieve this project, three main tasks were chosen to be objective of the project. The objectives of the project are:

1. To identify all possible root causes of over rejection in the testing operation and to determine the most critical root causes of the over rejection problems.
2. To propose counter measures to reduce the over rejection problems.
3. To implement and study the effectiveness of the counter measure.

1.5 Scope

This project will focus on reducing the vision lead over rejection which is related to the testing machine or the testing handler and vision system at Module2 (M2) testing process, Power Malacca (POM) department in Infineon Technologies Malacca, Malaysia and how to solve the vision lead over rejection problem. To solve this problem, 7QC Tools are used as a tool to identify the problem, root cause and solution action to reduce the vision lead over rejection problem.

The vision system used on the testing machine in the testing process is consist, of three type of vision system to detect different mode or type of defect on the single testing machine or handler. The types of vision system used in the testing machine are:

1. 3D lead vision inspection system
2. Mold vision inspection system
3. Mark vision inspection system

The project focused on reducing the vision lead over rejection which is related to 3D lead vision inspection system because the lead vision over rejection is among the highest losses compare to the other two vision losses.

The vision system is fixed on the handler to perform scanning or inspection which is used to detect the bent lead and to ensure the quality of the lead of component send to the customer. The testing machine is high speed machine where the unit per hour (uph) is 12,000 to 16,000 and it also depends to the type of test and test time assigned. Since it is a high speed machine, this will cause high vision lead rejects if the problem occurs and if the machine is not immediate stop for correction.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter consists of the actual definition of quality, the classification of product quality, bent lead defect and visual inspection use in manufacturing industry and Seven Quality Control (7 QC) tools. The definition and discussion on this chapter is based on the published information related to a particular project or research area. The published information use on this chapter is a useful method to review and updated on the knowledge and the research which is done to the particular research area such as product quality area, optimizing of vision lead system and 7 QC tools or selected project and the function. This chapter will discuss the function vision system in the manufacturing industry and the method used by researchers to improve the vision system efficiency toward the accuracy and the effectiveness of defect detection during inspection process. In the topic of 7 QC tools, issues such as the function of seven quality control tools in the process improvement and problem solving method are being covered. This chapter can be used as an information to evaluate the source and advise on the task of reducing the vision lead over rejection at testing operation.