UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND ANALYSIS OF MULTI VACUUM MANIFOLD FOR SEMICONDUCTOR INDUSTRY USING CAD TOOL

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Design)

by

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ABSTRAK

Multi vacuum manifold adalah tajuk untuk mengkaji kecekapan aliran udara dalam sistem vakum cekaman dalam industri semikonduktor. Tujuan kajian ini adalah untuk mengenali ciri-ciri mereka manifold dalam sistem vakum dan menganalisis hasil dasar pada perisian simulasi. Aliran udara adalah kajian utama pada sistem manifold. Daripada maklumat dikumpulkan, penurunan tekanan, jenis aliran yang terlibat, dan rekaan yang kurang sesuai adalah faktor yang berpengaruh terhadap kecekapan aliran di manifold. Ciri-ciri yang terlibat dalam rekaan manifold akan digunakan untuk kajian ini. Ciri-ciri tersebut meliputi berbagai saiz saluran masuk, jumlah saluran digunakan dan jarak antara saluran yang digunakan. Peranti software CAD yang dipilih untuk dilakukan kajian ini adalah SolidWorks dan SolidWorks Flow Simulation untuk mencipta dan mensimulasikan hasil rekaan. menurut hasil diperolehi, rekaan di mana jumlah luas permukaan untuk bahagian udara masuk kurang atau sama dengan udara keluar menunjukkan keputusan yang lebih baik bagi kelajuan dan tekanan sedutan bahagian masuk. Jarak perjalanan lagi oleh udara dari bahagian masuk sampai bahagian keluar juga mempengaruhi keputusan yang diperolehi. Untuk kajian di masa depan, rekaan boleh mempertimbangkan adalah kajian terhadap keseluruhan sistem supaya mendapatkan keputusan yang lebih baik. Selain itu, perisian lain seperti Ansys boleh digunakan untuk mendapatkan hasil simulasi yang lebih baik. Dan rekaan harus dibandingkan dengan produk yang ada tersedia di pasaran, maka optimasi boleh dilaksanakan.

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ABSTRACT

Design and analysis of multi vacuum manifold in semiconductor industry using CAD tool is a title to study efficiency of flow in vacuum gripping system in semiconductor industry. The objective of this study was to investigate the parameter of designing manifold in vacuum system and analyze the results base on simulation software. Air flow was main study on manifold system. From literature review, pressure drop, type of flow involved, and improper design are the factors influence on efficiency of flow in manifold. The study of multi vacuum manifold was carried out parameter involved in to the designs. These designs are including various size of inlet, number of inlet used and the distance between the inlets used. The CAD software selected for undertaken the study were SolidWorks and SolidWorks Flow simulation for creating and simulating the result of the designs. As the result obtain, the design in which total cross section area inlets is less or equal to out resulted better value of velocity and suction pressure distributed in each inlet. The longer distance travels by fluid from inlet to outlet also affect the result obtained. For future study, the design can consider design with manifold system in order obtain better result. Besides, other software such as Ansys can be used for better simulation result. And the design should compare to existing product available in the market, hence the optimization can be implemented.

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DEDICATION

This report and the whole effort that was given into coming up with it is dedicated to my very own parents, who not only believed in me but has also always been there for me when I needed support the most. Their supports are the effort for me in completing my report. Besides, when I felt hard and really need help in collection information for my report, there were someone always been here giving a lot of advices and guides to me. Thanks, my friends. On the other hand, I would like to dedicate this to my supervisor, En. Taufik, given me a lot of help and guide during completing this report.

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LIST OF ABBREVIATIONS

2D/3D	2 Dimensional/3Dimensional
ANSYS	Engineering simulation software
CAD	Computer Aided Design
CFD	Computational Fluid Dynamics
E&E	Electrical and Electronic
IC	Integrated circuit
PWBs	Printed Wiring Boards

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CHAPTER 1
INTRODUCTION

1.1 Introduction

Manifold is a pipe that has several lateral outlets to or from other pipes. It is used to drive the fluid flow inside the pipe. There are many types of manifold are design and used around us, such as gas manifold, exhaust manifold, hydraulic manifold and etc. Each of the manifolds has different functions depend on it design.

Vacuum manifold is the manifold that used in connecting equipments to vacuum source which is creating the vacuum state in the system. It used for air extraction process for a certain process. Most of the vacuum manifold used in automotive field in industry.

In semiconductor industry, vacuum manifolds are mostly used in pick and place machinery and holding device. The manifold is used to connect the components such as suction pads to the vacuum source. The vacuum source will extract the air inside the suction pad through manifolds and create a low pressure condition inside the suction pad. Since the air pressure at atmosphere is greater than pressure between item and suction pad, it encourages the items to push up or stick on the suction pad. The items are normally referred to PWBs (printed wiring boards), ICs or other small components.

The efficiency of the flow depends on the design of manifold. The proper design of the manifold will make the fluid distributed uniformly to all the outlet or branch of manifold. The design also can control the fluid flow rate through the design of the

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size manifold. Besides size of the manifold, the array or arrangement of the outlets manifold also have a great effect to fluid flow.

For the multi holding device used in semiconductor industry is quite different with the holding device used in automotive industry. The design of the manifold is depend on the design of suction pad used. Proper design of manifold will make the air extract uniformly to each area in the suction pad.

1.2 Background

Electrical and electronic industry is the leading industrial sector and economy growth in Malaysia. Malaysia's electronic industries have been developing for over least 30 years and become the largest the contributor to the country in manufacture and export electronic components. In 2006, exports of E&E products amounted to 61.7% of total manufactured exports. The industry had created 36.6% of total employment in the manufacturing sector. (MIDA, 2008)

The electrical and electronic industry comprise of 4 sub-sectors, which are electronic components, industrial electronics, consumer electronics and electrical product. As the result show in the Figure 1, electronic components are the largest contribute to electrical and electronic industry.

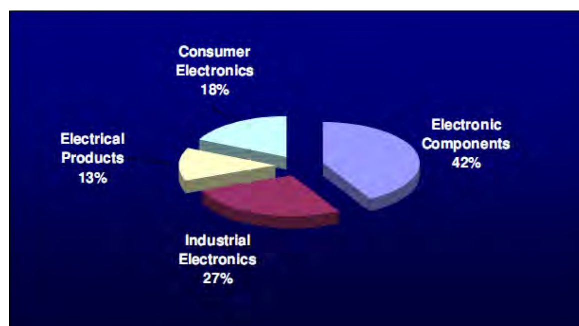

Figure 1.1: Output Structure of the E&E Industry in 2007 (Jan-Nov) (Department of Statistic)

Semiconductor industry is the industry which is rapidly growth under the electrical and electronic industry. Today, semiconductor is the major part of electrical and electronic industrial sector in Malaysia. The main activities involved in

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semiconductor industry are the assembly and testing of semiconductor devices, which include microprocessors, memory chips, power ICs, linear ICs, opto devices and other logic and discrete devices. Besides, semiconductor industries also involved in silicon wafer processing, wafer fabrication and chip design. The semiconductor companies that involved in this sector are Intel, AMD, Infineon, Toshiba, STMicroelectronics, and etc. (MGCC, 2009)

The trend of the technology development in the world, it has increase the demand of semiconductor in output of electric and electronic sector to the market. In 2007, the product of the electrical and electronic is the largest contributor to manufactured export with shared 58.9%. (MGCC, 2009)

The growth of semiconductor industry in industrial sector also affect to development of automation technologies. These technologies are used in solving the problems of automated operation in machinery of assembly, handling, inserting and etc. in order to increase the output of productivity in industries. Vacuum technology is the technology that is widely used in semiconductor industry for the purpose of handling and inserting electronic components.

1.3 Problem Statement:

Today, vacuum is involved in most every automated operation in most industrial sector. For semiconductor industries, almost all the machines are operated simultaneous with vacuum system such as pneumatic. The problems faced are not every machine is operated in optimize condition especially the vacuum manifold system in pick and place machinery.

The first problem is occurs in the suction pad. The suction pad cannot hold all the items efficient in a short time. There are various times taken to extract the air from the suction pad. Means the vacuum generated is not uniformly and the time taken is long until all the air is extracted.

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Using existed products in the market. Most of the industries are using the manifold product that can found in the market and just design as the function need for the machine. They do not have time to make analysis whether single outlet or multi outlet manifold is better for their special machine use especially to suction pad used.

The manifold design is not optimized. They do not have any experiment to test the manifold design. The lack of the experimental data make designer unable to confirm whether the system is optimized to the vacuum flow. Therefore, they are doing many modifications from time to time in order to make sure that the system can function as needed.

1.4 Objective:

i. To investigate the design parameters of vacuum manifold.
ii. To design parameters of manifold using CAD tools.
iii. To simulate the design parameter and analyze the better parameter for manifold design.

1.5 Scope of Project

In this study, design and analysis were to be concerned on the study of multi vacuum manifold. The design aspect were carried out in this study were the number of the inlets, diameter, and distances of inlets used in manifold design. For the analysis aspect, it was concerned on velocity of flow and pressure distribution in vacuum manifold for various parameter designs. Other aspects were not contain in this study.

1.6 Structure of the Reports

This report are contain with 6 chapter base on the study of the multi vacuum manifold. The following statements have described how the project was going on through each chapter.

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Chapter 1: Introduction

This chapter is simply describe the vacuum manifold and it uses in semiconductor industries. Then, followed by the problem had faced during selecting and using manifold system.

Chapter 2: Literature Review

Describe the use of vacuum in a certain application and parameters consideration for manifold design.

Chapter 3: Methodology

This chapter will describe how the study will going on in 2 main phases, designs planning and designs simulation.

Chapter 4: Design and Result

In this chapter, various parameter design of manifold will develop by using CAD tool and they will simulate by using CFD software.

Chapter 5: Analysis and Discussion

Discuss and analysis on simulation results according to the designs. The result will show which parameter would be better use for the certain purpose used in semiconductor industries.

Chapter 6: Conclusion

To simplify the study with the analysis of simulation results for manifold parameters designs.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Vacuum manifold is one of the media used to connect the components to vacuum source of the particular machine or equipment used in industry. For semiconductor industry, most of vacuum manifold is used simultaneously with vacuum system in vacuum holding devices. The main components that are using in vacuum holding devices are suction cup or suction pad. Manifold is function as the tubing that drives the air flow in and out of the system.

2.2 Vacuum

According to O'Hanlon (2003), a vacuum is a space from which air or other gas has been removed. Amount of air removed are depends on the application and is done for many reasons.

While Bannwarth (2005) was state that vacuum is the state of a gas, the particle density of which is lower than the one of the atmosphere on the earth's surface. As within certain limits the particle density depends on place and time, a general upper limit of vacuum cannot be define.

In practice, the state of a gas can mostly be defined as vacuum in cases in which the pressure of the gas in lower than atmosphere pressure, i.e. lower than the air pressure in the respective place.

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