UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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DESIGN AND DEVELOPMENT OF AN INTEGRATED QUALITY INSPECTION GAUGE FOR NT40-0Z25-70 MILLING ARBOR

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Manufacturing Engineering Technology (Product Design) with Honours.

by

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NUR FATIN DIYANAH BINTI NORAZAM

A thesis submitted
in fulfillment of the requirements for the Bachelor's Degree in Manufacturing Engineering Technology (Product Design) with Honours

Faculty of Mechanical and Manufacturing Engineering Technology

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Sesi Pengajian: 2019/2020

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APPROVAL

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DEDICATION

In the name of Allah, the Most Gracious, the Most Merciful and all praises to the Prophet, Muhammad S.A.W. Alhamdulillah, praise to Allah for His mercy, I have successfully completed this project in a timely manner.

I would like to take this opportunity to extend my utmost gratitude and sincere appreciations, to my father, ***Norazam Bin Suleiman*** for his support and sacrifice to confront with all problems and difficulties along this journey, mentally and physically.

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May Allah rewards all of you with a goodness and prosperity, here and hereafter.

ABSTRACT

The purpose of the project is to design and develop an integrated quality inspection gauge for NT40-0Z25-70 milling arbor. The research method includes Failure Mode and Effect Analysis, Quality Function Deployment, Screening and Scoring Matrix using Pugh Method. The design concept involves four major part which determine most critical for inspection process based on specific analyses using Coordinate Measuring Machine and Horizontal Optical Comparator. There are three design concepts had been developed based on current existing standard gauge in the industry. The prototype was fabricated using low cost material that able to enhance the inspection process for NT40-0Z25-70 milling arbor. On the other hand, the project involved the use of advanced machining process including laser cutting machine and high precision measuring equipment. The project significance for design and development of new inspection tool can be a good references to design a product.

ABSTRAK

Tujuan projek ini adalah untuk merekabentuk dan membangunkan gabungan alat pemeriksaan kualiti bersepadu untuk pengilangan arbor kod NT40-0Z25-70. Kaedah penyelidikan yang digunakan adalah Mod Kegagalan dan Analisis Kesan, Peningkatan Fungsi Kualiti, Matriks Penapisan dan Pemarkahan menggunakan Kaedah Pugh. Konsep reka bentuk ini melibatkan empat bahagian utama arbor yang menentukan bahagian kritikal untuk proses pemeriksaan berdasarkan analisis spesifik menggunakan Mesin Pengukur Selaras dan Perbandingan Optikal Horisontal. Selain itu, terdapat tiga konsep reka bentuk yang telah dibangunkan berdasarkan ukuran tolok sedia ada yang terdapat dalam industri. Disamping itu, prototaip ini direka dengan menggunakan bahan kos rendah yang dapat meningkatkan proses pemeriksaan untuk pengilangan arbor kod NT40-0Z25-70. Seterusnya, projek ini melibatkan penggunaan proses pemesinan canggih termasuk mesin pemotong laser dan peralatan pengukur berketetapan tinggi. Justeru itu, kepentingan-kepentingan yang terdapat dalam projek reka bentuk dan pembangunan alat pemeriksaan baru ini dapat dijadikan rujukan yang baik untuk merekabentuk produk.

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LIST OF ABBREVIATIONS

AIAG	-	Automotive Industry Action Group
ANOVA	-	Analysis of Variance
BOM	-	Bill of Material
CAD	-	Computer aided design
CNC	-	Computer Numerical Control
COQ	-	Cost of Quality
CMM	-	Coordinate Measuring Machine
FMEA	-	Failure Mode Effect Analysis
HOC	-	Horizontal Optical Comparator
HoQ	-	House of Quality
MSA	-	Measurement System Analysis
NPD	-	New Product Development
QC	-	Quality Control
QFD	-	Quality Function Deployment

CHAPTER 1

INTRODUCTION

1.1 Project Background

Quality can be defined as fulfilling specification or customer requirement, without any defect. According to Judi et al., (2014) a product is said to be high in quality if it is functioning as expected and reliable. Whereas Irudhayaraj et al., (2016) claimed that quality control refers to activities to ensure that produced items are fulfilling the highest possible quality. Most of tools and techniques to control quality are statistical techniques. Quality is a universal value and has become a global issue. A range of techniques are available to control product or process the production quality. These include seven statistical process control (SPC) tools, acceptance sampling, quality function deployment (QFD), failure mode and effects analysis (FMEA), quality inspection, six sigma, and design of experiments (DoE). In this project, quality inspection is known as one of the most important stages of the production process.

Inspection is defined as an official process of checking that things are in the correct condition. In engineering activities, inspection involves the measurements, tests, and gauges applied to certain characteristics in regard to an object or activity. The results are usually compared to specified requirements for determining whether the item or activity is in line with these targets. Nowadays, various types of inspection methods are being used in industry, from that quality of any product is to be checked. Bożek et al., (2017) state that the

different types of inspection methods involve Coordinate Measuring Machine and various type of gauges are used.

Gauges are the tools which are used for checking the size, shape and relative positions of various parts but not provided with graduated adjustable members. Therefore, in order to survive and be able to provide customers with good products, manufacturing organisations are required to ensure that their processes are continuously monitored and product quality are improved.

1.2 Problem Statement

Milling is a metal removal operation. In milling operation metal is removed by a rotating multipoint cutter which is fitted on the arbor of the milling machine. The varieties of features are formed by milling machine on a part by cutting away the unnecessary material. Milling machine is divided into certain main components, which are column, saddle, base, table, knee, arbor, over-arm and spindle. In milling process, certain aspects play a very important role such as arbor, fixture, and cutter which are needed in milling machine. However, this machining technology is still constrained by issues such as material properties, part accuracy, cost and performance (Mishra, 2017).

In improving process of milling, a very important role is played by the quality control. Manufacturing organisation applies various quality control techniques to improve the quality of the process by reducing its variability. The pressure from globalisation has made manufacturing organisations moving towards three major competitive arenas which are quality, cost, and responsiveness.

Therefore, optimization of the related number of activities is importance. According to Borror, (2014) manufacturing process is exposed to the effect of certain factors and obstacles which should be analysed and taken into consideration. Such factors often cause non-compliance or defects in products, processes or equipment.

Other than that, Stanojeska & Biospin, (2015) also stated that quality control in milling industrial processes has been developed only as a technical control, so the quality control of raw materials, process parameters and the final products has been provided with a numerous defects and high cost production. Furthermore, for the next fundamental condition, Cepova et al., (2018) claimed that by increasing the quality of manufactured products caused increase in the amount of research about techniques used successfully to increase the manufacturing productivity.

The new paradigm of quality assurance improvement should be made by appropriate research and study towards the new improvement in the quality inspection gauge. Hence, by creating an integrated quality inspection gauge, it helps to increase the part accuracy, cost, quality level and save lots of time (Petrzelka, 2010). In this project, an integrated NT40-0Z25-70 milling arbor for quality inspection is design and develop to enhance the production process in the milling industry. This help to encounter the problem of the high cost, part inaccuracy and save time of the inspection process.

In this study, the research questions are considered:

i. What does the current practice of quality inspection gauge in the manufacturing industry?

ii. How to make an improvement from the existing gauge by creating all in one quality inspection gauge for the milling arbor?

iii. How can a new design of quality gauge help the quality inspection process for milling arbor?

1.3 Project Objective

The objectives of the project are:

i. To identify the current practice of quality inspection techniques in milling arbor quality inspection process.

ii. To design an integrated quality inspection gauge for NT40-0Z25-70 milling arbor.

iii. To fabricate an integrated quality inspection gauge for NT40-0Z25-70 milling arbor.