



**Faculty of Mechanical and Manufacturing Engineering  
Technology**

**PARAMETER OPTIMIZATION OF SURFACE ROUGHNESS FOR  
AISI 1018 FOR LOW CARBON STEEL IN WET TURNING PROCESS**

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**Bachelor of Manufacturing Engineering Technology (Process and Technology) with  
Honours**

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AISI 1018 FOR LOW CARBON STEEL IN WET TURNING PROCESS**

**SITI AZILLAH BINTI IBRAHIM**

**A thesis submitted  
in fulfilment of the requirement for the degree of Bachelor of Manufacturing  
Engineering Technology (Process and Technology) with Honours**

**Faculty of Mechanical and Manufacturing Engineering Technology**

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## DECLARATION

I declare that this thesis entitled “Parameter Optimization Of Surface Roughness For AISI 1018 For Low Carbon Steel In Wet Turning Process” is the result of my own research except as cited in the references. 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 : .....

## **APPROVAL**

I hereby declare that I have read this report and in my opinion this report is sufficient in terms of scope and quality as a partial fulfillment for the degree of Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours.

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Date : .....

## **ABSTRAK**

Dalam projek ini, pelarikan bahan AISI 1018 keluli berkarbon rendah juga dipanggil keluli lembut menggunakan mesin CNC larik dengan menggunakan alat keluli laju tinggi dengan jenis yang berbeza parameter dikaji. Kaedah Taguchi digunakan untuk mengoptimumkan parameter bagi kekasaran permukaan dalam operasi pelarikan di mana bendalir pemotong juga yang dikenali sebagai bahan pendingin digunakan di dalam proses ini. Beberapa eksperimen akan dijalankan menggunakan L<sub>9</sub> tata susunan ortogon pada mesin pelarikan CNC. Keputusan langkah akan dikumpul dan dianalisis dengan bantuan perisian MINITAB 18. Analisis varians (ANOVA) digunakan untuk menentukan faktor - faktor kawalan yang paling utama yang menjejaskan kekasaran permukaan.

## **ABSTRACT**

In this project, turning of AISI 1018 low carbon steel also known as mild steel using CNC machine of turning operation with tool use is high speed steel in different parameters are reported. Taguchi method is used for optimizing the parameter of surface roughness in wet turning operation. Wet turning is a turning operation where the cutting fluid that be called coolant is being used in this process. A number of experiments will be conducted using L<sub>9</sub> Orthogonal array on CNC turning machine. The measured results will be collected and analysed with the help of the commercial software package MINITAB 18. Analysis of Variance (ANOVA) is used to determine the most significant control factors affecting the surface roughness.

## **DEDICATION**

As a token of appreciation, I dedicate this thesis to both of my parents,  
Mr. Ibrahim bin Ahmad and Mrs. Sharifah binti Yahaya.

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## LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

AISI	-	American Iron and Steel Institute
ANOVA	-	Analysis of Variance
BUE	-	Build Up Edge
CNC	-	Computer Numeric Control
CO <sub>2</sub>	-	Carbon Dioxide
DOE	-	Design Of Experiment
EPA	-	Environmental Protection Agency
Fe	-	Iron
FIB	-	Focused Ion Beam
FTK	-	Fakulti Teknologi Kejuruteraan
GPa	-	Gigapascal
H	-	Helium
HSS	-	High Speed Steel
in	-	Inches
ISO	-	International Organization of Standardization
kg	-	Kilogram
ksi	-	Kilopounds per square inch
LST	-	Laser Surface Technology
mm	-	Millimeter
Mn	-	Manganese
MPa	-	Megapascal
N	-	Nitrogen
NC	-	Numerical Control
O <sub>2</sub>	-	Oxygen

P	-	Phosphorus
psi	-	Pounds per square inch
Ra	-	Average Roughness
RMS	-	Root Mean Square
RPM	-	Revolution Per Minute
S	-	Sulfur
S/N	-	Signal to Noise
$\mu\text{m}$	-	Micro meter
$\mu\text{in}$	-	Microinches
$^{\circ}\text{C}$	-	Celsius

# CHAPTER 1

## INTRODUCTION

### 1.0 Introduction

Chapter one is about explanation for the introduction consists of the project background, problem statement, objectives and follow by the project scope. The entire sub-topic relates with each other to ensure the readers of this report can understand on how the project process flow. This project will described about the optimization parameter of surface roughness for AISI 1018 for low carbon steel in wet turning process. Several tests will be conducted with different parameters on AISI 1018 for low carbon steel. Boron steel will be used as material for turning cutting tool and Taguchi method will be used to analyse this project. By doing the analysis, the best parameter (cutting speed, feed rate and depth of cut) for the turning process that produce the best surface roughness can be determine.

### 1.1 Project Background

In the manufacturing technology industry, there are many challenges were faced because the new technology build in this modern age. The challenges that faced by the industry can be said major in controlling the surface roughness. The part quality that has been machined and the demand for the productivity are examples of the main challenges happen in the industry. Modern cutting tools such as turning tool allow cutting process at

high speed and increased the volume of product produce. In this project will be focus on the optimization parameter for turning process with coolant for surface roughness based on Taguchi method.

The cutting tool that use in this project is Boron Manganese steel which fabricated using CNC Laser Cutting machine. The gases involved in generating the CNC Laser Cutting machine are carbon dioxide, nitrogen and helium. The gas involved to assist cutting is oxygen. After insert has done fabricated, it can be tested turning process on work piece. Turning can be defined as a cutting process that rotated the work piece at its axis as single point cutting tools that fed into the work piece which shearing the unneeded material, come out with desired part. There are many factors that can be influence the quality of the turning process. For this project, cutting speed, feed rate and depth of cut has been choose as the parameter that need to be observe.

The turning process will be done by three axis CNC turning machine. CNC machining involves using a machine controlled by a computer which has been programmed to machine the material. Using this machine, it will be more precise and easier to set the value of the selected parameter. During the machining process, the cutting fluid is use for turning process and it is called as wet turning. The interest in wet turning machining is often related to the better surface roughness, reduces vibration and control temperature of material during machining.

In this project, CNC machine is used to cut along the work piece which has been decide to use AISI 1018 low carbon steel which also known as mild steel, parallel to its axis to reduce its diameter. This is called as parallel turning. AISI 1018 low carbon steel is

easy to be obtain as it is free machining grade that available around the world as the grade is easily available. It is also can be considered as cheap material. This project involved 54 pieces of AISI 1018 low carbon steel with diameter of 20mm and length of 100mm but only 27 pieces that will be taken to study the surface roughness. The type of cutting tool material use is Boron Manganese steel. This Boron Manganese steel was taken from waste of Proton Iriz's car chassis that has been hot stamped. Boron increases the strength of heat-treated steels in the quenched and tempered condition. It is also a poor electrical conductor at room temperature meanwhile Manganese (Mn) known as high impact strength and resistance to abrasion. Adsorption of manganese ion give the steel become resistance to corrosion.

Taguchi method design of experiment is used to determine and optimize the cutting parameter for surface finish of AISI 1018 low carbon steel. Taguchi method will be used to analyse this project and based on the analysis the best parameter for turning process with coolant that produce for surface roughness can be determine. The experiment layout will be design by Minitab 18 Software which is used to analyse and arranging the data of the experiment method with L<sub>9</sub> of Orthogonal Array. ANOVA is used to analysis the experimental data that has been obtain. The surface roughness of the work piece will be tested using Surface Roughness Measuring Instrument.

## **1.2 Problem Statement**

Nowadays, the industry is facing a problem in optimize the parameter of turning process for AISI 1018 low carbon steel. In addition, 1018 low carbon steel is a free

machining grade and mostly being used around the world. Due to that, variety parameter of CNC turning machine needed to be tested while machining the low carbon steel with turning process to ensure it achieve the optimum parameter. Surface roughness is high demanding in industry as the smooth surface roughness give several advantages. The advantages that industry try to achieve is better resistance corrosion, fatigue strength and creep life. All this criteria can be obtain from smooth surface roughness. This smooth surface roughness can be very much due to vibration and temperature increases. There will be presence of coolant during the turning process.

### **1.3 Objectives**

The objectives for this project are:

1. To perform Taguchi method as design of experiment for this project.
2. To analyse the significant factor affecting surface roughness in wet turning process.
3. To optimize the cutting parameter of Computer Numerical Control (CNC) turning machine for turning process.

### **1.4 Project Scope**

In this project, there are several scopes to be considered in order to achieve the objectives. The following important element that must be followed:

- a) The cutting tool material for turning process is Boron Manganese steel were fabricated using CNC laser cutting machine.
- b) AISI 1018 low carbon steel with diameter of 20mm and length of 100mm was used as

work piece and machined by using Computer Numerical Control (CNC) turning machine. The length that machined is 30mm with diameter reduced to 5 times of turning process.

- c) Parameter for CNC turning machine that will be use are cutting speed, feed rate and depth of cut.
- d) Surface roughness measuring instrument will be used to measure the surface roughness of the material after machined and Minitab 18 software for the analysis process.
- e) During the turning process, coolant is use as the project is on wet turning.

### **1.5 Project Requirement**

The requirement of this project are:

- a) The turning process cannot be done with conventional machine because it will be hard to maintain the values of parameter.
- b) There must be coolant during the turning process.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.0 Introduction**

In chapter two, there will be explanation or the discussion of the research background about related to the project. This chapter contain of turning process, cutting tools for turning process, AISI 1018 low carbon steel, surface roughness and statistical analysis.

#### **2.1 Turning**

Turning is one of the most normal operations of metal cutting and more fundamental compare to other operation of machining such as milling, grooving or drilling. It is most often implement in material removal. Turning can be defined as a cutting process that rotated the work piece at its axis as single point cutting tools that fed into the work piece which shearing the unneeded material, come out with desired part (P.P .Sirpurkar, S.R.Bobde, V.V. Patil, V.N .Kale, 2012). Turning need several important main thing in order to ensure the process is functioning such as turning machine, fixture, work piece and cutting tool. Work piece is a material with un-formed that been hold by fixture and attached to turning machine which it rotate with high speed. In order to get a beautiful surface roughness and efficient process at turning machining, it is important to modify the