UNIVERSITI TEKNIKAL MALAYSIA MELAKA

To Investigate Effect on surface Roughness for the Stainless Steel 304 Material in CNC Lathe Machining

This report submitted in accordance with requirements of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Process) with Honours.

By

MOGANAGANES A/L SUNDARAM MURGAN

FACULTY OF MANUFACTURING ENGINEERING

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_____
(TANDATANGAN PENYELIA)

Cop Rasmi:
MOHD. AMRI BIN SULAIMAN
Pensyarah
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka
Karung Berkunci 1200, Ayer Keroh
75450 Melaka

Tarikh: 14/5/09

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Mohd.Amri Bin Sulaiman

(Official Stamp & Date)

MOHD. AMRI BIN SULAIMAN
Pensyarah
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka
Karung Berkunci 1200, Ayer Keroh
75450 Melaka

APPROVAL

This thesis submitted to Faculty of Manufacturing Engineering of Utem as a partial fulfillment of requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Process) with Honours. The members of the supervisory committee are as follow:

(Signature of Principal Supervisor)

…….

(Official Stamp of Principal Supervisor)

(Signature of Co-Supervisor)

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(Official Stamp of Co-Supervisor)

DECLARATION

I hereby, declare this report entitled "" is the results of my own research expected as cited in references.

Signature	:	……
Author's Name	:	MOGANAGANES S/O SUNDARAM MURGAN
Date	:	16 April 2009

ABSTRACT

The project of investigation of cutting parameters influences the stainless steel grade 304 surface roughnesses with CNC turning machining process is divided in two parts. First part of the project is about proposal and the second part is about project implementation or experimental. This report fully describes about the combination of both part, which contains six chapters starting from introduction, literature review, methodology, results, discussion and conclusion respectively. The first chapter describes about scope and objective of the project and expected results. The main objectives of the project are to investigation of cutting parameters influences to recommended the optimized parametric to produce good cutting quality for stainless steel grade 304 by using CNC lathe. While the second chapter is discusses about literature review. The literature search is performed to study, analyses and understand the basic fundamental of CNC turning process. The next chapter is methodology. This chapter was describes the steps or procedures that are used to complete this project. In this project the experiment was conducted due to the design of experiment data (D.O.E). Therefore, some experimental results are obtained and described in chapter four such as surface quality measurement by using Profilometer which is equipped in FKP laboratory. The following chapter is discusses about the result, problems and suggestion to overcome the problems. Finally, the overall project and its achievements are concludes in chapter six.

ABSTRAK

Projek kajian mengenai peranan proses parameter terhadap permukaan bahan Stainless Steel jenis SUS 304 melalui proses pemesinan dengan meggunakan mesin larik CNC ini terbahagi kepada dua bahagian. Bahagian pertama projek ini menerangkan tentang cadangan projek dan bahagian kedua merangkumi perlaksanaan dan ujikaji. Keseluruhan laporan ini merangkumi gabungan kedua-dua bahagian tersebut,dimana terdapat enam bab keseluruhannya dengan pengenalan sebagai bab pertama dan kemudian diikuti dengan bab rujukan ilmiah, prosedur, keputusan ujikaji,perbincanagan dan diakhiri dengan bab kesimpulan. Bab pertama iaitu pengenalan projek terdiri daripada skop kajian, objektif dan keputusan yang dikendaki. Objektif yang paling penting yang perlu dicapai dalam kajian ini ialah menjalankan kajian terperinci terhadap peranan proses parameter pada permukaan bahan besi lembut dan mencadangkan proses parameter yang sesuai untuk penghasilan pemotongan yang berkualiti. Dalam bahagian bab dua pula menerangkan tentang rujukan ilmiah untuk membaca, meganalisis dan memahami tentang asas proses pemesinan menggunakan mesin larik CNC dan kajian permukaan bahan besi Stainless Steel jenis SUS 304. Bab seterusnya ialah prosedur atau carakerja yang merangkumi langkah-langkah pelaksanaan ujikaji berpandukan Design of Experiment (D.O.E). Bab empat pula merangkumi proses pemesinan dan ujikaji kauliti permukaan dengan menggunakan Profilometer. Perbincangan hasil ujikaji diterangkan dalam bab lima dan kesimpulan keseluruhan projek ini diterangkan dalam bab enam.

DEDICATION

To his Divine Grace and to my beloved family members

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My deepest appreciation to Mr. Mohd Amri bin Sulaiman for his support and cooperation in allowing me to successfully complete my final year project. His guidance has helped me to finish the first and second part of this final year project and his advice is so resourceful, which make a great impact on preparing this report.

At this juncture, it is only logical for me to pay tribute to my friends. Their undivided support is the beacons that have continued to motivate me through the harshest of situation and I believe it will also spur me on to greater achievement in the future.

Finally, I am also indebted to all people who have directly and indirectly helped to make my final year project stint an incredible journey of knowledge and self improvement. These are the men and women who have left an indelible mark in their own significant way in my life. Their kind gestures and warm smiles will always have a very special place in my heart.

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

%	-	Percent
^{0}C	-	Degrees Celsius
e.g.	-	For example
etc	-	and others
CNC	-	Computer Numerical Control
CAM	-	Computer Aided Manufacturing
&	-	and
UK	-	United kingdom
Hp	-	Horse Power
BUE	-	Built-up edge
Fc	-	Force
V	-	Spindle speed
Ft	-	Thrust Force
R	-	Resultant Force
μ	-	Coefficient of Friction
β	-	Friction Angle
ΔT_c	-	Average Temperature rise in the tool–chip interface
Pu	-	Friction Power spent on the Tool Face
c_s	-	Specific Coefficient of Heat on workpiece
F_u	-	Friction Force
h_c	-	Chip Thickness
δ	-	Ratio of the Plastic Layer Thickness over Deformed chip thickness
RPM	-	Revolution per Minutes
HSS	-	High Speed Steel
ipr	-	Inches per revolution
ipm	-	Inches per minute

DOC	-	Depth of cut
Ra	-	Arithmetic Mean value
R*q*	-	The root-mean-square average
Ry	-	Maximum Roughness Height
Rz	-	Ten Point Height of Irregularities
ε	-	Random Error
λc	-	Cutoff
D.O.E	-	Design of Experiment
HRB	-	Hardness Brinell
AC	-	Alternative current
IT	-	Information Technology
FKP	-	Fakulti Kejuruteraan Pembuatan

CHAPTER 1
INTRODUCTION

1.1 PROJECT BACKGROUND

Based on the project title, "effect on surface roughness for stainless steel material in CNC lathe machining" is conducted in consequence to study on relevant process parameters which are highly contributing factors to the defects of surface roughness of stainless steel grade 304.

CNC lathes are rapidly replacing the older production lathes due to their ease of setting and operation. They are designed to use modern carbide tooling and fully utilize modern processes. The part may be designed by the Computer-aided manufacturing (CAM) process, the resulting file uploaded to the machine, and once set and trailed the machine will continue to turn out parts under the occasional supervision of an operator. The machine is controlled electronically via a computer menu style interface and the program may be modified and displayed at the machine, along with a simulated view of the process.

There are three main controllable cutting parameters play important roles to produce the good quality of surface finishing. The combination of those parameters and other cutting facts such as cutting tool selection, usage of coolant and type of coolant and characteristics of the material being cut, and chip flow will produce the expected good cutting quality and an identical product in repeatable machining process. However in this empirical research, investigations are focused on parametric setting only. This project would be used as guideline to handle the CNC lathe model Hass more efficiently to obtain a good level of cutting accuracy within the range of experimental values.

1.2 PROBLEM STATEMENT

Stainless steel is an iron-based metal which contains very low carbon levels (compared to mild steel) and various levels of chromium. Chromium combines with oxygen to form an adherent surface film that resists oxidation. It is used for a wide variety of home and commercial applications, this is one of the most familiar and most frequently used alloys in the stainless steel family. One of the typical applications of stainless steel SUS 304 is in automation industry in bowl feeding making especially involved medical stuffs and milk processing. Some of the cylindrical part which involving SUS 304 material produced by CNC lathe machining. The smooth and fine surface finish of this material has produced especially in food industry and medical stuff underwent several machining process or finishing process such as grinding and chemical polishing else will affected manufacturing operation of maybe human health. These processes need high cost and ample of time to produce finish part. So, the proper cutting quality is needed in CNC lathe machining to reduce the second process such as finishing operation. Through in this investigation work, the optimal parametric setting will be decided to produce the good surface finish and to indentify the most affected parameters to the cutting quality such as spindle speed, feed rate and depth of cut.

1.3 SCOPE OF PROJECT

This project aims to develop and recommend a set of process variables which could produce a good cutting quality level with minimal geometrical errors within the range of experimental values by controlling the major controllable machining parameters. The machine to be used for cutting will be the Hass 20 Hp SL series model. The investigation research work is expected to be conducted on the stainless steel grade 304 solid cylinders with 30mm diameter. Controlling process parameters which are depth of cut, spindle speed and feed rate have to be manipulated in order to produce good cutting quality. Quality examinations in the aspects of surface roughness will be investigated and conducted by using profilometer.

1.4 OBJECTIVES

Upon conducting the effect of parameter investigation of CNC lathe machining, some of the major objective are expected to do meet among them are as follow:

- To conduct the factors that influences the cutting quality of CNC lathe.
- To investigate the influence of design parameters such as spindle speed, depth of cut, and feed rate.
- To investigates the effected surface roughness of stainless steel grade 304 by using profilometer.
- To recommended the optimized parametric to produce good cutting quality for stainless steel grade 304 by using CNC lathe.

CHAPTER 2
LITERATURE REVIEW

2.1 CNC Lathe

2.1.1 CNC Lathe Description

The accelerated application of computer aided manufacturing (CAM) to machining by the use of CNC machine tools has focused on developing reliable machinery data systems, to ensure optimum production using expensive equipment. These computerized machinability data systems have been classified into general types, namely database system and mathematical model system. The database system uses the collection and storage of large quantities of data from experiments, and the mathematical models attempt to predict the optimum conditions.

The demand for high quality and fully automated production focuses attention on the surface condition of the product, especially the roughness of the machined surface, because of its effect on product appearance, function, and reliability. For these reasons it is important to maintain consistent tolerances and surface finish. Also, the quality of the machined surface is useful in diagnosing the stability of the machining process, where a deteriorating surface finish may indicate workpiece material non-homogeneity, progressive tool wear, and cutting tool chatter.

Among several industrial machining processes, CNC lathe is a fundamental machining operation. Lathe is the most common metal removal operation encountered. It is widely used in a variety of manufacturing industries including the aerospace and automotive sectors, where quality is an important factor. The quality of the surface plays a very important role in the performance of lathe as a good-

quality machined surface significantly improves fatigue strength, corrosion resistance, and creep life. Surface roughness also affects several functional attributes of parts, such as wearing, heat transmission, and ability of holding a lubricant, coating, or resisting fatigue. Therefore, the desired finish surface is usually specified and the appropriate processes are selected to reach the required quality. Several factors influence the final surface roughness in CNC lathe operation. Factors such as spindle speed, feed rate, and depth of cut that control the cutting operation can be setup in advance. However, factors such as tool geometry, tool wear, and chip formation, or the material properties of both tool and workpiece are uncontrolled. One should develop techniques to predict the surface roughness of a product before machining in order to evaluate the robustness of machining parameters such as feed rate or spindle speed for keeping a desired surface roughness and increasing product quality. It is also important that the prediction technique should be accurate and reliable.

2.2 About HAAS SL series Type CNC Lathe

Figure 2.1: HAAS SL series Type CNC Lathe (FKP Laboratory).

The SL-20, with a max turning capacity of 262 x 508 mm and 211 mm chuck, has a bar capacity of up to 50 mm. Haas high-performance turning centers also feature massive headstock castings with symmetric ribs for rigidity and thermal stability; on-the-fly wyes-delta switching for peak performance throughout the rpm range; and embedded chip trays and high-volume coolant systems for efficient chip removal. Haas has raised CNC turning to new levels of reliability, ease and productivity. The model comes standard with a 20 horse power for tail stock, and 5000 rpm spindle speed.

2.2.1 HAAS SL series Machine Specification

DIRECTION	Horizontal	
TURNING DIAMETERS	NOMINAL:8.000 "	MAXIMUM:8.200 "
TURNING LENGTHS	NOMINAL:15.000 "	MAXIMUM:16.300 " OPTION: 17.500
MAXIMUM SWING	23.000 "	
CHUCK DIAMETER	STANDARD:8.300 "	MAXIMUM:10.000 "
BAR CAPACITY	STANDARD:2.000 "	MAXIMUM:2.500 "

MAIN SPINDLE		
AVAILABILITY	Standard	
TURNING DIAMETERS	NOMINAL:--	MAXIMUM:--
TURNING LENGTHS	NOMINAL:10.000 "	MAXIMUM:10.000 "
MAXIMUM SWING	5.300 "	
CHUCK DIAMETER	STANDARD:--	MAXIMUM:--
BAR CAPACITY	0.875	
NOSE: A2-5	DRIVE MOTOR (HP): 8.0	

HEADSTOCK - SPINDLE 1	
NOSE: A2-6	**BORE:** 3.000 "
SPEED: 50 - 4000 RPM OPTIONS (top speed): • 3400 RPM • 5000 RPM • 7000 RPM	**DRIVE MOTOR (HP):** 20.0 OPTIONS: • 30.0
RANGE: 1	**INDEX INCREMENT (degrees):** 0.001