CUTTING TOOL ANGLE OF LATHE MACHINE FOR DIFFERENT MATERIALS

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We hereby declare that we have checked this project and in our opinion this project is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering with Manufacturing.

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I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

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"To my beloved mother, late father, family and someone special who gave me encouragement and support towards this study"

ACKNOWLEDGEMENT

بسم الله الرحمن الرحيم

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ABSTRACT

Metal removals widely use industries. There are many factors need to be considers to investigate to produce a optimum cutting angle. Experimental were used a few of machine which is grinder machine, lathe machine, rough surface and angle measured. High speed steel will be used to create a tool bit. During the tests, the depth of cut and cutting speed were kept constant and each test was conducted with a sharp uncoated tool insert. The tool will be test on difference type of material which is aluminum and steel. Underlying of this research is based on the literature review. Harder material needs the tool bit angle closer upon to the wok piece. Less clearance angle need because more force required overcoming the existing force. As we know area will influence the performance of force. Larger area will reduce force. Steel and aluminum are employed as test material in order to check the effectiveness of the tool bit. First assumption for optimum cutting angle for both materials is base on recommended angle. Optimum angle for Steel is 12 degrees and for aluminum is 15 degrees. Both material use different angle because different in structure of grain and composition of the metal. Aluminum is ductile material and the steel is brittle metal. It not all steel is totally brittle because brittle depends on carbon present in the metal itself. According to the first expectation, chip will be form for steel is non-continuous because it ductile material and for aluminum is continuous chip because brittle. The results obtained when the process complete are steel required 9 degree angle and the chip produced is discrete and for aluminum the angle required is 18 degree and the chip produce is continuous. Experimental is applied to find the optimal angle for both metals.

ABSTRAK

Penggunaan proses pembuangan logam digunakan secara meluas dalam industri pembuatan Terdapat banyak faktor yang harus pertimbangkan untuk mengkaji satu sudut memotong yang optima. Percubaan telah dilakukan mengunakan beberapa mesin yang tersedia ada seperti mesin pengisar,mesin larik, alat pengukur permukaan kasar dan protekter sudut .Keluli laju tinggi akan menjadi bahan untuk menghasilkan mata alat. Sepanjang proses, ukur kedalaman semasa memotong dan kelajuan memotong telah dimalarkan secara berterusan dan setiap ujian telah dikendalikan dengan alat motong yang tidak disadurkan. Alat memotong akan diuji keatas dua jenis bahan uji yang berbeza iaitu aluminum dan keluli. Projek ini adalah berdasarkan penyelidikan yang telah dijalankan oleh orang lain.Bahan uji yang lebih keras memerlukan sudut yang lebih kecil dan rapat. Sudut yang diperlukan adalah untuk mengurangkan hentaman mata potong terhadap bahan uji dan mengatasi daya yang wujud untuk setiap bahan uji. Sebagaimana kita sedia maklum,luas permukaan mempengaruhi daya yang terhasil. Luas permukaan yang lebih besar akan mengurangkan tekanan pada bahan uji. Keluli dan aluminium akan digunakan untuk menguji kebekesanan sudut terhadap kehalusan permukaan.Andaian pertama untuk sudut optimum bagi alat pemotong terhadap kedua-dua bahan uji adalah berteraskan pada sudut yang disyorkan. Sudut optimum untuk keluli adalah 12 darjah dan untuk aluminum adalah 15 darjah. Kedua-dua memerlukan sudut yang berbeza kerana berbeza dari segi komposisi logam bahan dan struktur. Aluminum adalah bahan mulur dan keluli adalah logam rapuh. Keluli ia yang tidak semua adalah betul-betul rapuh kerana kerapuhan bergantung kepada kandungan karbon dalam logam itu sendiri. Setelah analysis dijalankan secara experimen ,keputusan menunjukan keluli memerlukan 9 darjah dan serpiahn bahan yang dihasilkan adalah berbentuk serpih. Manakala bagi aluminum, sudut optimanya adalah 18 darjah dan serpihan logam yang dihasilkan adalah berterusan. Percubaan diaplikasikan untuk mencari sudut optimum untuk kedua-duanya logam.

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CHAPTER 1

INTRODUCTION

1.1 Introduction:

Lathe machine is one of the oldest machine has been created and very useful in industry until now. It play role in main processes which are turning and drilling. This analysis of cutting tool angle only focuses on turning process. It will be considered on angle of side rake angle on the tool. Experimental will be applied on difference material which is mild steel and aluminum to analyze the optimum selected angle of the tool bit base on surface finish produced and chip performance .The cutting forces are mainly affected by many factors such as cutting speed, feedrate, chip thickness, cutting tool material, tool geometry which is approaching angle, and rake angle, depth of cut and tool wear. This factor will work as constant parameters including type of machine.

Cutting force is known to be very sensitive even the smallest changes in the cutting process. Special focus was proposed for the selection conditions of the tests and experimental methodology. Measuring the cutting forces involve three successive stages: pre-process, measuring, and analysis of the results obtained in the test. Therefore, instead of calculating the cutting force theoretically, measuring them in process by dynamometers is preferred. Dynamometer is generally used to instead the calculation method. But this experiment not considered the force exerted on specimens but it will differentiate base on chip thickness produce and the final surface roughness produced on the workpieces. Surface roughness analyzes and the chip will evaluate by observation.

Operator may encounter difficulties during operating the machine. Cost will affect during the analysis. Large numbers of material needs to make available in order to grind and as a test material with difference angle of the tool. More time are needed to analyze because lots of machine have to exploit and many cutting tool angle need to produce. Lacks of experience in conducting the equipment also raise the time consume.

In a toolbit there are four angles exerted. One angle will be considered as variable and the other will be constant to reduce the time consume. This importance because more tool need to grind with difference angle. The difficulty is too precise the angle of the toolbit. Furthermore for constant angle part are hard to make each cutting tool alike. During the tests, the depth of cut and cutting speed, force and other criteria are keep constant for each test. The entire test will perform in similar condition. This is importance in order to reduce the error during operating the trial. Force and temperature will influence the toolbit because certain material will change the properties when temperature increase but these factors are negligible. Even thought it will ignore the result will affect the results obtain.

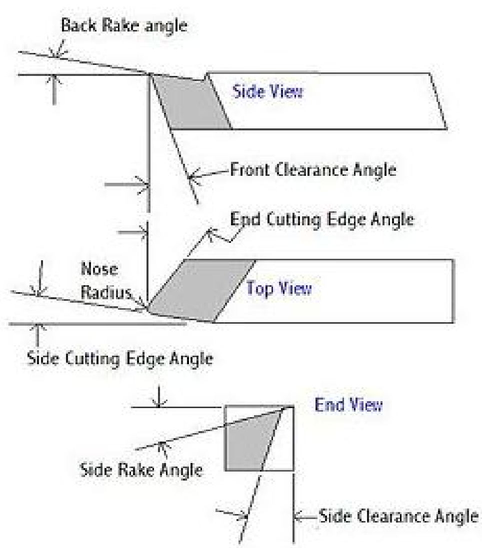


Figure 1: Cutting tool angle for Lathe machine

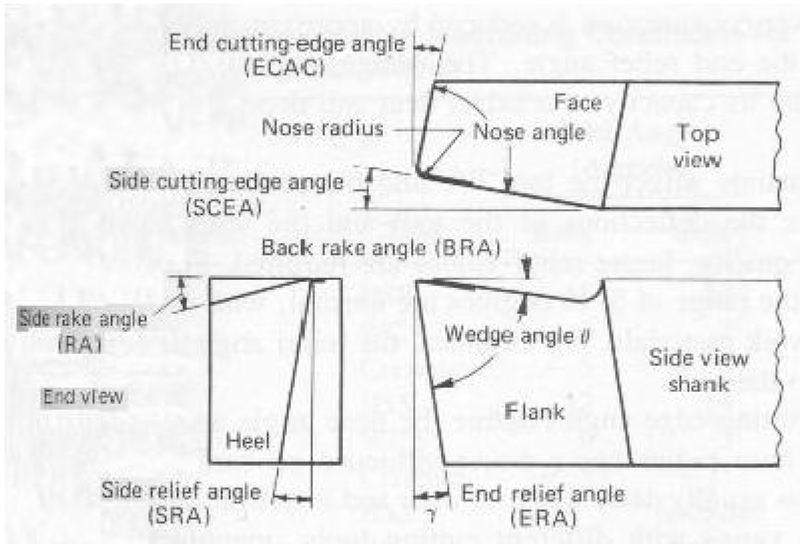


Figure 2: Tool geometry for cutting tool depends mainly on the properties of the tool material and work material. For single point tools the most important angle are the rake angle, the end relief angle and side relief angle.

1.2 Project background:

Cutting tool is one of the importance machine tool part in order to operate the workpiece. Metal removal and cutting process has long being known as one of significant and widely use in manufacturing process. The optimum cutting tool angle may give good surface finish. In industry, the quality plays importance role in mass production to market the product. By choose the tool wisely will produce good quality product. Optimum cutting tool angle used may minimize the time consume, reduce the force exerted on the workpiece depends on the properties of the material. The test will examine the optimum angle of the toolbit and fortunately will improve the existence angle.

Lathe machine, grinder, profile projectile, surface roughness machine (Pietometer S2) and Sine vice are among the machine and device will be use during the operation. Many operation need to face during conducting this analysis. Grinder use to grind the toolbit .Grinding the toolbit is the first process need to operate. Various angles will be produce base on type material and the recommendation angle. Difference material desired difference angle in order to produce the best surface finish. Usually materials which have high strength, have smaller angle to reduce the force on the toolbit and tool life is extended. Sine vice will be used ad initiative to produce constant angle for for each toolbit look alike. Profile projectile is used to measure the angle of the toolbit. During operate, it difficult to predict and get exact angle for each cutter. Lathe machine is applied during test upon the material. Turning process is the main process for the lathe machine operation of this analysis. Surface roughness machine (Piethometer S2) is the final machine to be use to determine the surface roughness produce. This machine is use to get the optimum angle and the best angle of tool bit will be get base on the surface roughness produce.

The analysis is base on the surface roughness produce on the workpieces and the chip performs for each material. During the tests, the depth of cut and cutting speed, force and other criteria are keep constant for each test. The entire test will perform in similar condition. This is importance in order to reduce the error during operating the trial.

Case studies are examining the angle and will be test on the difference. Two type of material will be used which are aluminum and steel. Each material has difference properties and all include as soft material. High speed steel (HSS) is decided material for cutter or insert. HSS is cheap and high toughness. HSS also able withstand in higher or elevated temperature without losing the temper or hardness.

1.3 PROBLEM STATEMENT:

Now a day, people or engineer keep on investigate the optimum angle for metal removal process. Day by day they able to improve and proved wisely choose the tool angle able produced good surface finish. Cutting tool angle will effects:

i. The tool life and Tool wear
ii. Time of operating
iii. Quality of product
iv. The force on the workpiece

This criterion is influence by performance of the tool. We noticed that tool life for the tool will increase when less wear exerted in the tool. Toolbit need to be alter when wear on the tool is worst. Otherwise, good angle will influence duration of the operation. Time consume is decrease and high quality of product will produce when optimum angle is used. Besides that, with this, the cutting process can reduce wastage of material and less cost.

1.4 OBJECTIVE:

To find the optimum cutting tool angle within the experimental range for tool bit of high speed steel on different materials for lathe machine.

1.5 PROJECT SCOPES:

i. Grind the tool bits to get the desired angle.
ii. The tool bits produced are tested at a lathe machine on different materials to check its effectiveness. The material will be use are steels and aluminum.
iii. The average surface roughness (Ra) of the test material and chip performed are obtained

CHAPTER2

LITERATURE REVIEW

2.1 INTRODUCTION

Literature review is one of the scope studies. It works as guide to run this analysis. It will give part in order to get the information about the toolbit and will give idea to operate the test. This part will include almost operation involved in the test, history, machining properties and results. History of the lathe will be story little bit in this section. Properties feature and application of the material used also will be discussed. For the result it was touch bout the chip formation, force and temperature and surface roughness. Literature review section work as reference, to give information and guide base on journal and other source in the media.

2.2 HISTORY OF LATHE MACHIN

Machine tool is a power mechanical device. It used to fabricate the metal component of machine by machining. Machine tools are selective removal of metal. Lathe machine tools were invented around 1715 by Jacques De Vaucanson because he was the first to amount the cutting instrument on mechanical adjustable head. Machine tool really began develop to develop after steam engine leading to industrial revolution.

The powered may generated by human, flywheel, animal and now a day electricity are mainly used. The machine can operate manually or automatic control ‘

All lathes by their very nature rely on revolving workpieces. Bow lathes figure in early engineering especially in clock and watch making. Small lathes driven by hand held bow probably provided the earlier form of turning, particularly of small item not just wood but ivory and precious metals. Strap or bow lathes could have been used for the smaller artifacts but turning wheel hubs would require more power than would probably be available from a strap lathe. It is almost certain that pole lathes were used to produce the larger items.

Since 2000BC wheel is start establish. Man was making spoke wheels yet the earliest symbolic reference. The great advantage of a wheel driven lathe is that continuous and controlled rotary motion is possible. This was not an automatic benefit to every aspect of woodturning though, as is illustrated by the continuing use of the reciprocating bow, strap and pole lathes. These ancient, simple lathes could still compete and perform efficiently in certain specialist areas such as small spindle and bowl turning. The main eliminates required for self-propelled continues rotation is clearly shown, the flywheel, crank and treadle. It was the crank in conjunction with the flywheel that provided a huge leap forward in technological advance. The crank, linked to a treadle provided constant rotation whilst the momentum of the large flywheel ensured the crank was carried over its ‘dead spot’. The drawing also shows an adjustable tailstock with a threaded cranked handle.

One disadvantage of this lathe is that it only provided direct drive, so the speed of the machine relies entirely on the speed of the turner’s foot on the treadle, but it is beautifully simple and compact with its integral wheel. The next advance was to mount the wheel independent of the headstock and linking the two via a belt or cord, this allowed the use of stepped pulleys to be useEven though the foot treadle wheel lathe was a great advance, for many forms of turning it still had it’s limitations regarding the size of object to be turned. For heavy work the ‘great wheel’ was developed. These wheels were often six feet (2m) or more in diameter and were freestanding, usually being some distance from the lathe itself

No advantage was to be gained by expensive investment when the simple reliable technology of the strap, bow, pole and latter wheel lathes was usually just as efficient and more reliable. In 1854 the waterwheel had been replaced with water turbines. Turbines were much more efficient; they consisted of a large shaft-mounted propeller submerged in a duct through which the water flowed. The force of the water turned the propeller and shaft and by means of gearing drove the machinery.

First practical in using the steam engine is in 1698. Early steam engines were huge and developed to pump water from mines and later to drive heavy engineering machinery (including metalworking lathes) to produce machine tools. By the middle of the nineteenth century steam engines were to be found driving woodworking machinery in a few factories and even in specialist wood turneries

A well-adjusted and sharpened automatic lathe is capable of tuning very complex and highly detailed shapes extremely quickly. Water driven was used to replace or improve the previous lathe. Water wheel power is applied. After a few years the water driven was updated with water turbine. Turbine are more efficient because consist large shafted mounted propeller submerged in a duct through which the water flowed .the force water turned the propeller and shaft and by means of gearing drove the machine.

Steam engines develop upon to lathe machine in 1698 to drive heavy engineering engine to produce machine tool. Internal combustion built in 1860 and start use oil engine in operating.oil engine became more reliable, compact and cheaper. Electric motors provide compact and powerful drive force and allow modern lathe to be built.

Finally automatic lathe were establish. it give significant in industries in order to increase the speed production .less labor cost or manpower and reduce operating cost. Time consumption also reduces. Improvements of feature on lathe machine are very useful in manufacturing process and material removal process [11].

2.3 TURNING PROCESS

Turning is the machining operation that produces cylindrical parts. In its basic form, it can be defined as the machining of an external surface with the workpiece rotating, a single-point cutting tool and With the cutting tool feeding parallel to the axis of the workpiece and at a distance that will remove the outer surface of the work.

Taper turning is practically the same, except that the cutter path is at an angle to the work axis. Similarly, in contour turning, the distance of the cutter from the work axis is varied to produce the desired shape. Even though a single-point tool is specified, this does not exclude multiple-tool setups, which are often employed in turning. In such setups, each tool operates independently as a single-point cutter.

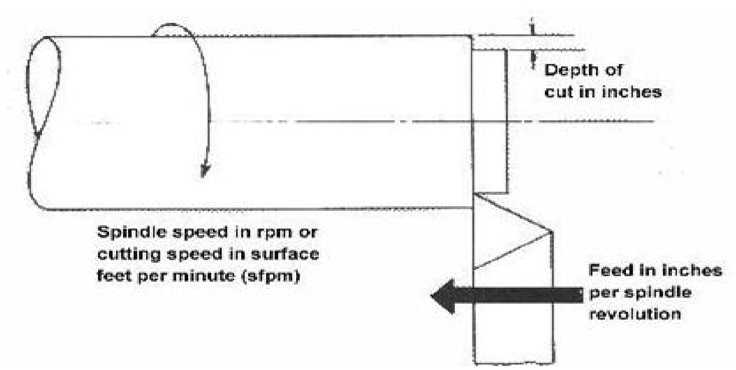


Figure 3: Turning and the adjustable parameters

The three primary factors in any basic turning operation are speed, feed, and depth of cut. Other factors such as kind of material and type of tool have a large influence, of course, but these three are the ones the operator can change by adjusting the controls, right at the machine.

Speed**,** always refers to the spindle and the workpiece. When it is stated in revolutions per minute (rpm) it tells their rotating speed. But the important figure for a particular turning operation is the surface speed, or the speed at which the workpeece material is moving past the cutting tool. It is simply the product of the rotating speed times the circumference (in feet) of the workpiece before the cut is started. It is expressed in surface feet per minute (sfpm), and it refers only to the workpiece. Every different diameter on a workpiece will have a different cutting speed, even though the rotating speed remains the same.

Feed, always refers to the cutting tool, and it is the rate at which the tool advances along its cutting path. On most power-fed lathes, the feed rate is directly related to the spindle speed and is expressed in inches (of tool advance) per revolution (of the spindle), or ipr. The figure, by the way, is usually much less than an inch and is shown as decimal amount.

Depth of Cut is practically self explanatory. It is the thickness of the layer being removed from the workpiece or the distance from the uncut surface of the work to the cut surface, expressed in inches. It is important to note, though, that the diameter of the workpiece is reduced by two times the depth of cut because this layer is being removed from both sides of the work.

2.4 CUTTING TOOL FOR LATHE

Most lathe operations are done with relatively simple, single-point cutting tools. On right-hand and left-hand turning and facing tools, the cutting takes place on the side of the tool; therefore the side rake angle is of primary importance and deep cuts can be made. On the round-nose turning tools, cutoff tools, finishing tools, and some threading tools, cutting takes place on or near the end of the tool, and the back rake is therefore of importance. Such tools are used with relatively light depths of cut. Because tool materials are expensive, it is desirable to use as little as possible. It is essential, at the same, that the cutting tool be supported in a strong, rigid manner to minimize deflection and possible vibration. Consequently, lathe tools are supported in various type of heavy, forged steel tool holders, as shown in the figure.

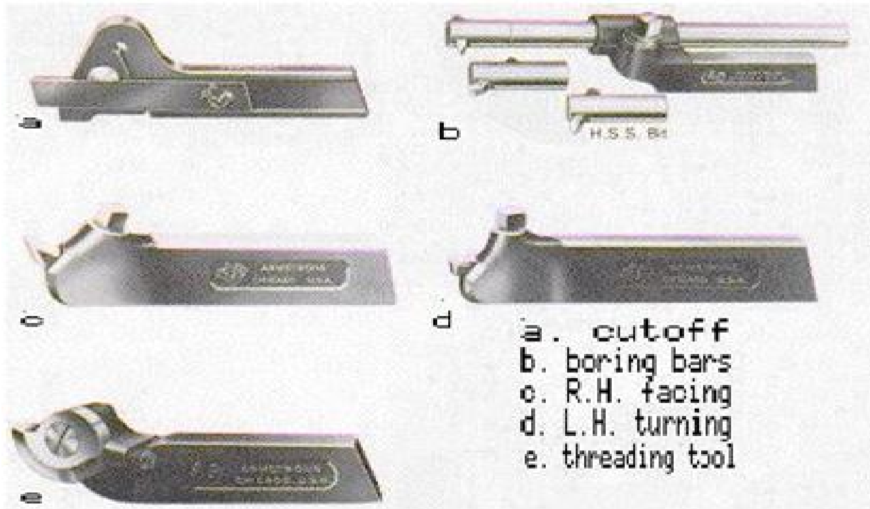


Figure4: Type of holder for tool bit on lathe machine

The tool bit should be clamped in the tool holder with minimum overhang. Otherwise, tool chatter and a poor surface finish may result. In the use of carbide, ceramic, or coated carbides for mass production work, throwaway inserts are used; these can be purchased in great variety of shapes, geometrics (nose radius, tool angle, and groove geometry), and sizes.

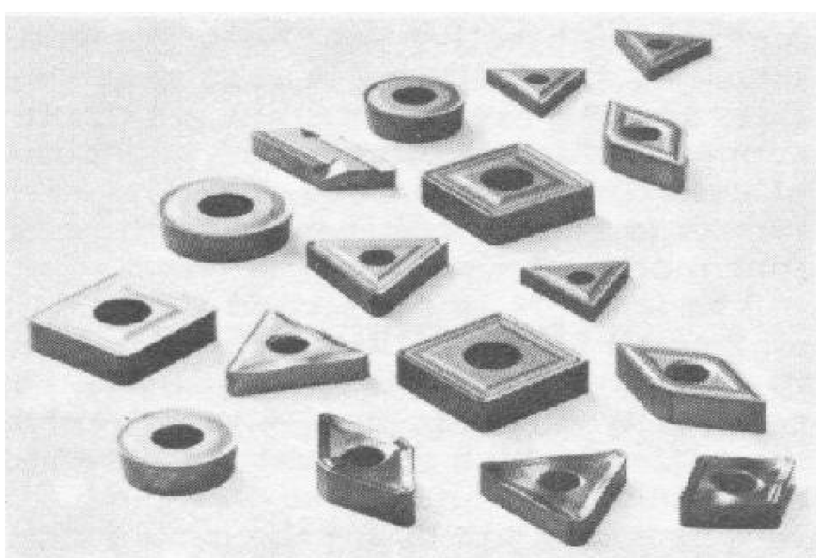


Figure 5: Type of carbide toolbit

2.5 STEEL

Steel is type of ferrous metal. This metal contain iron element but the properties of exist in this group deferent according to percentage of the iron contain in the metal. Steel also contain carbon element. High carbon content can make the steel more harder and stronger then iron but more brittle. Increasing number of carbon thus the metals become more brittle. Steel also have good hardness and ductile strength but it depends on alloying element present in the steel. This metal very significant thus it usually apply on major component in the building tool and automobile.

2.6 ALUMINUM

These metals actually exist in non-ferrous. Aluminum is one of the non ferrous which is not containing iron element. it has their own properties depend on the percentage of carbon and element added into metal to be alloy metal. Aluminum has ability on resist to corrosion and light weight. It usually use in transportation, cooking utensil and construction like window door.

2.7 HIGH SPEED STEEL (HSS)

High speed steel is one the material can be use to made cutter or tool bit. Other tool material will use except HSS is tungsten. Tungsten work on steel because high tensile strength. Aluminum, brass and steel are in type of soft material. Soft material not good for cutter because can cause vibrating during operating.

High speed steel, HSS can withstand in high or elevated temperature without losing it temperature and hardness. It will cut faster than high carbon steel. Other advantages of HSS is ,it cheap and toughness than tungsten. In addition, to increase their life tool sometime this metal coated with other metal like TiN (titanium nitride) to increase the hardness and lubricity to decrease the temperature.

2.8 RELIEF ANGLE AND RAKE ANGLE

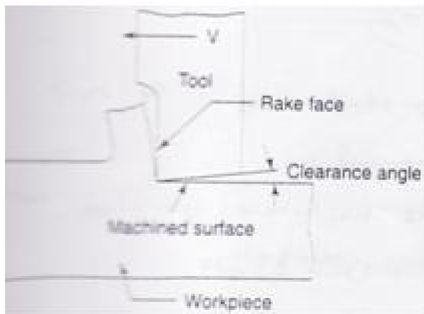
Angle play important role in manufacturing especially in metal removal in order to get a get result. There are a few angle consider in cutting process which is rake angle and relief angle. Cutting edge is the leading of the land in the direction of rotation for cutting.

In relief angle there are other two subdivisions, end relief angle and side relief angle. Relief angle mean that the angle measured in transverse plane between the relieved surface and plane tangent to the periphery at the cutting edge. It will influence the torque force exerted on the workpiece. Stronger the edge when the relief dimension is constant. The result of removal of tool material behind or adjacent to the cutting edge will provide clearance and prevent rubbing on the workpiece.

For rake angle also divide into two subdivisions which is back rake angle and side rake angle. Rake angle is the angle between the cutting edge of tool and a plane perpendicular to the working surface to which the tool is applied. The position is inclination to the perpendicular.

The back rake angle affects the ability of the tool to shear the work material and form the chip. It can be positive or negative. Positive rake angles reduce the cutting forces resulting in smaller deflections of the workpiece, tool holder, and machine. If the back rake angle is too large, the strength of the tool is reduced as well as its capacity to conduct heat. In machining hard work materials, the back rake angle must be small, even negative for carbide and diamond tools. Higher the hardness, thus smaller the back rake angle. For high-speed steels, back rake angle is normally chosen in the positive range.

Different between these two angles is rake angle work on perpendicular to the cutting edge and relief angle work on tangential to the cutting edge and will prevent the tool rubbing the surface of the workpices.



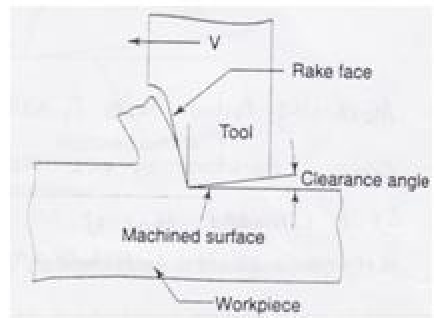


Figure 6: Tool cutting at different rake angle.

2.9 CUTTING FORCE AND TEMPERATURE:

There is much factor influence the performance of the cutting tool. This factors including cutting speed, formed chip thickness ,cutting tool material, depth of cut, tool wear, tool life , tool geometry and coolant. The entire factor may influence the force and temperature produce during operating the machine. Increase the cutting speed can reduce the machining hour or time consumes but will reduce the tool life of the tool bit.

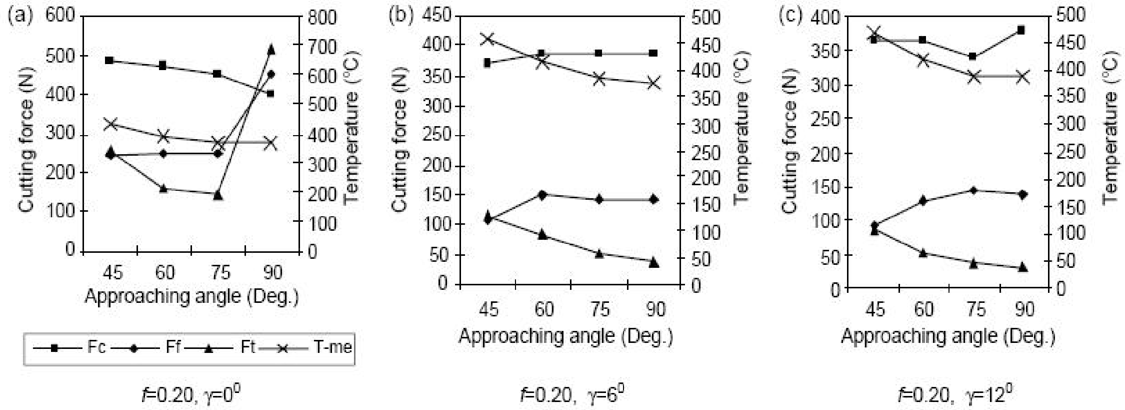


Figure 7: The cutting forces and temperature change due to rake angle in diferent feedrate.

Based on analysis proposed by Huci Saglam ,Faruk Unsacar and Suleyman Yaldiz [9] under the title investigation of effect of rake angle and approaching angle on main cutting force and tool temperature, it examine the related force and temperature with the rake angle of the tool bit. Purposed of the analysis is to make comparison of measured and calculated results of cutting force component and temperature variation generated on the tool tip in turning for different cutting parameter and difference tool having various geometries. The method used is similar for this analysis where it maintain or constant the depth of cut, cutting speed were kept constants for each test with sharp uncoated tool inserts. The dynamometer used to instead the calculating the force theoretically. Cutting force have been measured by dynamometer designed for different working principle as strain gauge based [1, 5], load cell based [6] and piezoelectric principle [4].

Rake angle is one of the important parameter which determines the tool and chip contact area. Increasing the rake angle over it optimum value has negative effect on tool's performance and accelerate the tool wear. Excessive wear causes large clearance face contact with machine surface with lead to increase the cutting force. Increasing the rake angle from small values to the optimum values cause reduction in tool or chip contact length. In expected the force will reduce. Negative rake angle cause larger contact area and cause also higher chip volume and lead to increase both, temperature and force. Force and temperature may influence the surface finish produce.

The cutting process is defined as being as stochastically stationary process so that its prediction cannot be made on the basis of it theoretical analysis. Because the cutting known to be very sensitive to even smallest changes in cutting process. According to analysis projected by Mustafa GÜnay,Ihsan Korkut,Ersan Aslan and Ulvi Seker [8] state that cutting force decreasing trends was observed due to rake angle increasing to positive. According to the graph, increasing the angle will reduce the force exerted to the workpieces.

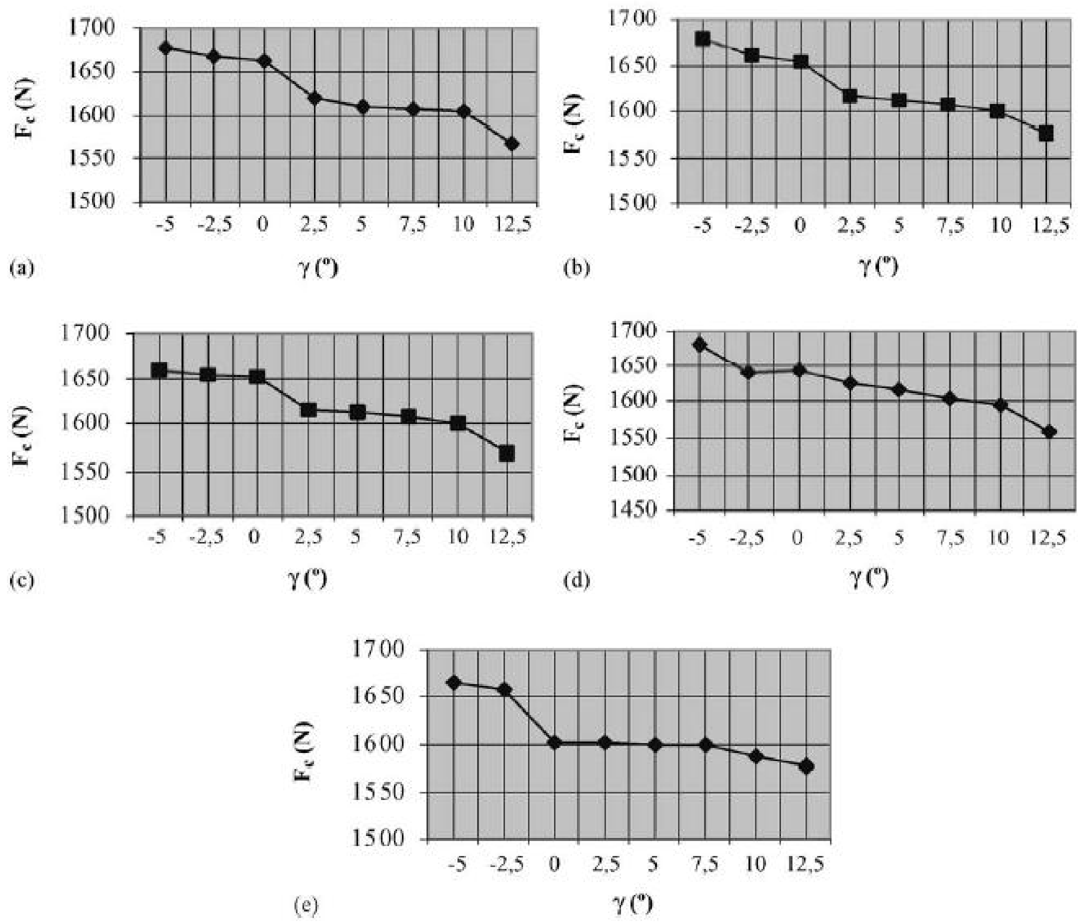


Figure 8: Main cutting force (Fc) alteration due to rake angle (γ)

2.10 SURFACE ROUGHNESS:

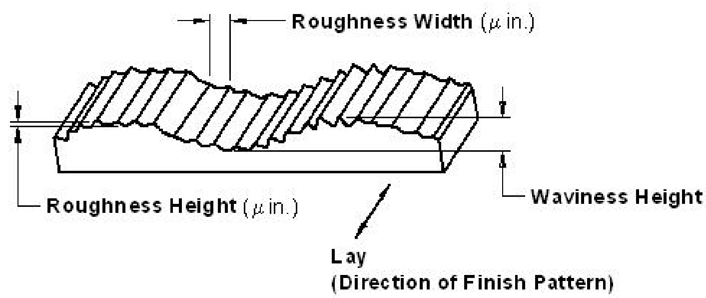


Figure 9: the surface structure after cutting process.

Surface roughness is the measure if the finer surface irregularities in the surface texture. These are the result of the manufacturing process employed to create the surface. The ability of manufacturing operation is base on many factors. The final surface depends on the rotational speed of the cutter, velocity of traverse, feed rate and mechanical properties of workpieces being machined. Type and amounts of lubricant use at the point of cutting also influence the surface produce. A small change in any of the factor above can have a significant effect on the surface finish.

A single parameter of the surface roughness could not indicate a change in the manufacturing process. There for many parameter and method were developed over the years to enable improved ways of surface roughness evaluation. Base on the formula below [9], F represent the full evaluation length are usually divided into five sub-array of equal number of samples to enable better statistical analysis. These sub-arrays are commonly referred to as the sampling length. Mathematically the sampling length arrays f_i obtained as below.

$$f_i(m) = F\,(m + i(N/5) - (N/5))$$

From the equation above where N presents the total number of element in the evaluation length array, F. i is the sampling length data array number having an integer value in the range of 1 to 5 and m presents the element number within each of the sampling length data arrays thus m has integer value of 1, 2, 3 until N/5

2.11 CHIP FORMATION:

According to thesis proposed by M.Ibrahim Sadik and Bo Lindstrőm [3] careful classification of the chip form will contribute to greater productivity through correct tool or cutting data selection and will facilitate the design and construction of the chip control system ,based on knowledge of the cutting process. Tool selection has become a difficult process.

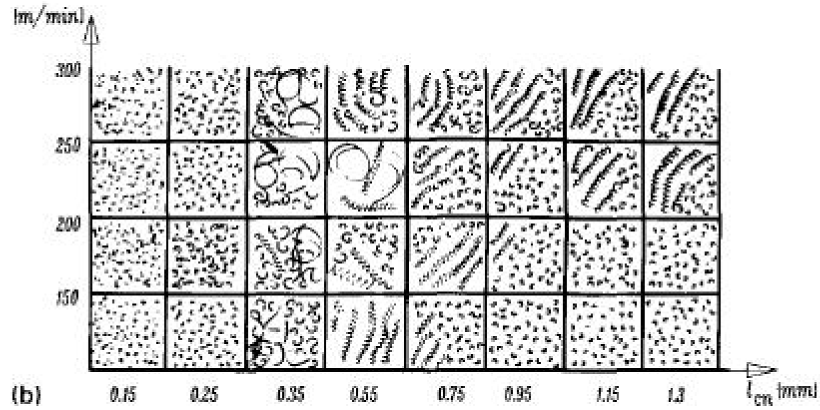


Figure 10: The chip form with contact length (mm) and cutting speed (m/min).

The chip thickness compression ratio, A_h is a parameter indicating the amount of deformation to which the chip has been exposed and related to the chip curl radius governing the chip form. Based on their experiment done by M.Ibrahim Sadik and Bo Lindstrőm [3] the chip thickness compression ratio A_h is a function of the contact length. Increase in cutting speed which leads to decrease in natural contact length, results in decrease in the chip thickness ratio. High chip thickness compression ratio, the chip exposed to low shear deformation. It results of the low feed. Compression ratio is affected more by the feed and the cutting force.

I.S. Muhsin [2] states that the factors which affect the chip form are similar as those affecting the contact length. It is including the cutting data, tool material, workpiece material, tool geometry cutting fluid and operation type.

The chip can be classified into different type depending on the relationship between the shear strength of the workpiece and the shear deformation to which the chip is exposed. The problem is in which range of the cutting data each chip-breaker groove should be used to achieve optimum tool life and acceptable chip form.

CHAPTER 3

METHODOLOGY:

3.1 INTRODUCTION:

Machine from the scientific definition is a device that transmitted or modifies energy. In common usage, the meaning is restricted to devices having rigid moving part that perform or assist in performing some work. Machine normally requires some energy source or input and always accomplishes some sort of work or output. Device with no rigid moving part are commonly considered tools or simply devices not machine.

People have used mechanisms to amplify their abilities since before written records were available. Generally these devices decrease the amount of force required to do the given amount of work, alter the direction of the force or transform one form of motion or energy into another.

The mechanical advantage of a simple machine is the ratio between the force if exert on the load and the input force applied. Force required overcoming the friction as well. Modern power tool automated machine tools and human operated power machinery is tools that are also machines. Machine used to transform heat or other energy into mechanical energy are known engine.

Hydraulics device may also be used to support industrial application although devices entirely lacking rigid moving part are not commonly considered machined. Hydraulics is widely used in heavy equipment industries, automobile industries, marine industries, aerospace industries, construction equipment industries, and earthmoving equipment industries.

Machine tool is a power mechanical device. It used to fabricate the metal component of machine by machining. Machine tools are selective removal of metal. Lathe machine tools were invented around 1715 by Jacques De Vaucanson because he was the first to amount the cutting instrument on mechanical adjustable head. Machine tool really began develop to develop after steam engine leading to industrial revolution. The powered may generated by human, flywheel, animal and now a day electricity are mainly used. The machine can operate manually or automatic control.

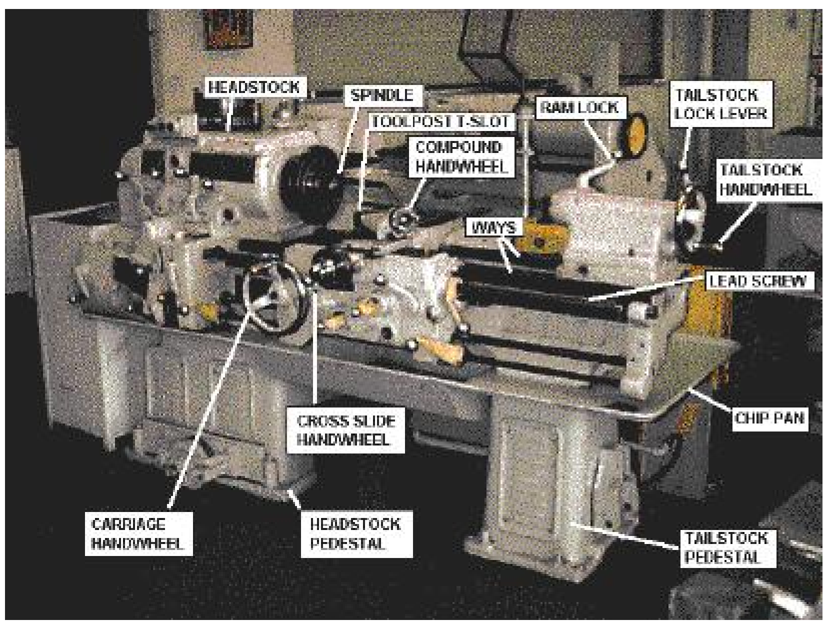
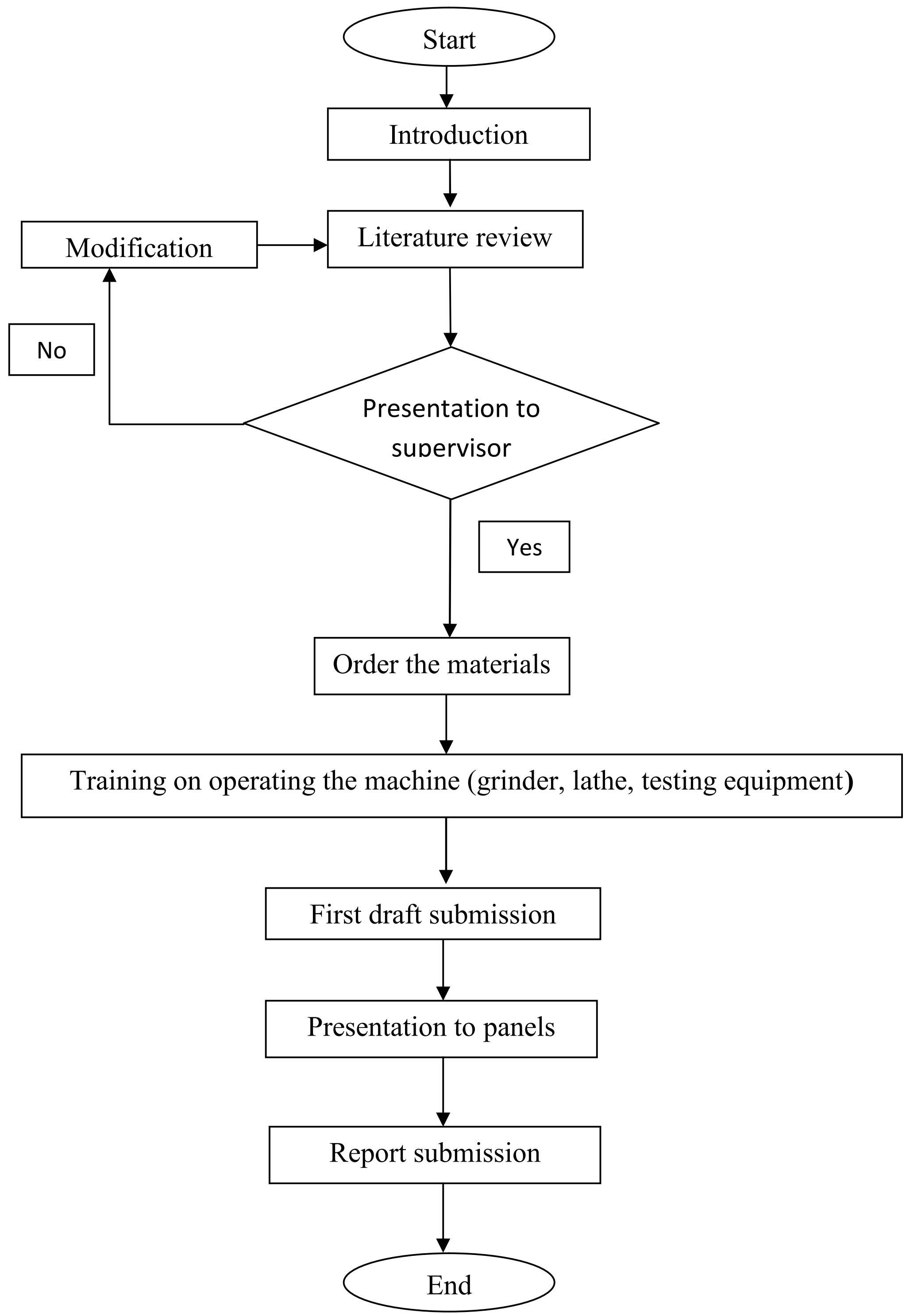


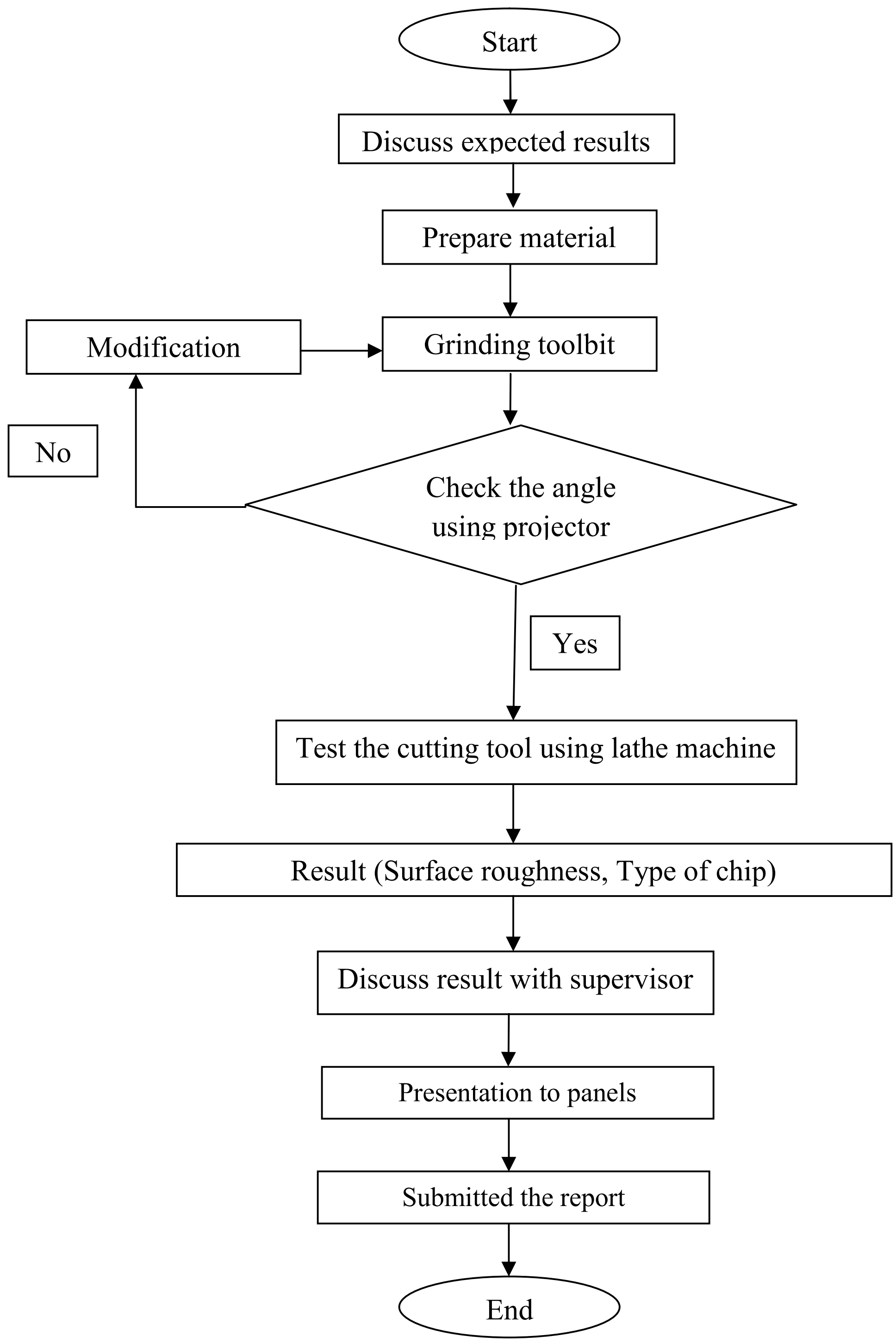
Figure 11: Manual lathe machine

3.2 FLOW CHART:

3.2.1 FLOW CHART FYP1:



3.2.2 FLOW CHART FYP2:



3.3 MACHINING PROCESS

3.3.1 Grinding

There a few command step to operate the lathe machine which are:

i. Hold the tool bit firmly while supporting the hand on the grinder tool rest.
ii. Tilt the bottom of the tool bit in toward the wheel and grind the 10^0 side-relief angle and form required on the left side of the toolbit.
iii. Grind until the side cutting edge is about ½ inch (12.7mm) long and the point is over about one-fourth the width of the toolbit.
iv. High speed steel toolbits must be cooled frequently
v. Hold the back end of the toolbit lower than the point and grind the 15^0 end-relief angle on the right side. At the same time the end cutting edge should form an angle of 70^0 to 80^0 with the side cutting edge.
vi. Hold the toolbit about 45^0 to the wheel tilt the bottom of the toolbit in and grind the 14^0 side rake on the top of the toolbit.
vii. Grind the side rake the entire length of the side cutting edge but do not grind the top of the cutting edge below the top of the toolbit.
viii. Grind a slight radius on the point being sure to keep the same end and side-relief angles.
ix. Use an oilstone to hone the point and cutting edge of the toolbit to remove sharp edge, produce a keener cutting edge and improve its cutting action

Figure 12: Hand holding the tool to " Break" the point saves resetting the angle on the tool rest.

3.3.2 LATHE MACHINE PROCESS

An aircraft is permitted to takeoff, the pilot or crew must go through a check-out procedure to determine whether the engines, controls, and safety features are in first-class operating condition. The same applies to the operation of a machine tool such as a lathe. The operator should inspect the machine for safe and proper operation.

i. Clean and lubricate the machine.
ii. Be sure all guards are in position and locked in place.
iii. Turn the spindle over by hand to be sure it is NOT locked nor engaged in back gear.
iv. Move the carriage along the ways. There should be no binding.
v. Check cross slide movement.
vi. Mount the desired work holding attachment.
vii. Adjust the drive mechanism for the desired speed and feed.
viii. If the tailstock is used, check it for alignment.
ix. Clamp the cutter bit into an appropriate tool holder and mount it in the tool post. Do NOT permit excessive compound rest overhang as this often causes tool "chatter" and results in a poorly machined surface.
x. Mount the work. Check for adequate clearance between the work and the various machine parts.
xi. In addition, to the above procedures, the operator must take some precautions. Sleeves should be rolled up and rings, jewelry and necktie or necklace removed.

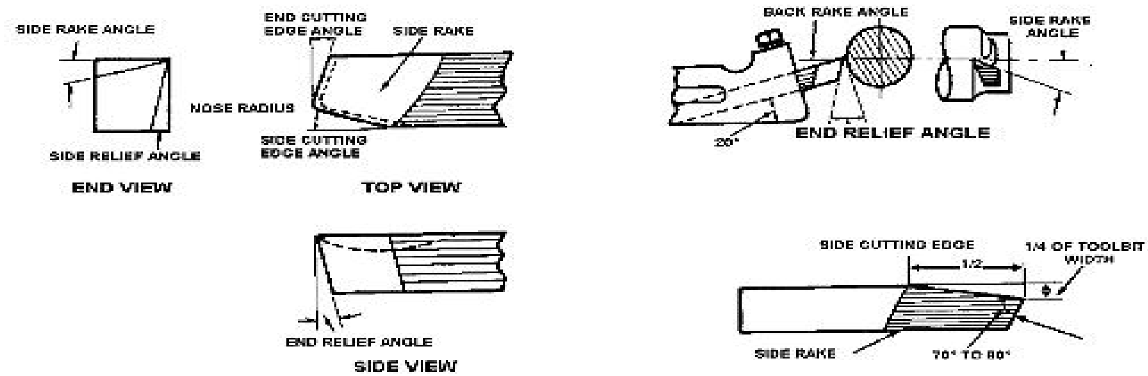


Figure 13: The tool bit angle on the lathe machine using tool holder

3.4 MATERIAL

Table 3.4: Prediction of quantity of workpieces[10]

Materials	Angle (degree , ^{o})	Number of workpieces	Total workpieces
Aluminum	9,12,15,18,21	5	10
Mild steel	10, ,12,15,18,21	5	

The materials that will apply for the test are aluminum and steel. All material has discrepancy in chemical composition, element count and microstructure and grain size. It will present in difference hardness of material the specimens were cut off in required length which is 200mm and the diameter was 30mm. all the dimension of the material is constant.

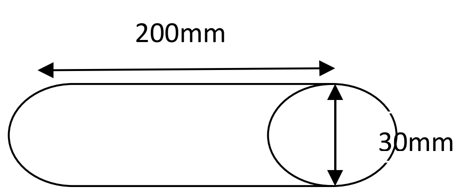


Figure 14: Dimension of test material

3.5 CUTTING TOOL AND CUTTING PARAMETER:

Table 3.5: The recommended of rake and relief angles for Lathe toolbits.

MATERIAL	SIDE RELIEF		END RELIEF		SIDE RAKE		BACK RAKE	
	HSS	CARBIDE	HSS	CARBIDE	HSS	CARBIDE	HSS	CARBIDE
ALUMINUM	12	6 to 10	8	6 to 10	15	10 to 20	35	0 to 10
STEEL	10	5 to 8	8	5 to 8	12	6 to -7	8	0 to -7

Table above shown the standard angle of insert for the turning process using lathe machine. Main cutting tool material will be used is high speed steel (HSS). Actually for generally there two type of tool material commonly used in turning process which is high speed steel and carbide. Carbide tool exist is coated tool. The four side of the blank are ground to a smooth and shiny finish. The carbide tool bit may use as comparison of performance of cutting process. There are normal dimension of tool blank of HSS which is 5/16"x5/2" or 64mm x 8mm. in this analysis, it required 15 tool blank to produce the tool bit. Coolant also applied to prevent the tool wear and tool life. The type of coolant is constant. It could be water or oil.

3.6 SURFACE ROUGHNESS AND PROFILE PROJECTILE:

There are two process will be carry out to find the optimum angle which is grind the tool and applied the tool on difference material. The tool will grind using the grinder. Geometry of the tool will be state and profile projectile will be used to predict the angle. The lathe machine will be use to continue the process for turning process. The results of the turning process are based on surface roughness and chip produce during the process. The surface roughness device known as Pethometer S2 will be use to examine the surface finish for each material. It will analyze base on the surface produce. Other than that the chip perform for each material also will be observe and evaluate by sight. Comparing will carry out to find the best angle for each material.

3.7 CONSTANT PARAMETERS:

Cutting process involved many factors that influence the surface finish of the material. There a few criteria need to be considered as constant to control the result. During the tests, the depth of cut and cutting speed, force and other criteria are keep constant for each test. The entire test will perform in similar condition. The suggested parameters are as below:

i. Cutting speed= 110m/min(aluminum) and 30m/min (steel)
ii. Feed rate = 0.16mm/rev
iii. Depth of cut = 0.5mm
iv. Coolant = water and oil

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter will discuss the experimental result and summarized all data material that has been tested on two different materials which each table have different variables and constant and alter parameter. The parameter likes feed rate, speed and depth of cut are important consideration when selecting the actual cutting data and preparing NC program. There are parameter have to be considered in relation to their importance because there are technological limits in some cases while others demand that certain quality requirements are satisfied.

To achieve generally improved metal-cutting conditions, proper application of coolants is recommended. The use of coolants generally permits higher machining speeds and avoid from produced burn chip. The functions of coolants are to dissipate heat generated at the tool point and thus keep work piece temperature down, to reduce friction and tool wear by lubrication and to facilitate chip disposal.

Wisely choose the cutting speed and cutting angle will give good surface finish finished because lack force exerted on the workpieces and influence the production in metal removal sector.

4.2 PRELIMINARY FINDING OF RESEARCH

Underlying of this research is based on the literature review. Harder material needs the toolbit angle closer upon to the wokpiece. Less clearance angle need because more force required overcoming the existing force. As we know area will influence the performance of force. Lager area will reduce force. Steel and aluminum are employed as test material in order to check the effectiveness of the tool bit. First assumption for optimum cutting angle for both materials is base on recommended angle. Optimum angle for Steel is 12 degrees and for aluminum is 15 degrees. Both material use different angle because different in structure of grain and composition of the metal. Aluminum is ductile material and the steel is brittle metal. It not all steel is totally brittle because brittle depends on carbon present in the metal itself. According to the first expectation, chip will be form for steel is non-continuous because it ductile material and for aluminum is continuous chip because brittle. Experimental is applied to find the optimal angle for both metals.

4.3 RESULTS

Table below show the entire results for both materials. It will judge against the chip performance and the surface roughness on each workpieces.

4.3 RESULTS

Table 4.3.1 RESULTS FOR ALUMINUMS:	VARIABLE ANGLE	CONSTANT ANGLE			CONSTANT PARAMETERS			RESULTS FOR SURFACE FINISED				
			negligible									
NO. OF TOOLBIT	SIDE RAKE ANGLE	SIDE RELIEF ANGLE	BACK RAKE ANGLE	END RELIEF ANGLE	DEPTH OF CUT (mm)	CUTTING SPEED (m/min)	FEED RATE (mm/rev)	**1**	**2**	**3**	4	mean
1	9							1.33	2.13	1.33	1.6	1.598
2	12							2.67	3.2	3.2	1.6	2.668
3®	15	12	35	8	0.4	110 (990rpm)	0.18	0.53	1.07	1.07	5.27	1.985
4	18							0.67	1.33	2.18	1.07	1.313
5	21							1.07	1.6	3.2	1.67	1.735

Table 4.3.2 RESULTS FOR STEELS:

NO. OF TOOL BIT	VARIABLE ANGLE	CONSTANT ANGLE			CONSTANT PARAMETERS			RESULTS FOR SURFACE FINISED				
			negligible									
	SIDE RAKE ANGLE	SIDE RELIEF ANGLE	BACK RAKE ANGLE	END RELIEF ANGLE	DEPTH OF CUT (mm)	CUTTING SPEED (m/min)	FEED RATE (mm/rev)	**1**	**2**	**3**	**4**	Mean
1	9		\					2.67	8.37	2.67	1.6	3.828
2®	12							5.27	8.37	3.7	1.6	4.735
3	15	10	8	8	0.4	30 (635rpm)	0.18	6.3	8.37	3.2	2.13	5.000
4	18							2.67	8.37	4.23	2.13	4.350
5	21							10.43	12.5	12.5	8.37	10.955

Table 4.3.3: average Surface roughness using Surface Roughness Standard Comparator Flexbar Composite Pocket:

angle	Reading for aluminum				angle	Reading for steel			
	1	2	3	mean		1	2	3	Mean
9	1.6	1.6	1.6	1.6	9	3.2	3.2	1.6	2.67
12	1.6	1.6	1.6	1.6	12	6.3	3.2	6.3	5.27
15	3.2	6.3	6.3	5.27	15	6.3	6.3	6.3	6.3
18	0.8	0.8	1.6	1.07	18	3.2	3.2	1.6	2.67
21	0.8	1.6	0.8	1.07	21	12.5	12.5	6.3	10.43

Table 4.3.3.1: Person 1

4.3.3.2: Person 2

angle	Reading for aluminum				angle	Reading for steel			
	1	2	3	mean		1	2	3	Mean
9	1.6	1.6	0.8	1.33	9	12.5	6.3	6.3	8.37
12	3.2	3.2	3.2	3.2	12	12.5	6.3	6.3	8.37
15	1.6	0.8	0.8	1.07	15	12.5	6.3	6.3	8.37
18	3.2	1.6	1.6	2.13	18	12.5	6.3	6.3	8.37
21	3.2	3.2	3.2	3.2	21	12.5	12.5	12.5	12.5

4.3.3.3: Person 3

angle	Reading for aluminum				angle	Reading for steel			
	1	2	3	mean		1	2	3	Mean
9	3.2	1.6	1.6	2.13	9	1.6	3.2	3.2	2.67
12	3.2	3.2	3.2	3.2	12	3.2	1.6	6.3	3.7
15	1.6	0.8	0.8	1.07	15	3.2	3.2	3.2	3.2
18	1.6	1.6	0.8	1.33	18	3.2	6.3	3.2	4.23
21	1.6	1.6	1.6	1.6	21	12.5	12.5	12.5	12.5

4.3.3.4: Person 4

angle	Reading for aluminum				angle	Reading for steel			
	1	2	3	mean		1	2	3	Mean
9	1.6	0.8	1.6	1.33	9	1.6	1.6	1.6	1.6
12	1.6	3.2	3.2	2.67	12	1.6	1.6	1.6	1.6
15	0.8	0.4	0.4	0.53	15	3.2	1.6	1.6	2.13
18	0.8	0.8	0.4	0.67	18	3.2	1.6	1.6	2.13
21	1.6	0.8	0.8	1.07	21	6.3	12.5	6.3	8.37

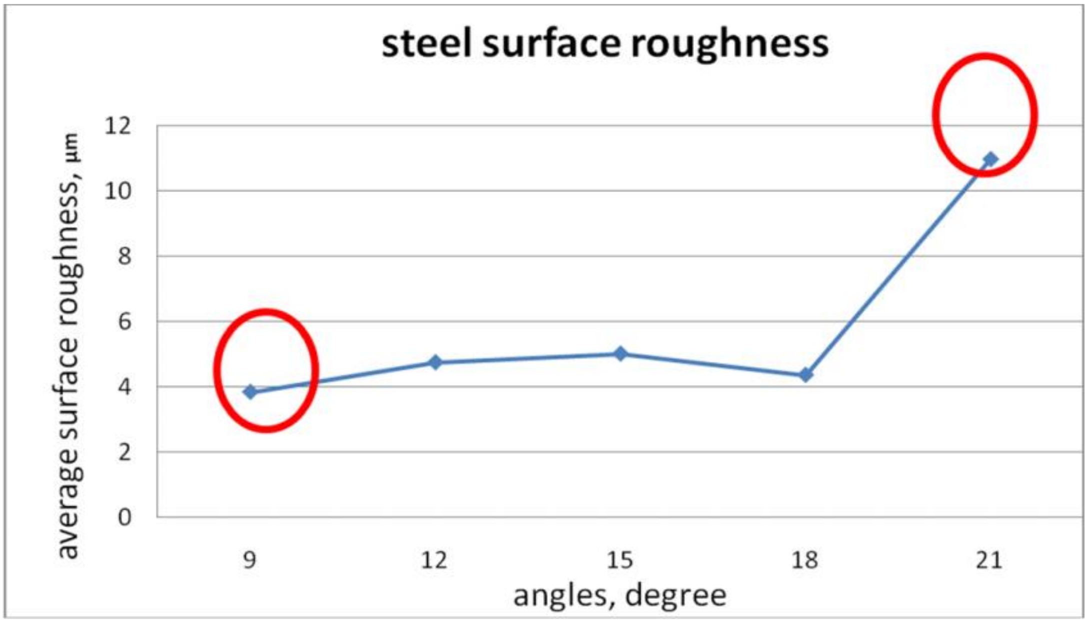


Figure15: The results of average surface roughness for the steels.

Discussion:

1. Steel requires small angle to remove the material. Small clearance need to give enough force to overcome the existence force on the test material. As we know when the force increases the force also increase. When the machining operate to fast and the feed to deep the toobit will wear and defect occur on the toolbit. The material need to feed little by little to ensure that the toolbit not burning. In case the tool burning the toughness of the insert will reduce.
2. According the result of the sensoring process, steel produces a good surface finish when the HSS tool bit of 9° is used. Because the lowest number of average surface roughness (Ra) will produce good surface finish which is Ra equal to 3.828µm.
3. Degree 21show the highest number of Ra thus it has the worst surface finish produce.
4. Chip performance for steel is discrete because a steel property is brittle.

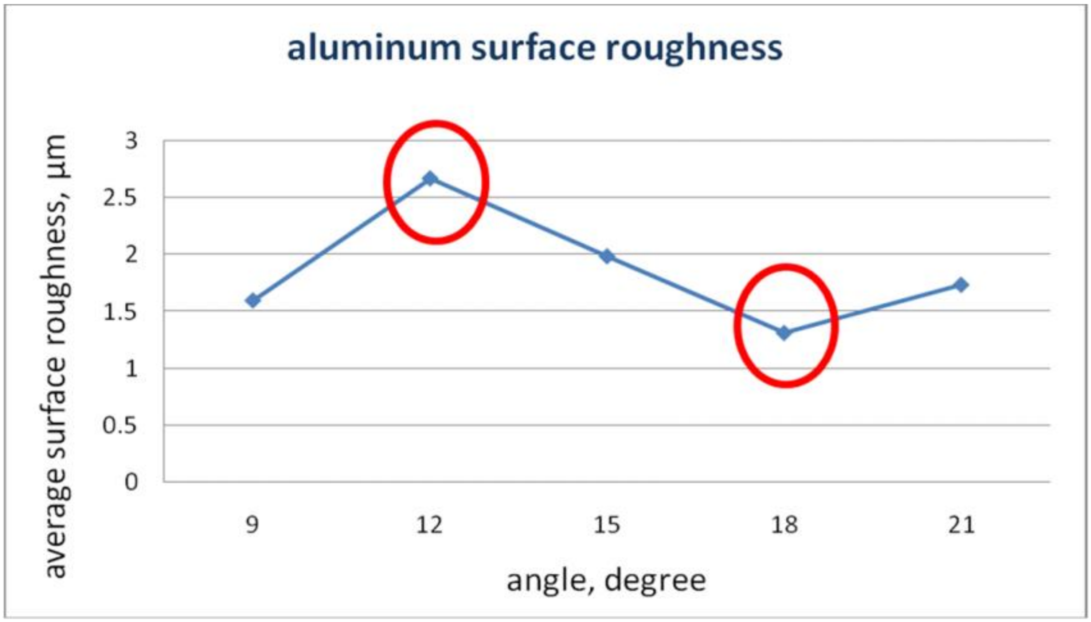


Figure15: The results of average surface roughness for the steels.

Discussion:

1. Aluminum is classified as a soft material and it is a ductile metal. During machining process the chip obtained is continuous.
2. Based on the results obtained from the sensoring process, the optimum angle for Aluminum to produces a good surface finish is 18°. The average surface roughness is 1.313 µm.
3. According to the graph degree 12 show the worst surface finish for aluminum. The average surface roughness is 2.668 µm.
4. The tool cannot feed too much because the wear will occur and the toughness will reduce when the toll bit burning.

4.4 ANALYSIS IN IDENTIFYING SIGNIFICANT FACTOR

There are many factor need to be consider during operating the machine to make sure the results produce are in good condition, satisfied and logical, speed of spindle, type of direction, federate, coolant, cutting geometry and etc. all the factor have their own condition or criteria in order to maximize the application of the that factor. Employed the factor below:

4.4.1 Selection on proper feed rate.

(i) The depth and width of the cut
(ii) The design or type of the cutter
(iii) The sharpness of the cutter
(iv) The workpiece material
(v) The strength and uniformity of the workpiece
(vi) The type of finish and accuracy required
(vii) The power and rigidity of the machine

4.4.2 Formula for speed (n)

The spindle speed for turning is defined as the speed at which the spindle of a Lathe machine rotates per minute. It is expressed in RPM. Its symbol is n.

$$\text{Spindle speed, } n = \frac{\text{Cutting speed}}{\text{Diameter of cutter} \times \pi}$$

$$n\ (\text{rpm}) = \frac{V}{d \times \pi}$$

* High speed steel cutter, V = 21-30 m/min (machine steel)

4.4.3 Selection of proper spindle speed

In order to obtain best results during machining, several factors need to be observed for the selection of proper spindle speed.

(i) For longer cutter life, use the lower cutting speeds in the recommended range.
(ii) Know the hardness of the material to be machined.
(iii) When starting a new job, use the lower range of the cutting speed and gradually increase to the higher range if conditions permit.
(iv) If a fine finish is required, reduce the feed rather than increase the cutter speed.
(v) The use of coolant, properly applied, will generally produce a better finish and lengthen the life of the cutter since it absorbs heat, acts as a lubricant and washes chips away.

4.4.4 Tool and coolant

The choice of tools for CNC machining operations depends on the type of tool socket in the tool carrier and, primarily, on the type of contours that require machining. Since both the tool carrier and the tool holder have to sustain high and rapidly changing forces, they must offer are high rigidity and favorable vibration characteristics.

The cutting action is mainly influenced by the tool edge. For costs reasons, this is generally kept small and index able tool tips predominate. The tool geometry affects stock removal. Important characteristics are the rake angle γ and the wedge angle β. Moreover, chip breakers are very important in the case of index able tool tips as these prevent long stringy chips.

A general property of all tools is the tool life which can be controlled under given conditions. Tools with long life are generally more expensive but they reduce tool change costs. To achieve generally improved metal-cutting conditions, proper application of coolants is recommended. It is the function of coolants are to dissipate heat generated at the tool point and thus keep work piece temperature down, to reduce friction and tool wear by lubrication and to facilitate chip disposal.

The use of coolants generally permits higher machining speeds. Watery solutions offer good cooling effect but poor lubrication properties. Inversely, greasy oils provide exemplary lubrication but poor cooling. The coolant is cutting oils (with grease or solid additives).

The following should be noted when using coolants:

(i) Coolants tend to age and therefore require renewal at regular intervals.

(ii) There are coolants which affect the skin and therefore demand the wearing of protective clothing.

(iii) Coolants can affect slide ways. Therefore it is advisable to use mineral oil based coolants exclusively.

(iv) Metal-cutting tools become blunt after a certain working time and will require regrinding or changing. The time in question is called tool life.

This is affected by cutting speed, tool material, work piece material, chip cross-section (the cross sectional area of the chip before it is severed) and frequency of cut interruption. Tool manufacturers can in most cases provide reliable information as to the expected tool life for particular applications.

4.4.5 Chip formation

4.4.5.1 Nose Radius and Depth of Cut

Nose radius and depth of cut also affect the shape and direction of chips. Small depth of cut produces spiral-shaped chips, larger depth of cut leads to comma-shaped chips (Figure 4, below right). By the same token, a small nose radius generates thinner chips that are easier to push away from the workpiece. On the other hand, a large nose radius increases demands on the tool. It produces thicker chips and pushes them generally in many directions, generating higher cutting forces and requiring higher machine power for chip control.

Figure17: Two major chip type, spiral and comma-shape chip. A small depth of cut produces spiral-shaped chips (left diagram) and longer depth of cut lead to comma-shape chips.

To achieve better surface finish in finish turning, conventional wisdom says to use a larger nose radius and decrease feed rate. The flip side, however, is that larger nose radii tend to cause vibration and poor chip breaking. To ensure that you get good surface finish, a special wiper insert is recommended for high finish turning. Wiper inserts have a modified nose radius with larger corners to wipe the surface smooth, allowing you to run at up to double the recommended feed rate.

To summarize, here are some general rules to assist you in generating optimum chips.

1. Base your insert selection on the workpiece material and application. Also consider machine stability, horsepower and surface finish requirements.
2. Rule of thumb for feed rate in turning: minimum feed rate 0.2 mm/rev and maximum one half of the nose radius.
3. If you're losing chip control, getting chip hammering and chatter, it may be a sign that your insert chipbreaker is too open. In that case, your first recourse is to increase feed rate and/or select an insert with a tighter chipbreaker. However, the chipbreaker should not be too tight, otherwise you'll increase heat buildup leading to chip welding, edge chipping or even breakage. On the other hand, if you find that you're getting chip crowding or the chip is crushed, or not shaped like a 6 or 9, decrease the feed rate or select a more open chipbreaker.
4. If you have a specific surface finish requirement, you may not have the option of running at higher feed rates. The alternative is to select a tighter chipbreaker and maintain comfortable feeds. Usually a wiper insert will do the trick.
5. If you're generating ideal chips, but getting excessive heat and tool wear, such as clattering, decrease feed rate. If crater wear continues, select an insert with a more resistant coating, such as aluminum oxide.
6. Generally speaking, if chip color is off, check cutting speed. Example: if your steel chips are not deep blue, but brownish, increase machine speed. If the color is silver, it means the chips may be getting too hot. Decrease speed. In stainless steel, aim for wheat-colored chips and in cast iron for grayish-red.
7. Whether you're doing heavy roughing, medium roughing or finishing, select an insert with the nose radius of $^{3}/_{64}$ inch or slightly larger.
8. Select a minimum depth of cut of two thirds of the nose radius and maximum one third of the cutting edge length. For finishing, select cutting depths of less than one third of the nose radius.

9. Generally select tools with high positive rake and tight chipbreakers for smoother chip flow, lower cutting forces, and lower temperatures. They will compensate to some extent for the deformation-hardening of the material.

4.4.5.2 Continuous chip

Continuous chips are normally produced when machining steel at high cutting speeds. The continuous chip which is like a ribbon flows along the rake face. Production of continuous chips is possible because of the ductility metal (steel at high temperature generated due to cutting) flows along the shear plane instead of rupture. Thus, on a continuous chip do not see any notches. It can be assumed that each layer of metal flows along the slip plane till it is stopped by work hardening.
The condition which favour a continuous types of chip:

(i) High temperature
(ii) Sharp cutting tool
(iii) Fine feed
(iv) Larger rake angles
(v) High cutting speed
(vi) Ductile work material
(vii) Proper coolant

4.4.5.3 Non-Continuous chip

When brittle materials like cast iron are cut, deformed material gets fractured very easily and thus the chip produced is in the form of non-continuous segments. In this type the deformed material instead of flowing continuously gets ruptured periodically.

Non-continuous chip are easier from the view point of chip disposal. However, the cutting force becomes unstable with the variation coinciding with the fracturing cycle.

The condition which favor a non-continuous type of chip:

(i) Low cutting speeds

(ii) Small rake angles on cutting tool

(iii) Brittle work material

(iv) Coarse machining feeds

(v) Major disadvantages – could result in poor surface finish

4.4.5.4 Continuous with built-up edge

When the friction between tool and chip is high while machining ductile materials, some particles of chip adhere to the tool rake face near the tool tip. When such sizeable material piles upon the rake face, it acts as a cutting edge in place of the actual cutting edge. This is termed as built up edge (BUE). By virtue of work hardening, BUE is harder than the parent work material. As the size of BUE grows larger, it become unstable and parts of it get removed while cutting. The removed portions of BUE partly adhere to the chip underside and partly to the machined surfaced. This are the cause when surface finish to be rough.

Conditions which favor a BUE type of chip:

(i) This type of chip is common in softer non-ferrous metals and low carbon steel.

(ii) BUE chip formation increases as the tool begins to dull

Problems associated with BUE chip formation:

(i) Welded edges break off and can become embedded in work-piece

(ii) Decreases tool life

(iii) Can result in poor surface finishes

4.4.6 Toolbit

4.4.6.1 Angle of the toolbit

The successful operation of the lathe and the quality of work that may be achieved depend largely on the angles that form the cutting edge of the tool bit show in figure below. Most tools are hand ground to the desired shape on a bench or base grinder. The cutting tool geometry for the rake and relief angles must be properly ground, but the overall shape of the tool bit is determined by the preference of the machinist or machine operator.

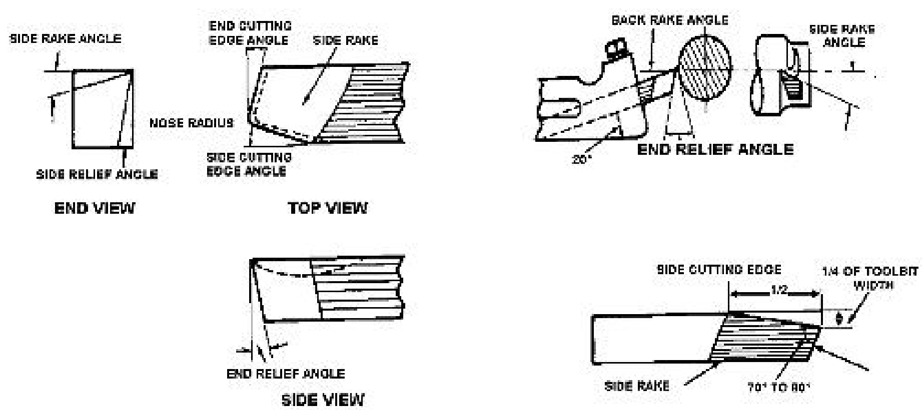


Figure18: tool bit angle

Lathe tool bit shapes can be pointed, rounded, squared off, or irregular in shape and still cut quite well as long as the tool bit angles are properly ground for the type of material being machined. The angles are the side and back rake angles, the side and end cutting edge angles, and the side and end relief angles. Other angles to be considered are the radius on the end of the tool bit and the angle of the tool holder. After knowing how the angles affect the cutting action, some recommended cutting tool shapes can be considered.

Rake angle pertains to the top surface of the tool bit. There are two types of rake angles, the side and back rake angles. The rake angle can be positive, negative, or have no rake angle at all. The tool holder can have an angle, known as the tool holder angle, which averages about 15°, depending on the model of tool holder selected. The tool holder angle combines with the back rake angle to provide clearance for the heel of the tool bit from the workpiece and to facilitate chip removal. The side rake angle is measured back from the cutting edge and can be a positive rake angle or have no rake at all.

Rake angles cannot be too great or the cutting edge will lose strength to support the cutting action. The side rake angle determines the type and size of chip produced during the cutting action and the direction that the chip travels when leaving the cutting tool. Chip breakers can be included in the side rake angle to ensure that the chips break up and do not become a safety hazard.

Side and relief angles, or clearance angles, are the angles formed behind and beneath the cutting edge that provide clearance or relief to the cutting action of the tool. There are two types of relief angles, side relief and end relief. Side relief is the angle ground into the tool bit, under the side of the cutting edge, to provide clearance in the direction of tool bit travel. End relief is the angle ground into the tool bit to provide front clearance to keep the tool bit heel from rubbing. The end relief angle is supplemented by the tool holder angle and makes up the effective relief angle for the end of the tool bit.

Side and cutting edge angles are the angles formed by the cutting edge with the end of the tool bit (the end cutting edge angle), or with the side of the tool bit (the side cutting edge angle). The end cutting edge angle permits the nose of the tool bit to make contact with the work and aids in feeding the tool bit into the work. The side cutting edge angle reduces the pressure on the tool bit as it begins to cut. The side rake angle and the side relief angle combine to form the wedge angle (or lip angle) of the tool bit that provides for the cutting action

A radius ground onto the nose of the tool bit can help strengthen the tool bit and provide for a smooth cutting action.

4.4.6.2 Shapes of Tool Bits

The overall shape of the lathe tool bits can be rounded, squared, or another shape as long as the proper angles are included. Tool bits are identified by the function they perform, such as turning or facing. They can also be identified as roughing tools or finishing tools. Generally, a roughing tool has a radius ground onto the nose of the tool bit that is smaller than the radius for a finishing or general-purpose tool bit.

A right-hand turning tool bit is shaped to be fed from right to left. The cutting edge is on the left side of the tool bit and the face slopes down away from the cutting edge. The left side and end of the tool bit are ground with sufficient clearance to permit the cutting edge to bear upon the workpiece without the heel rubbing on the work. The right-hand turning tool bit is ideal for taking light roughing cuts as well as general all-around machining.

A left-hand turning tool bit is the opposite of the right-hand turning tool bit, designed to cut when fed from left to right. This tool bit is used mainly for machining close in to a right shoulder.

The round-nose turning tool bit is very versatile and can be used to turn in either direction for roughing and finishing cuts. No side rake angle is ground into the top face when used to cut in either direction, but a small back rake angle may be needed for chip removal. The nose radius is usually ground in the shape of a half-circle with a diameter of about 1/32 inch.

The right-hand facing tool bit is intended for facing on right-hand side shoulders and the right end of a workpiece. The cutting edge is on the left-hand side of the bit, and the nose is ground very sharp for machining into a square corner. The direction of feed for this tool bit should be away from the center axis of the work, not going into the center axis.

A left-hand facing tool bit is the opposite of the right-hand facing tool bit and is intend to machine and face the left sides of shoulders.

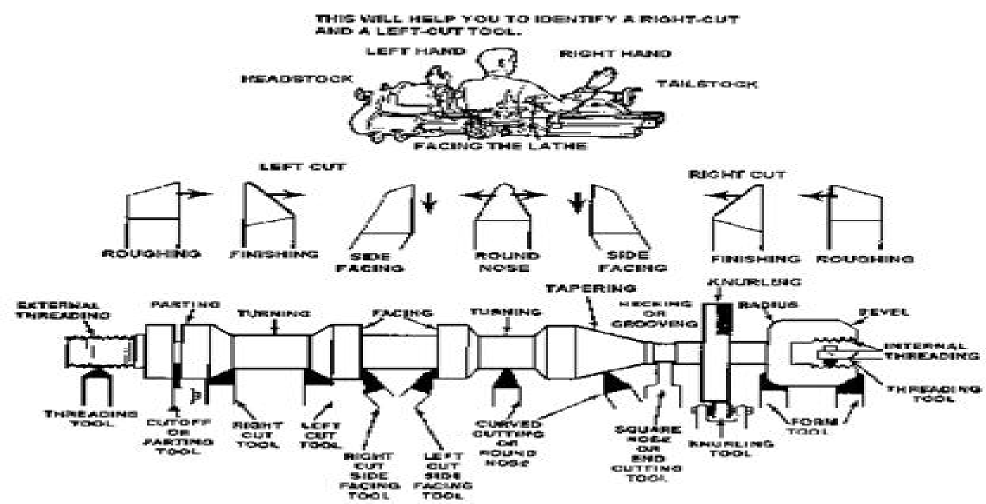


Figure19: toolbit shape

4.4.7 Surface Roughness.

. The final surface depends on the rotational speed of the cutter, velocity of traverse, feed rate and mechanical properties of workpieces being machined. Type and amounts of lubricant use at the point of cutting also influence the surface produce. A small change in any of the factor above can have a significant effect on the surface finish.

4.4.8: Selecting material

When selecting a material, several factors must be considered, including the cost, strength, resistance to wear, and machinability. The machinability of a material is difficult to quantify, but can be said to posses the following characteristics:

1. Results in a good surface finish
2. Promotes long tool life
3. Requires low force and power to turn
4. Provides easy collection of chips

4.4.9: Design feature:

4.4.9.1: Workpiece

1. Select a material that minimizes overall cost. An inexpensive workpiece may result in longer cut times and more tool wear, increasing the total cost
2. Minimize the amount of turning that is required by pre-cutting the workpiece close to the desired size and shape
3. Select the size of the workpiece such that a large enough surface exists for the workpiece to be securely clamped. Also, the clamped surface should allow clearance between the tool and the fixture for any cuts

4.4.9.2: Features

1. Minimize the number of setups that are required by designing all features to be accessible from one setup
2. Design features, such as holes and threads, to require tools of standard sizes

3. Minimize the number of tools that are required
4. Ensure that the depth of any feature is less than the tool length and therefore will avoid the tool holder contacting the workpiece
5. Lower requirements for tolerance and surface roughness, if possible, in order to reduce costs
6. Avoid undercuts

CHAPTER 5

CONCLUSIONS

5.1 INTRODUCTION

This chapter finally discusses about the summary and decision for the optimum cutting angle after the operation is ended. The best cutting angle can be decide and the chip performance can be evaluate after assemble the entire outcome from the each material.

Manufactured part qualities are determined by their form errors and surface finishes produces by manufacturing process. Surface roughness generally plays important role in wear resistance, ductility, tensile and fatigue strength for machined part ad cannot be neglected in design. In actual practice, there are many factors such as workpiece material ,cutting condition ,tool geometry , run out and machine vibration affecting the chip formation and machined surface roughness. How to control the turning process and choose appreciate cutting tool to meet the accuracy requirement is an important issue due to produce good quality of product.

All difficulties all ready successful overcome with any suitable way and initiative to get the results. Constant parameter also take part to control the result thus variable will be reducing. Lack experience in conducting the machine is not the matter because it can be learn time by time. Actually this is constitute the climax of this analysis or project after able to achieve the objective.

5.2 SUMMARY

There are many difficulties are faced during operating the machining and operate the vice. It need confidential and patient to ensure all be done well and fulfill the satisfactory. Below show afw difficulties need to be face during operating the task:

Table 5.1: summary progress

Equipment or vice	Difficulty/problem	Alternative /solution
Hand Grinder	- Vibration - Speed to fast causing burn on tool - Difficult to grind.	- Used the pedestal grinder.
Sine vice	- No manual to guide - Not accurate to fix the angle using the protector - Lack of skill	- Grind manually using pedestal grinder. - Continuously repeat to learn grinded the tool to get the skill.
Cutter elevation on lathe	- To center the tool upon to the workpiece - Vibration causing the center slightly change	- Centering device - Checked the tool centered frequently. - Tied the holder properly.
Perthometer	- Needle part on vice currently damage - Lack number of vice - queue up	- Take the reading using coparator standard surface roughness with different person. - Ask 4persons to take the reading and calculate the average reading for each angleof surface roughness
Tool	- Easy to burn causing reduce toughness of the tool - Sensitive during coupled on the holder will cause wear.	- Avoid to touched the other side tool bit - Alternate the speed and feed rate during lathe operation. - Used coolant to prevent from high force of friction, low the temperature and stress on the toolbit.
Profile projector	- High time consumed because allocated far from the grinder	- Protector to measure the angle manually. - Fordable vice
Lathe machine	- Vibration on workpiece during operating the machine operating the machine	- Use the center vice

5.3 CONCLUSION

This experiment investigated the performance of chip and surface roughness for different angle of the toolbit during lathe turning process. Metal removal process related with depth, speed and feed rate which the chip thickness will thicker when there exist forces resisting the chip from flowing out and influence the surface roughness of the workpiece. It is found that different angle will give different performance either base on surface roughness of chip present.

After the results obtained, the objective is excellently achieved. Steel requires small angle to remove the material compare to aluminum. Small clearance need to give enough force to overcome the existence force on the test material. Harder material requires smaller angle to overcome the exerted force on the work piece. The optimum angle will produce a good surface finish. The tool cannot feed too much because the wear will occur and the toughness will reduce when the toll bit burning

Recommended angle did not produce good surface finish may be because the factor influence the surface roughness like speed, feed rate and many more. Vibration and rubbing on work piece also influence the surface roughness.

material	**Recommended angle**	**Angle obtained by experimental**
aluminum	15^0	18^0
steel	12^0	9^0

Table5.2: comparison surface roughness of the recommended angle and angle obtained.

Chip performance depended on type of material will be use. Test material used in this research steel and aluminum. Ductile material will produce discrete chip and brittle material will produce continuous chip. Experimental prove that steel produce discrete chip and aluminum produce continuous chip.

5.4 SUGGESTION AND RECOMMANDATION

5.4.1: Surface roughness

There are few Possible defect will occur during turning processes. It can be avoid producing good surface roughness. Most defects in turning are inaccuracies in a feature's dimensions or surface roughness. There are several possible causes for these defects, including the following:

1. Incorrect cutting parameters
   - If the cutting parameters such as the feed rate, spindle speed, or depth of cut are too high, the surface of the workpiece will be rougher than desired and may contain scratch marks or even burn marks. Also, a large depth of cut may result in vibration of the tool and cause inaccuracies in the cut.
2. Dull cutting tool
   - As a tool is used, the sharp edge will wear down and become dull. A dull tool is less capable of making precision cuts.
3. Unsecured workpiece
   - If the workpiece is not securely clamped in the fixture, the friction of turning may cause it to shift and alter the desired cuts.

The material of the tool is chosen based upon a number of factors, including the material of the workpiece, cost, and tool life. Tool life is an important characteristic that is considered when selecting a tool, as it greatly affects the manufacturing costs. A short tool life will not only require additional tools to be purchased, but will also require time to change the tool each time it becomes too worn.

5.4.2: Chip performance

The speed and feed rate are important factors that must consider. It is because the factors affect the amount of time required to complete an operation and long a cutting tool (tool life). If the speed and feed too low, time will be wasted. And the cutting tool will wear too quickly if the speed and feed are set too high.

Tool play importance role in metal removal process.below note the suggested to select the tool for chip performances during the lathe turning process:

1. Compensate for the challenges of your workpiece materials. Select high positive rake inserts and chipbreakers and geometries matched to the materials, so that cutting forces work for, not against you.
2. For optimum material removal, maximize the depth of cut allowed by the cutting tool, then set the feed rate so that it works with your chipbreaker geometry to create the ideal chip.
3. Generally, select the smallest lead angle that the operation will allow for lower cutting forces and better chip disposal
4. Select a nose radius of $^{3}/_{64}$ inch or larger for stainless steel, steel, and cast iron

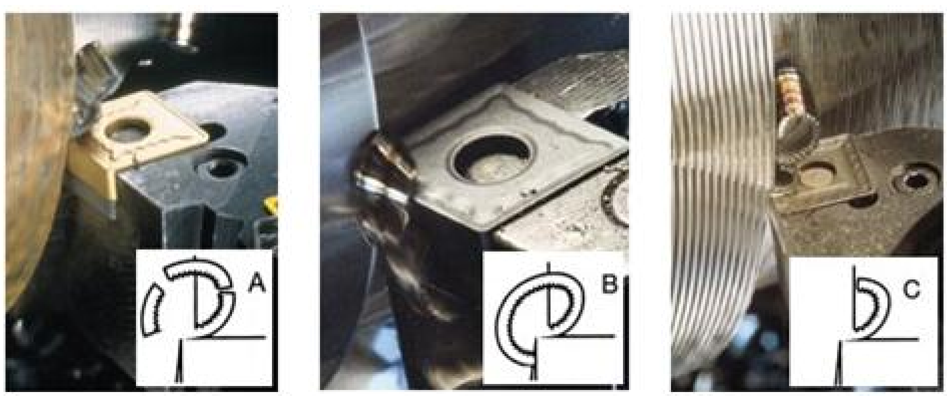


Figure20: There are three type of chip formation (A) self-breaking (B) breaking against the tool (C) breaking against the workpieces.

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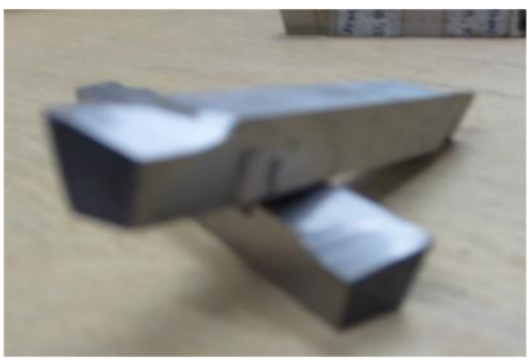
APPENDIXES

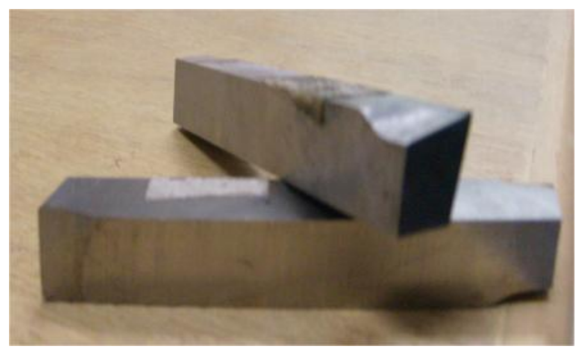
APPENDECE A: Grinding Process

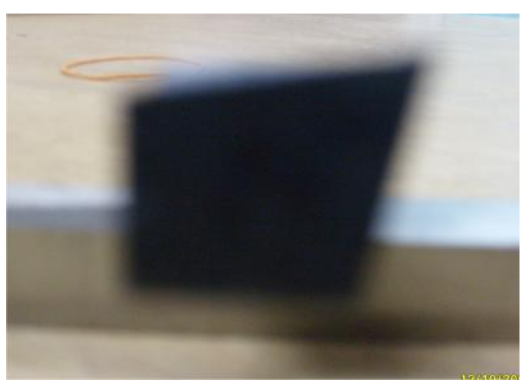
Type of pedestal grinder

APPENDECE B: Measurement of the tool bits and the tool bits produced.

Protector is used to measure the angle on the tool bits.

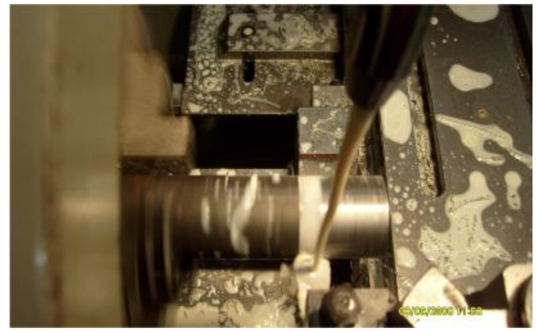




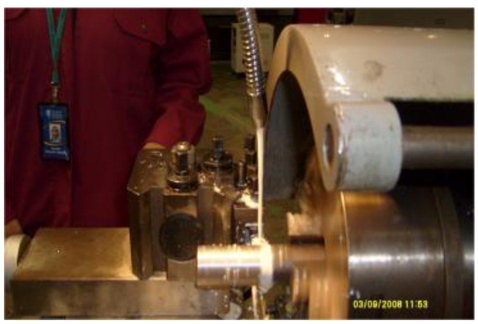


View of the tool bit obtained after grinded process.

APPENDIX C: Process Machining on Test Materials



Manual lathe machine

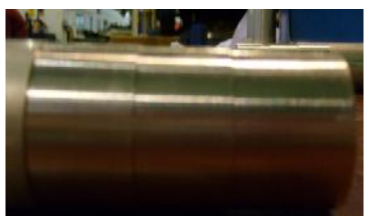


APPENDECE D: Test Materials after Machining Process



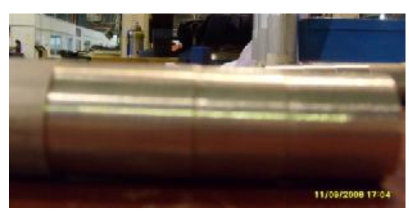
Aluminum for angle 9^0 Aluminum for angle

12^0

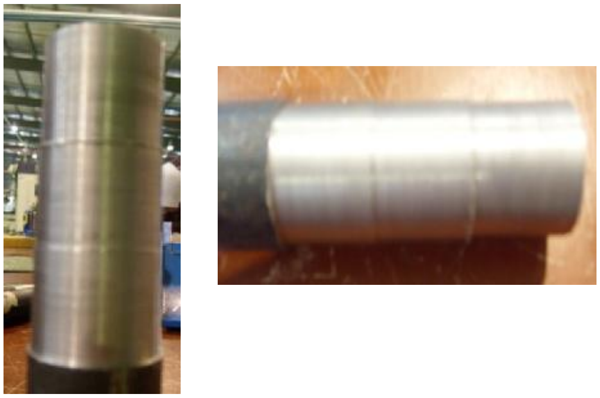



Aluminum for angle 15^0 Aluminum for angle

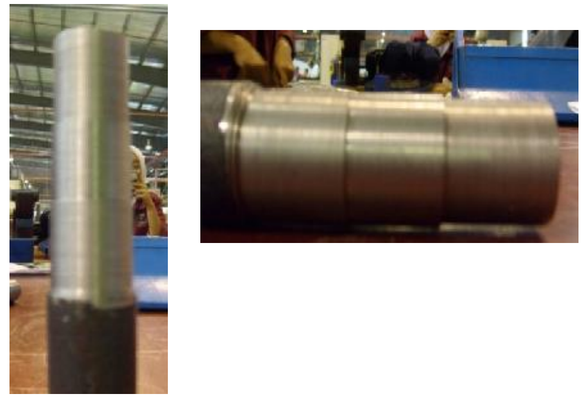
18^0



Aluminum for angle 21^0

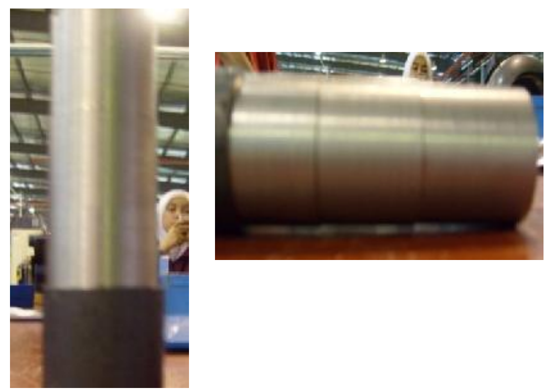


Steel for angle 9^0



Steel for angle 12^0

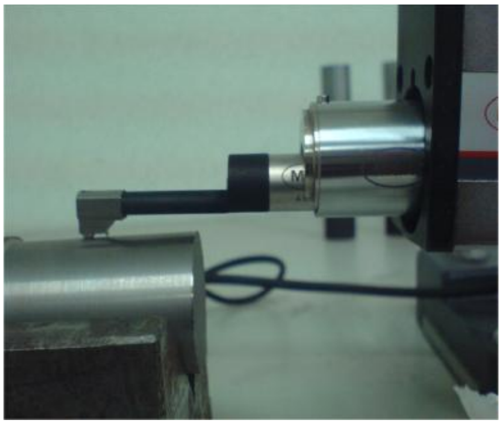
Steel for angle 15^0

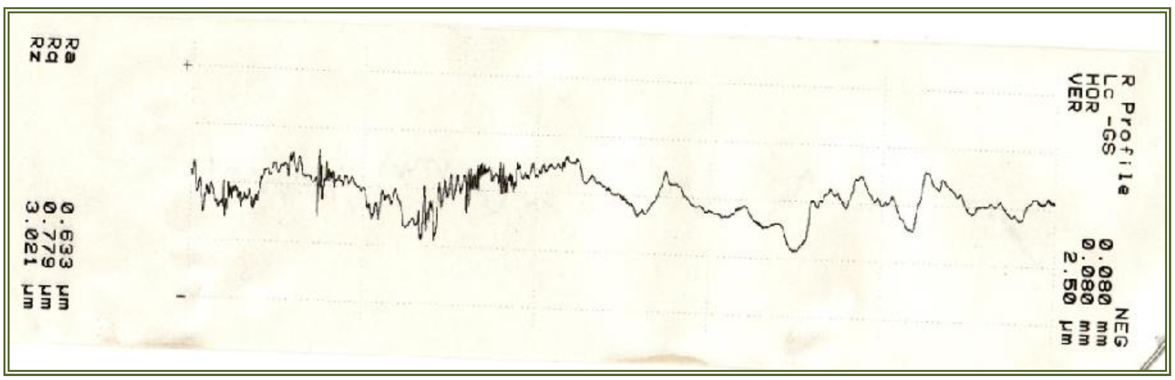


Steel for angle 18^0

Steel for angle 21^0

Appendices E: Pethometer S2 to measured surface roughness on test materials.





The reading obtain are reliable because too small. The smaller value of average surface roughness the better surface we obtain. The test value are not sufficient thus the other alternative were applied

Appendices F: Sensoring process (feeling)

Ask four peoples to implement the feeling process. Subject's texture examined surfaces with rigorously Specified textures under conditions of direct moving contact between the fingertip and the surface (direct touch). Condition is that materials have to be Comparable with standard surface roughness comparator flex bar. The reading obtains and average Value is calculated.