MECHANICAL ENGINEERING LABORATORY
NEW JERSEY INSTITUTE OF TECHNOLOGY

Report Submitted by	Sundeep Singh	Experiment No.	6
Date Performed	09/30/2019	Date Submitted	10/07/2019
Course & Section	ME 215-101 (2)	Instructor	Naruemon Suwattananont

Metal Cutting Processes and Tool Geometry

Experiment Title

Performed by Group A2 With TA Abhishek

Group Members Petros Apostolidis

Ertugrul Atlas

Christopher Chia

Anmol Sethi

Simerpreet Singh

Students are not to write below this line

GRADING

Date Received ____________

Days Late (if any) ____________

☐ Abstract	☐ Data	☐ Discussion
☐ Introduction	☐ Calculations	☐ Conclusion
☐ Theory	☐ Curves	☐ Questions & Answers
☐ Procedure	☐ Sketches	☐ See Pages ________

Comments: ____________

(For further comments see inside cover)

Graded by: ____________ Grade: ________ Date Recorded: ____________

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Abstract

The Metal Cutting Experiment (Experiment 2) is about familiarizing the students with the main metal cutting processes, cutting machines, and cutting tool geometry. The equipment used in this lab was a lathe, carbide lathe tools, protractor, and high-speed steel cutters. The experiment consisted of first getting a power point lesson by the teacher assistant, then getting a demonstration of the lathe by the operator, and finally the last part of the laboratory experiment consisted of measuring the tools. The final results are provided in the data sheet and overall, the experiment helped enforce the objective.

Introduction

The metal cutting processes and tool geometry experiment consisted of familiarizing students with the main metal cutting processes as well as familiarizing them with the metal cutting machines and cutting tool geometry. The goal of this laboratory experiment was to familiarize students with the main metal cutting processes. Furthermore, a second goal of this laboratory experiment was to familiarize students with cutting machines and cutting tool geometry. Students also learned the basics of how to operate the lathe and all the different parts of the lathe. In comparison to the CNC machine, the lathe had less option, and was simpler to work with.

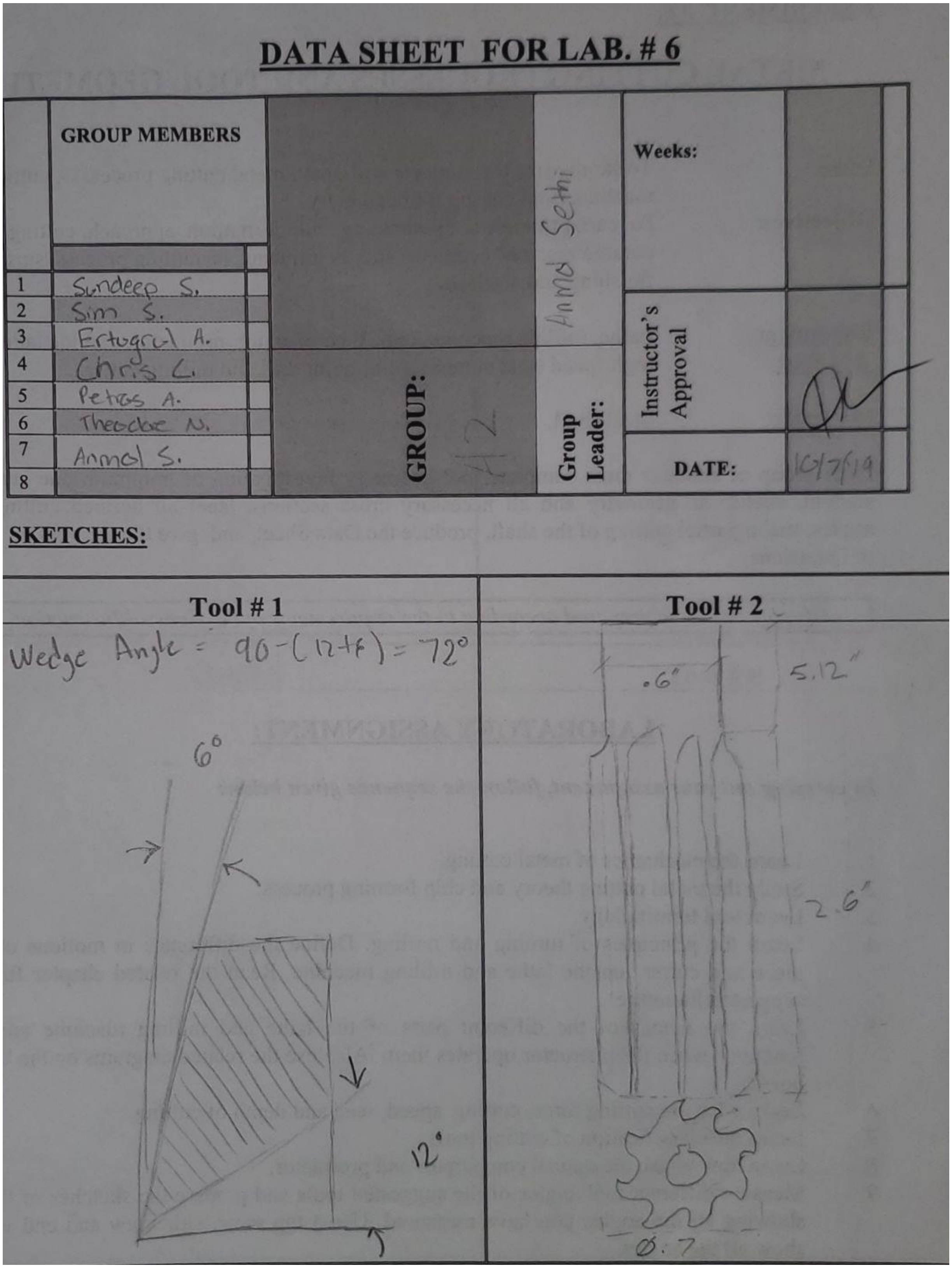
The various different metal cutting processes include turning, grinding, drilling, waterjet, and many more (American). However, in this experiment, the turning process was the main focus. The turning process is essentially using a sharp cutter to remove materials from the work piece as it is rapidly spinning. The material is usually removed in small increments since using small increments will result in less heat and will extend the life of the cutting tool. Another use of the turning process is to make a thread cut into the tool. In order to make thread, a different tool is used called a threading tool rather than the cutter. The same concept is used here, the threading tool makes contact with the workpiece as it is spinning rapidly in order to remove material for the thread and this is also done in increments as well.

Procedure

The laboratory experiment started with the students learning about the lathe and how it functions. The operator of the lathe helped teach students the mechanics of metal cutting and tool terminology. The different parts of the lathe and different tools were also introduced to the students. The operator then proceeded to show the students a demonstration of the turning process followed by a demonstration of the threading cut. The final product was passed around to the students for examination. After the demonstration of the lathe was finished, the lab was split in two groups.

Each group was given two tools, both of which had to be measured accurately and drawn in the data sheet. The different tool angles were measured using a protractor and the lengths of the tools were measured using a caliper. The sketches were drawn using the most appropriate view which would be the one that showed all the different angles and lengths in the same view. When each group finishing measuring and drawing their set of tools, the groups switches tools and the process was repeated. In total, students should have a sketch of a single point cutting tool, the reamer, twist drill A, and twist drill B. Once all the sketches were drawn, students had to get the data sheet approved and signed by the teacher assistant.

Data Sheets



DATA SHEET FOR LAB. # 6

	GROUP MEMBERS
1	Sundeep S.
2	Sim S.
3	Ertugrul A.
4	Chris L.
5	Petros A.
6	Theodore N.
7	Anmol S.
8	

GROUP: 12

Group Leader: Anmol Sethi

Weeks:

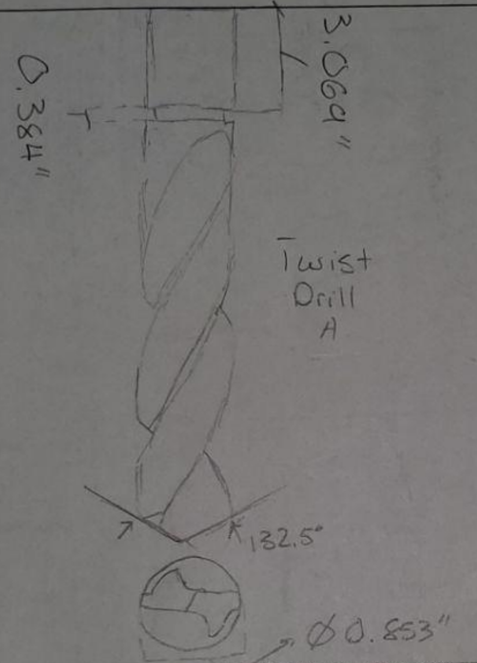
Instructor's Approval:

DATE: 10/7/19

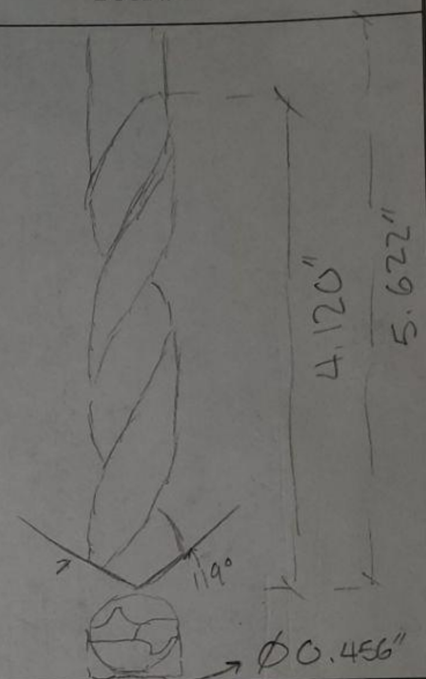
SKETCHES:

Tool # 1	Tool # 2
Wedge Angle = 90-(12+6) = 72°	

Tool # 3



Tool # 4



Tool # 5

Tool # 6

Dw 10/07

Results and Calculations

Caliper:

$Measured\ Length = A + B(0.025) + C(0.001)$

A = Inches (Up to the tenths)

B = Number of ticks after the previous measurement

C = Using the hundredths slider, find the first tick mark that lines up with the main body

Discussion

The results in the data sheet were approved and signed by the teacher assistant. Overall, the data sheet helped confirm the objectives of the lab. The objective of the lab was for students to learn the learning principles of machining, chip formation approach, cutting parameters, tool geometry and its influence on cutting process, surface finishing and accuracy. The objective was heavily reinforced as the students were given a power point lecture on machining and given a demonstration of the lathe and a lesson on all of the different parts of the lathe. Furthermore, a large objective of the laboratory experiment, tool geometry, was reinforced when students were to measure the lengths and angles of the given tools while also sketching them in the lab data sheet. However, no laboratory experiment is perfect and some possible errors in this laboratory experiment could have been human error while reading the tools when measuring the different angles and lengths of the tools. Our best effort was put into being steady and accurate while measuring the tools, but it is possible that human error could have been made.

Conclusion

The purpose of the Metal Cutting Processes and Tool Geometry laboratory was to familiarize students with the main metal cutting processes as well as familiarizing them with the metal cutting machines and cutting tool geometry. Furthermore, the objective of the lab was for students to learn the learning principles of machining, cutting parameters, and tool geometry and its influence on cutting process. Throughout the laboratory experiment, both the purpose and objective were achieved with the help of the teacher assistant and operator and the proof is shown in the data sheet.

After viewing a small power point on metal cutting processes and tool geometry as well as given a demonstration of the lathe by the operator, over half of the objectives had been introduced and reinforced. Additionally, one of the main objectives of the laboratory, tool geometry, was achieved when students were measuring the lengths and angles of the different tools in order to sketch the tools. The signed data sheet is proof that the objectives of this lab were achieved and that students have a basic understanding on metal cutting processes and tool geometry. Students are not experts in metal cutting processes and completing this lab does not quality the students to operate a lathe machine since more training is required.

Questions and Answers

1. Calculate the revolutions per minute for a lathe to cut a rough finish 5'' (127mm) diameter of a gray cast iron shaft with a high-speed steel cutter. Use the supporting Table 6-1.

   $N_s = \frac{12V}{\pi d} = \frac{12(350\ fpm)}{\pi(5*12)}$= 3208.56 rpm

2. Name the factor, which causes the tool to lose its hardness.

   Exposure to large amounts of heat, caused by friction, is the main factor which causes the tool to lose its hardness.

3. List the properties of materials used to make cutting tools.

   - Thermal conductivity (Waqar)
   - Coefficient of thermal expansion
   - Elastic modulus

4. What are the effects of a large frictional force on a cutting tool and how can they be reduced?

   The effects of a large frictional force on a cutting tool are reduced sharpness in the tool, making it dull, and reduced lifecycle of the tool. These effects can be reduced by using small increments for which the tool cuts into the workpiece.

5. What is the function of each of the following lathe parts?

   A. Face Plate- Usually a flat, round, and threaded plate used to hold in fasteners for the workpiece.

   B. Lead Screw- The screw that automatically moves the carriage during threading.

   C. Back Gears- Used to reduce speed of the lathe and increase torque, useful for threading operations.

D. Tail Stock- Used to hold the workpiece on the right side when necessary, primarily when the workpiece is too long in order to prevent sway.

6. Name four methods for turning a taper on a lathe.

   The four methods for turning a taper on a lathe are using compound slide, taper turning attachment, form tool, and off-setting the tail stock.

7. A bar of steel 3 in. (76.2mm) in diameter is to be machined at 90 fpm (0.5 m/sec). What spindle speed should be used?

   $Spindle\ Speed = \frac{12V}{\pi d} = \frac{12(90\ fpm)}{\pi * 3in}$ = 115 rpm

8. Assuming a 0.020 " (0.508 mm) feed per revolution and 0.062 in. (1.575 mm) depth of cut to machine a 2 in. (50.8mm) diameter bar of SAE 1020 low carbon content plain carbon steel, calculate the metal removal rate on cubic inches per minute (mm^2/sec) as a function of the cutting speed. If necessary, make an additional assumption. Use the Table 6-1.

   $MRR = 12 * cutting\ speed * feed * depth\ of\ cut$

   $MRR = 12 * cutting\ speed * 0.020 * 0.062 = = 0.01488 * cutting\ speed$

9. What type of machining should be used to make a shaft?

   The turning process should be used to make a shaft.

10. A 2." (50.8mm) diameter rod turning at 120 rpm is to be cut off by a tool having feed of 0.004 in. per revolution (0.1 mm/rev). Calculate the cutting time.

    $Cutting\ Time = \frac{l}{rpm * feed} = \frac{2\ in}{120\ rpm(0.004\ in)}$ = 4.1667 min

11. What is the cutting speed in fpm of a 4 in. (101.6 mm) cutter rotating at 50 rpm?

    $Cutting\ Time = \frac{\pi * d * rpm}{12} = \frac{\pi * 4 * 50rpm}{12}$ = 52.3599 FPM

12. Explain the difference between up-milling and down-milling from the figure shown below.

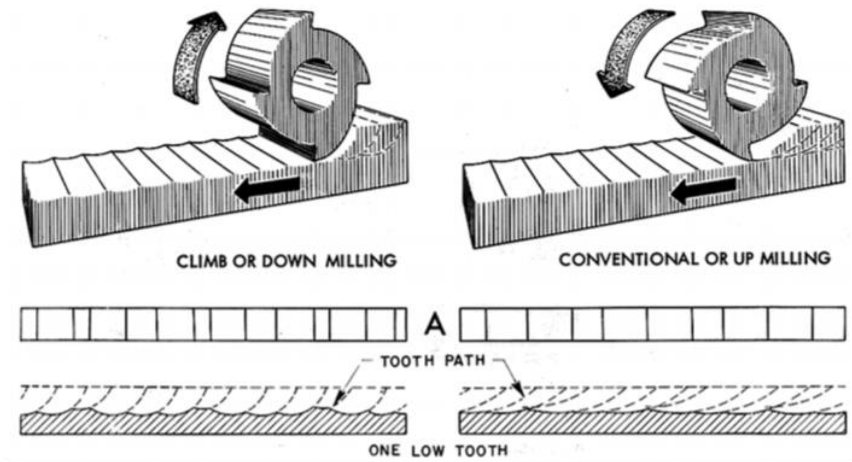


Fig.6-2 Climb and Conventional Milling Approach

For climb or down milling, the tool is cutting in the same direction as the feed which leaves a smooth finish, whereas in conventional or up milling, the tool is cutting in the opposite direction as the feed and leaves a rough finish.

References

American Welding Society. (2018). *AWS WHC-10.1.01:2018 Chapter 1 - Survey of Joining, Cutting, and Allied Processes*. Retrieved from https://www.astm.org/cgi-bin/resolver.cgi?3PC+AWS+AWS WHC-10.1.01:2018+en-US

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