LAB. #3, MACHINING EXPERIMENT I

STRAIGHT AND FACE TURNING

Purpose: To study methods for setting up and operating a lathe, and the use of measuring instruments to produce accurate workpiece dimensions.

Machine: Engine lathe

Tools: 6 inch digital caliper, steel scale (steel ruler),
uncoated carbide tools

Material: Aluminum 6061-T6 bar (approximately 2 inch in diameter)

Operations:

A. Note relationship between cross slide and tool movement

1. Upon advancing the cross dial by 0.25" in the X-direction, the digital 'X' scale on the lathe should also indicate the same distance moved. This is also the change in diameter of the part.
2. However, the distance advanced by tool in the x-direction is only half the distance moved by the cross-dial (0.125" in this case). This is also equal to the change in radius of the part.

B. Check tool set-up.

1. A carbide insert should already be located in a right-hand tool holder. Ensure it is at least finger-tight.
2. After inserting the tool holder onto tool post, check that the shank of the tool bit is at approximate right angles to the axis of centers. (See Figure #1).
3. Set the height of the tool to the same height as tailstock center point (slightly below is better than slightly above center). See Figure #1.

C. Insert workpiece.

Safety Note: Point of tool is sharp, be careful when inserting workpiece.

1. Insert the workpiece into the chuck.
2. Tighten the three jaw chuck using the chuck key.

D. Set spindle speed.

1. Calculate RPM from cutting speed and diameter (in inches) of the workpiece. For specific cutting speeds, see steps E-1, F-1, G-1 as you perform each operation.

$$RPM = \frac{V \times 12}{\pi \times D} \approx \frac{V \times 4}{D}$$

D: diameter in inches, V: cutting speed in ft/min.

2. Locate closest RPM on spindle speed chart, located on headstock of lathe. Slide the handle under that column. Note: Spindle needs to be rotated to make sure that gears are properly engaged.
3. Locate feed on the thread and feed chart, using the F column. Using the four handles and/or dials, set it accordingly. Note: Spindle needs to be rotated to make sure that gears are properly engaged.

E. Facing of workpiece.

1. Set RPM for a cutting speed of 400 ft/min.
2. Set power cross feed to 0.0154".
3. Set direction of cross slide travel towards the center of the workpiece.
4. Turn the lathe on with control lever and advance your tool until it touches the end of the workpiece. This is your reference point.
5. Crank the cross slide towards you until your tool clears the workpiece.
6. Engage the cross feed to make a trial facing cut in center of workpiece. Reset point of the tool to the center of projection, if the circle cut appears asymmetrically positioned on the face of the workpiece. Set the digital readout to zero (Z direction).
7. Set depth of cut to 0.020" by moving the carriage (z axis).
8. Turn lathe on and engage power cross feed. After facing to the center of the workpiece, disengage power feed.
9. Reset digital readout to zero. This will be your z axis zero datum for the remaining cuts.
10. Move carriage away from the part, then crank the cross slide out towards you until tool clears the workpiece and turn the lathe off.

F. Rough turning

1. Set RPM for a cutting speed of 450 ft/min. Refer back to steps D-1 and D-2.
2. Set feed for 0.007 in./revolution. Refer back to step D-3.
3. Turn the lathe on by pulling control lever up and advance cross slide until tool bit touches rotating workpiece. This is your reference point for setting the depth of cut. Zero digital readout.
4. Take a light cut of 0.025” or so to your first z step. Move the carriage away from the part without changing the x-axis setting. Stop the machine and measure the part diameter. Now enter this dimension for x on the digital readout.
5. Advance tool with cross slide crank to remove 0.250" from diameter of workpiece (use multiple cuts of 0.100” or less).
6. Turn lathe on. Engage power longitudinal feed. Turn the initial 0.750 inches only. Feel free to stop powerfeed early and hand feed the tool the last bit for more accuracy. Disengage power feed. Return carriage to starting position without backing the tool from the workpiece. Turn lathe off.

G. Semi-finish turning

1. Set RPM for a cutting speed of 500 ft/min.
2. Feed remains the same as in rough turning.
3. Measure the diameter of the workpiece and set the depth of cut such that the diameter after semi-finish turning is about 1.630 inches.
4. Turn approximately 1/4" in length. Stop and check the diameter. If correction is needed, return carriage to starting position and make correction.
5. Repeat step F-6.

H. Finish turning

1. RPM remains the same as for semi-finish turning.
2. Set feed for 0.003 in./revolution.
3. Measure the diameter and adjust the cross slide to produce a diameter of 1.600" ± 0.002"
4. Repeat step G-4
5. Repeat step F-6.

I. Completion of the part

1. Repeat steps F through H for the other diameter.
2. Ask the lab instructor to show you how to add the taper.

J. Clean machine and remove chips from pan and floor. Safety Note: If necessary, remove tool bit from tool holder first, turn the lever away from you, and then remove tool holder from tool post.

K. Return tools to cabinet and workpiece to instructor.

Computation

1. Cutting conditions
2. Ideal cutting time
3. Material removal rate

Measurement

1. Final diameter of the workpiece
2. Lengths of the cut sections from the end (faced surface).

Straight Turning Operation

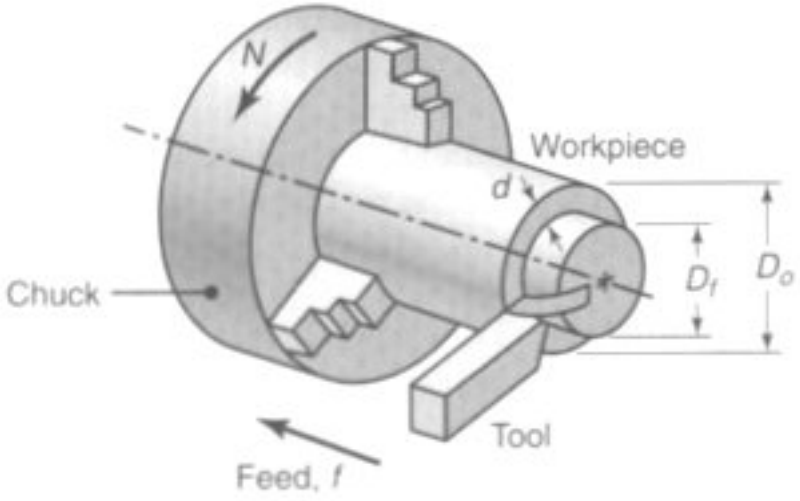

Figure 1: Straight turning set-up

(a) Roughing Cut

V = _____ ft/min

N = _____ rpm

f = _____ ipr

d = _____in

l = _____ in

(b) Semifinishing Cut

V = _____ ft/min

N = _____ rpm

f = _____ ipr

d = _____ in

l = _____ in

(c) Finishing Cut

V = _____ ft/min

N = _____ rpm

f = _____ ipr

d = _____ in

l = _____ in

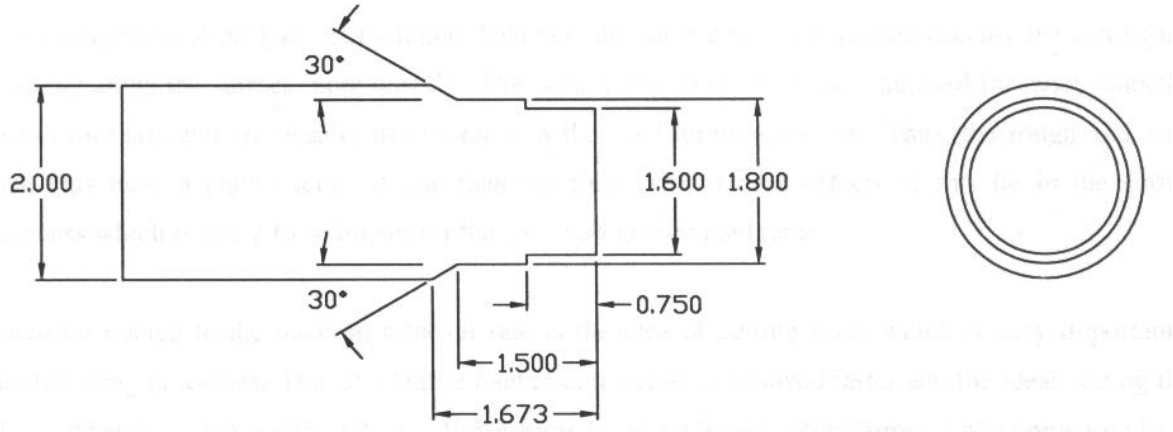

Figure 2: Desired geometry of the finished part.