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PARAMETRIC STUDY ON SURFACE ROUGHNESS OF ALUMINUM BAR AFTER TURNING BY USING DOUBLE POINT CUTTING TOOL

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Abstract:

Man, Machine, Material and Method play very important role in the field of Manufacturing. The objective of this research paper is to reduce the time for turning a long workpiece and to study the surface roughness by choosing new Method of turning. Turning is the process of reducing the required diameter on the workpiece. Usually we use single point cutting tool for the same. Here this is the work where half of the total turning time is reduced by using a special tool namely double point cutting tool.

The HSS double point cutting tool has two cutting points with height difference of 0.5 mm and the distance between them is 6 mm. Hence as the first point takes 0.5 mm depth of cut, the second point also takes 0.5 mm depth of cut as the tool proceeds for turning. So the half of the total turning time is reduced. Detailed study is made and presented on surface roughness after turning Aluminum bar of 50 mm diameter and 300 mm long workpiece by using double point cutting tool for different speed and feed rate.

Keywords: turning, HSS double point cutting tool, turning time, Aluminum bar, surface roughness, speed, and feed rate.

1. Introduction

Turning is the process of reducing the required diameter on the workpiece. Usually single point cutting tool is used for the same. But when we turn a long workpiece it takes long time. Hence in order to reduce the total turning time a new tool is designed and made where it has two cutting points of height difference of 0.5mm and distance between them is 6

mm. when we turn the long workpiece by using double point cutting tool, the first point takes 0.5 mm depth of cut, as the tool proceeds further for turning, the second point with a distance of 6mm also takes 0.5 mm depth of cut.

Hence the total turning time is reduced. So it is stated that when we turn a long work piece by using double point cutting tool, it takes short time which is attractive feature. Aluminum is used as work piece material which is an attractive material in the field of Engineering. Because it is low weight material and has high strength, moreover it has high machinability and low cost etc., Detailed study is made and presented on surface roughness after turning Aluminum bar of 50 mm diameter and 300 mm long work piece by using double point cutting tool for different speed and feed rate by keeping 0.5 mm depth of cut as constant. Though the double point cutting tool does time reduction in turning, but we are also interested in surface finish.

Good Surface finish will make the workpiece to work for long time for its application. Because wear will occur less on the workpiece which has good surface finish. In this research work surface roughness of the Aluminum bar is measured on the surfaces which are turned by first point and as well as by the second point of the double point cutting tool. A first attempt is made in this research work by using a new innovative HSS double point cutting tool on Aluminum bar as workpiece material for turning.

Researchers' work is to develop and improve the existing system by way research. Research will not stop at one point and it goes on for further and further improvement. Here this is the different work from the existing method of turning by using a special developed tool namely double point cutting tool. A detailed literature review is made in the field of metal cutting particularly with respect to the surface finish of the workpiece before going into the actual work by using the double point cutting tool.

2. Literature Review

K..G. Nikam et. al [(2)] concluded that feed rate is most significant parameter which affects the surface finish than other cutting parameters. The cutting speed and depth of cut are least significant parameters. This work is on EN8 steel. Jitendra Verma et. al[(4)] concluded that the cutting speed is the only significant factor which contributes to the surface roughness i.e. 57.47%, the feed rate contributes 23.46% on surface roughness and depth of cut This is on EN31 alloy steel. contributes 16.27 on surface roughness . This is on type –1 alloy steel. C.R Barik[(6)] stated that surface roughness decreases with decrease of depth of cut.

This is on EN31 alloy steel. S.Thamizhmanii et. Al[7] found that the depth of cut has significant role to play in producing lower surface roughness followed by feed. This is on SCM440 steel. Hiren Gajena[9] concluded that the surface roughness increase with increasing feed from 0.05 to 0.15 mm/rev and at lower depth of cut 0.5 mm as speed increase, the surface roughness decreased.

This is on E19 steel. All the above research works are on different workpieces for the surface roughness by using usual single point cutting tool. But S.Vanangamudi et. Al[11] used a new innovative tool i.e double point cutting tool for turning Mild steel to investigate the surface roughness for different speed and feed rate and he concluded that as the speed increases the surface finish also increases (roughness decreases) when the feed rate is low.

3. Materials, Machine and Instrument

Aluminum bar of 50 mm diameter and 300 mm long is used as workpiece material which is an attractive material in the field of Engineering. Because it is low weight material and has high strength, moreover it has high machinability and low cost etc., Turning operation is done on the Aluminum bar for various speed and feed by keeping 0.5 mm depth of cut as constant in the Precision Centre Lathe Machine.

For turning operation a new innovative tool namely double point cutting tool is used which is made of HSS material and it is ground to the required tool geometry by Tool and Cutter Grinding Machine. The double point cutting tool has two cutting points one after another with height difference of 0.5 mm and distance between them is 6 mm.

After turning the Aluminum bar by using the double point cutting tool, the Taylor – Hobson Surtronic Surface Roughness Measuring Instrument is used for measuring the surface roughness on the turned surfaces for different speed and feed.

4. Methodology

Similar to method of fixing the single point cutting tool in the tool post, in the same manner, i.e., the double point cutting tool is also fixed in the tool post by referring the dead centre of the tailstock and cutting points are made to coincide with the axis of the centre by keeping necessary metal strips under the tool.

Aluminum bar of 50 mm diameter and 300 mm long is fixed carefully in the self centering three jaw chuck by tightening the jaws gently and rigidly and other end of the long aluminum bar is supported by the tailstock to avoid wobbling of long Aluminum workpiece. Taylor – Hobson Surtronic Surface Roughness Measuring Instrument is used for measuring

the surface roughness on the turned surfaces for different speed and feed. The machined Aluminum bar is placed precisely on the long V Block and surface roughness of the Aluminum bar is measured by Taylor – Hobson Surtronic Surface Roughness Measuring Instrument on the surfaces which are turned by first point and as well as by the second point of the double point cutting tool for various speed and feed.

5. Experimental Setup

Figure -1: HSS Double Point Cutting Tool for turning on Aluminum Bar.

Figure-1: shows the HSS Double Point Cutting Tool Which has been fixed rigidly in the Tool Post and Aluminum Bar workpiece is fixed in the three jaw chuck and the other end of the Aluminum bar is supported by the dead centre of the tailstock.

Figure-2: HSS Double Point Cutting Tool does turning on Aluminum Bar.

Figure-2: shows HSS double point cutting tool does turning on Aluminum Bar. A Trial run is made in order to check and ensure that the double point cutting tool is fixed properly in the tool post and to check and ensure that the Aluminum bar is fixed rigidly in the three jaw chuck. After the trial run by choosing the different speed and feed the turning operation is carried out on the Aluminum bar.

Figure-3: Taylor-Hobson Surtronic 3+ Surface Roughness Measuring Instrument.

Figure-3: shows the Taylor – Hobson Surtronic 3+ Surface Roughness Measuring Instrument. The machined Aluminum bar is placed precisely on the long V Block and surface roughness of the Aluminum bar is measured by Taylor – Hobson Surtronic Surface Roughness Measuring Instrument on the surfaces which are turned by first point and as well as by the second point of the double point cutting tool for various speed and feed.

Results and Discussion

Turning is done on Aluminum workpiece of 50mm diameter and 300 mm length by keeping 0.5 mm depth of cut as constant for various speed such as 135 rpm, 215 rpm and 325 rpm and as well as for various feed rate such as 0.205 mm/rev ,0.238 mm/rev and 0.260 mm/rev by using the HSS double point cutting tool. Taylor-Hobson Surtronic Surface Roughness Measuring Instrument is used for measuring the surface roughness of the machined surfaces. Surface Roughness is measured on three different locations on each machined surface and the average value is taken for analyzing.

6.1 First Surface: Speed Vs Surface Roughness

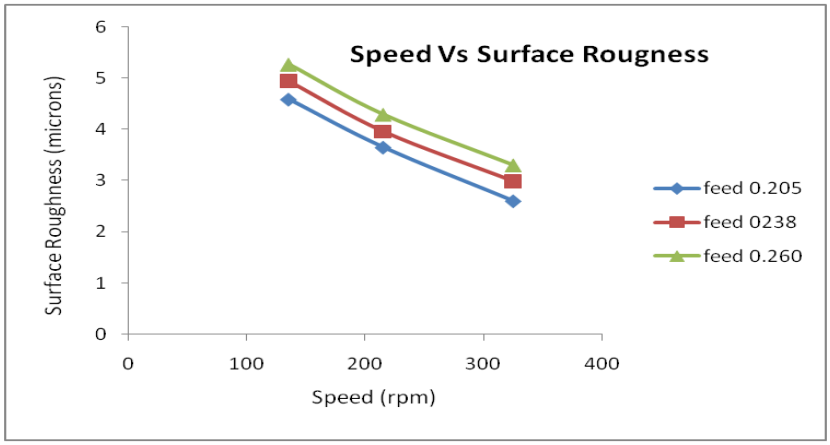

Figure-4: HSS Double Point Cutting Tool – Aluminum Bar : First Surface : Speed Vs Ra.

When the speed is 135 rpm and the feed is 0.205 mm/rev, the surface roughness is measured and recorded as 4.59 microns. When the speed is 135 rpm and the feed is 0.238 mm/rev, the surface roughness is measured and recorded as 4.95 microns. When the speed is 135 rpm the feed is 0.260 mm/rev, the surface roughness is measured and recorded as 5.27 microns. It is noted that as the feed increases, the surface roughness also increases. Similarly when the speed is 215 rpm and the feed is 0.205 mm/rev, the surface roughness is measured and recorded as 3.65 microns. When the speed is 215 rpm and the feed is 0.238 mm/rev, the surface roughness is measured and recorded as 3.96 microns. When the speed is 215 rpm and the feed is 0.260 mm/rev, the surface roughness is measured and recorded as 4.29 microns. Here also it is noted that as the feed increases, the surface roughness also increases. But compared to 135 rpm speed , the surface roughness with respect to 215 rpm is lower i.e better. Finally when the speed is 325 rpm and the feed is 0.205 mm/rev, the surface roughness is measured and recorded as 2.6 microns. When the speed is 325 rpm and the feed is 0.238 mm/rev, the surface roughness is measured and recorded as 2.98 microns. When the speed is 325 rpm and the feed is 0.260 mm/rev, the surface roughness is measured and recorded as 3.3 microns. With respect to 325 rpm also, it is noted that as the feed increases, the surface roughness also increases. But best surface finish is obtained as 2.6 microns at 325 rpm when the feed is 0.205 mm/rev. Figure: 4 shows the same.

6.2 Second Surface: Speed Vs Surface Roughness

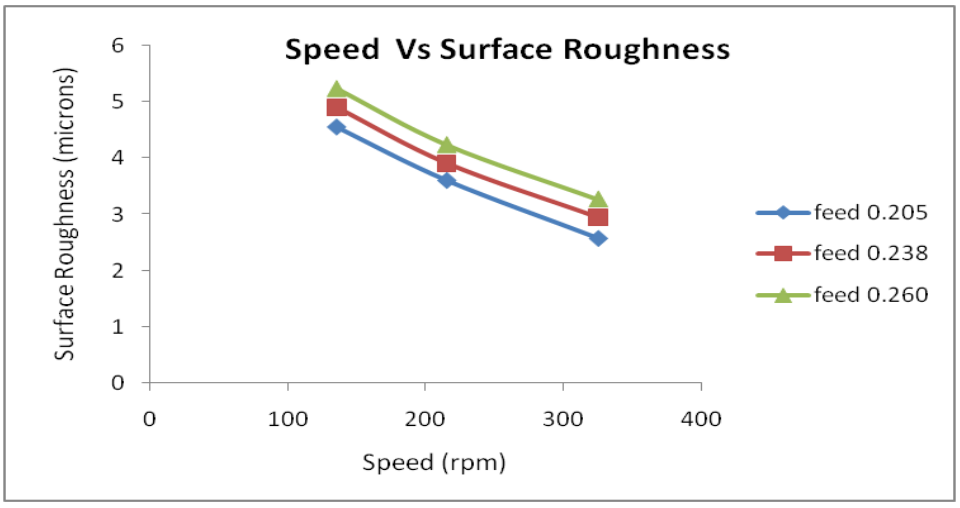

Figure-5: HSS Double Point Cutting Tool – Aluminum Bar : Second Surface : Speed Vs Ra.

When the speed is 135 rpm and the feed is 0.205 mm/rev, the surface roughness is measured and recorded as 4.55 microns. When the speed is 135 rpm and the feed is 0.238 mm/rev, the surface roughness is measured and recorded as 4.9 microns. When the speed is 135 rpm the feed is 0.260 mm/rev, the surface roughness is measured and recorded as

5.24 microns. It is noted that as the feed increases, the surface roughness also increases. Similarly when the speed is 215 rpm and the feed is 0.205 mm/rev, the surface roughness is measured and recorded as 3.6 microns. When the speed is 215 rpm and the feed is 0.238 mm/rev, the surface roughness is measured and recorded as 3.91 microns. When the speed is 215 rpm and the feed is 0.260 mm/rev, the surface roughness is measured and recorded as 4.24 microns. Here also it is noted that as the feed increases, the surface roughness also increases. But compared to 135 rpm speed , the surface roughness with respect to 215 rpm is lower. Finally when the speed is 325 rpm and the feed is 0.205 mm/rev, the surface roughness is measured and recorded as 2.57 microns. When the speed is 325 rpm and the feed is 0.238 mm/rev, the surface roughness is measured and recorded as 2.95 microns. When the speed is 325 rpm and the feed is 0.260 mm/rev, the surface roughness is measured and recorded as 3.27 microns. With respect to 325 rpm also, it is noted that as the feed increases, the surface roughness also increases. But best surface finish is obtained as 2.57 microns at 325 rpm when the feed is 0.205 mm/rev. Figure : 5 shows the same.

It is also noted that the second surface has better surface finish than the first surface for various speed and feed which is desirable.

6.3: First Surface : Feed Vs Surface Roughness.

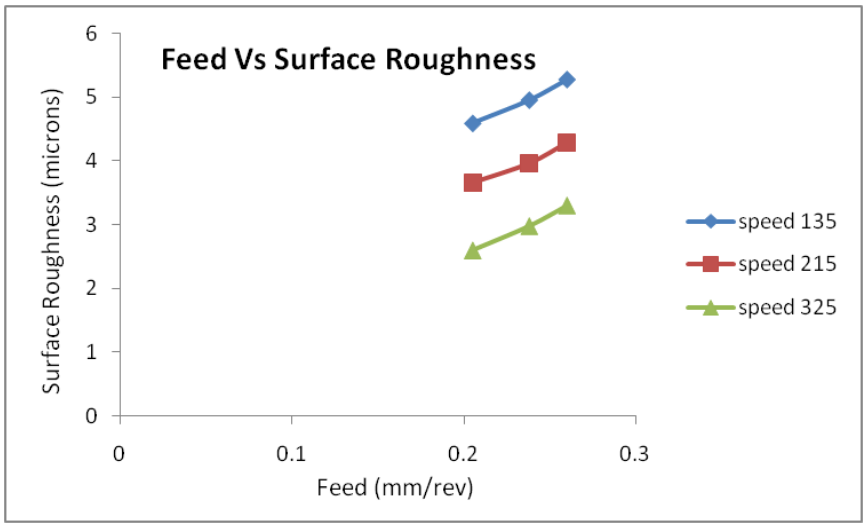

Figure-6: HSS Double Point Cutting Tool – Aluminum Bar : First Surface : Feed Vs Ra.

When the feed is 0.205 mm/rev and the speed is 135 rpm, the surface roughness is measured and recorded as 4.59 microns. When the feed is 0.205 mm/rev and the speed is 215 rpm, the surface roughness is measured and recorded as 3.65 microns. When the feed is 0.205 mm/rev and the speed is 325 rpm, the surface roughness is measured and recorded as 2.6 microns. It is noted that as the speed increases, the surface roughness decreases (surface finish increases) which is

desirable. When the feed is 0.238 mm/rev and the speed is 135 rpm, the surface roughness is measured and recorded as 4.95 microns. When the feed is 0.238 mm/rev and the speed is 215 rpm, the surface roughness is measured and recorded as 3.96 microns. When the feed is 0.238 mm/rev and the speed is 325 rpm , the surface roughness is measured and recorded as 2.98 microns. It is noted that as the speed increases, the surface roughness decreases (surface finish increases). But compared to feed 0.205 mm/rev, the surface roughness for various speeds is worse. When the feed is 0.260 mm/rev and the speed is 135 rpm, the surface roughness is measured and recorded as 5.27 microns. When the feed is 0.260 mm/rev and the speed is 215 rpm, the surface roughness is measured and recorded as 4.29 microns. When the feed is 0.260 mm/rev and the speed is 325 rpm, the surface roughness is measured and recorded as 3.3 microns. It is noted that as the speed increases, the surface roughness decreases.

On comparing to feed 0.260 mm/rev and feed 0.238 mm/rev, the surface roughness with respect to feed 0.205 mm/rev for various speeds is the best. The surface finish is not only depending upon the feed but also depending upon the speed. The best surface finish is obtained on the Aluminum Bar at speed 325 rpm and feed 0.205 mm/rev after turning by using the HSS double point cutting tool.

6.4: Second Surface : Feed Vs Surface Roughness

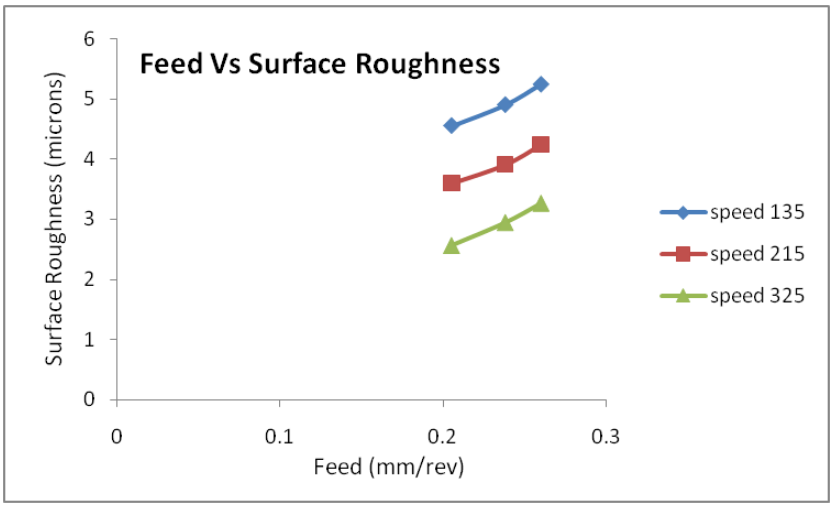

Figure-7: HSS Double Point Cutting Tool – Aluminum Bar : Second Surface : Feed Vs Ra.

When the feed is 0.205 mm/rev and the speed is 135 rpm, the surface roughness is measured and recorded as 4.55 microns. When the feed is 0.205 mm/rev and the speed is 215 rpm, the surface roughness is measured and recorded as 3.6 microns. When the feed is 0.205 mm/rev and the speed is 325 rpm, the surface roughness is measured and recorded as 2.57 microns. It is noted that as the speed increases, the surface roughness decreases (surface finish increases) which

is desirable. When the feed is 0.238 mm/rev and the speed is 135 rpm, the surface roughness is measured and recorded as 4.9 microns. When the feed is 0.238 mm/rev and the speed is 215 rpm, the surface roughness is measured and recorded as 3.91 microns. When the feed is 0.238 mm/rev and the speed is 325 rpm, the surface roughness is measured and recorded as 2.95 microns. It is noted that as the speed increases, the surface roughness decreases (surface finish increases). But compared to feed 0.205 mm/rev, the surface roughness for various speeds is worse. When the feed is 0.260 mm/rev and the speed is 135 rpm, the surface roughness is measured and recorded as 5.24 microns. When the feed is 0.260 mm/rev and the speed is 215 rpm, the surface roughness is measured and recorded as 4.24 microns. When the feed is 0.260 mm/rev and the speed is 325 rpm, the surface roughness is measured and recorded as 3.27microns. It is noted that as the speed increases, the surface roughness decreases.

On comparing to feed 0.260 mm/rev and feed 0.238 mm/rev, the surface roughness with respect to feed 0.205 mm/rev for various speeds is the best. The surface finish is not only depending upon the feed but also depending upon the speed. The best surface finish is obtained on the Aluminum Bar at speed 325 rpm and feed 0.205 mm/rev after turning by using the HSS double point cutting tool.

It is also noted that second surface has better surface than the first surface for various speed and feed.

7. Types Of Chip (At N = 135 rpm)

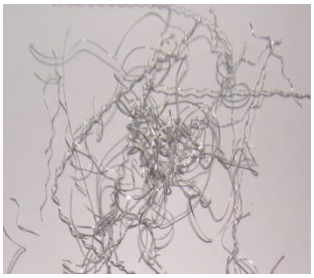

Figure 8 (a) f= 0.205 mm/rev

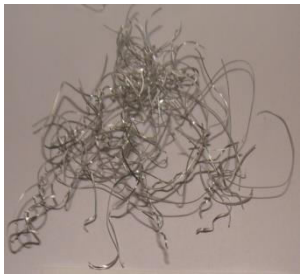

Figure 8 (b) f= 0.238 mm/rev

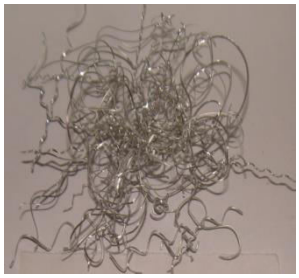

Figure 8 (c) f= 0.260 mm/rev

When turning is done on Aluminum bar at 135 rpm speed and at 0.205 mm/rev feed a thin continuous chip is obtained. Figure 8 (a) shows the same. When turning is done on Aluminum bar at 135 rpm speed and at 0.238 mm/rev feed a thick continuous chip is obtained. Figure 8 (b) shows the same. When turning is done on Aluminum bar at 135 rpm speed and at 0.260 mm/rev feed compared to the previous chip , a thicker continuous chip is obtained. Figure 8 (c) shows the same.

At N = 215 rpm

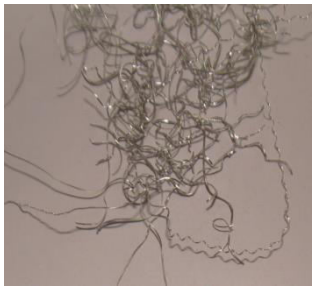

Figure 9 (a) f= 0.205 mm/rev

Figure 9 (b) f= 0.238 mm/rev

Figure 9 (c) f= 0.260 mm/rev

When turning is done on Aluminum bar at 215 rpm speed and at 0.205 mm/rev feed a thin continuous chip is obtained. Figure 9 (a) shows the same. When turning is done on Aluminum bar at 215 rpm speed and at 0.238 mm/rev feed a thick continuous chip is obtained. Figure 9 (b) shows the same. When turning is done on Aluminum bar at 215 rpm speed and at 0.260 mm/rev feed compared to the previous chip a thicker continuous chip is obtained. Figure 9 (c) shows the same.

At N = 325 rpm

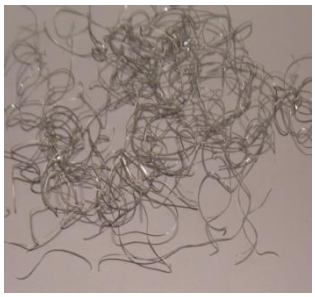

Figure 10 (a) f= 0.205 mm/rev

Figure 10 (b) f= 0.238 mm/rev

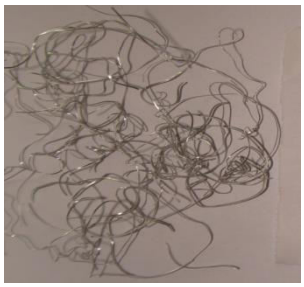

Figure 10 (c) f= 0.260 mm/rev

When turning is done on Aluminum bar at 325 rpm speed and at 0.205 mm/rev feed a thin and long continuous chip is obtained. Figure 10 (a) shows the same. When turning is done on Aluminum bar at 325 rpm speed and at 0.238 mm/rev feed a thick and long continuous chip is obtained. Figure 10 (b) shows the same. When turning is done on Aluminum bar at 325 rpm speed and at 0.260 mm/rev feed compared to the previous chip a thicker continuous chip is obtained. Figure 10 (c) shows the same. Continuous Chip is not desirable during turning. Because it disturbs turning and even it may spoil surface finish of machined surface. Hence it is good to have a chip breaker in the double point cutting tool during turning of Aluminum bar.

8. Conclusion

On observing the turning process on Aluminum bar by HSS double point cutting tool it is stated that the performance of the double point cutting tool is very good and it reduces the total machining time which is attractive feature. The best

surface finish is obtained at 325 rpm speed and at 0.205 mm/rev feed. On careful study on turning for different speed and feed by the double point cutting tool it is stated that as the speed increases the surface finish also increases (surface roughness decreases) when the feed is low. It is also noted and stated that the second surface has better surface than the first surface for various speed and feed which is desirable.

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