

## Determination of Surface roughness at different parameters cutting speed, depth of cut & feed rate

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### **ABSTRACT**

*In the present research work gives the effect of different machining parameters (cutting speed, feed rate and depth of cut) on surface roughness in end milling is determined. Taguchi technique of optimization is used to select different parameter. The experimental work is carried out on hardened Die-Steel H-13. The processing of the job was done by solid carbide four flute end-mill tool under finishing conditions to calculate different variables and their levels. L-9 standard orthogonal array is used for calculation of number of variables and number of levels. Signal to Noise Ratio is used to calculate the significant parameter where as ANOVA F-Test is carried out to determine the percentage effect of each parameter.*

### **Introduction**

Automation and mass production are associated with advancement in technology. In the mass production units since the quantity of item required is very high with little or no variety special purpose machines, automatic machines or transfer lines have been used. On a CNC machine it is possible to make hundreds or even thousands of the same items in a day. Out of various machining processes, milling process has the advantage of multi-point cutting tool with high dimensional accuracy. The end milling is the most common metal removal operation encountered. In end milling the tool can cut the work-piece either horizontally or vertically. We are used three parameters (1) cutting speed (2) feed rate (3) depth of cut. and methodology adopted taguchi method the tool used in the Taguchi method is the orthogonal array (OA). The Taguchi method employs a generic signal-to-noise (S/N) ratio to quantify the present variation. Hass surya vf 30 cnc vs milling machine is finalized to carry out the experimentation. The range and levels of various process parameters have been identified using Pilot Experimentation. The software used for analysis in this project is Minitab 15. results

shows that the highest value of cutting speed, lower value of feed rate and higher value of depth of cut gives the better surface finish (lower surface roughness).

### **1.2 Milling Process**

Out of various machining processes, milling process has the advantage of multi-point cutting tool with high dimensional accuracy. Milling process can be of two types up and down milling so any method can be used according to the requirement of work piece. Among several CNC industrial machining processes, milling is a fundamental machining operation and the end milling is the most common metal removal operation encountered. In end milling the tool can cut the work-piece either horizontally or vertically. The processing of the job can be done by different types of end-mill tool under finishing conditions.

Milling is a process of producing flat and complex shapes with the use of multi-tooth cutting tool, which is called a milling cutter and the cutting edges are called teeth. The axis of rotation of the cutting tool is perpendicular to the direction of feed, either parallel or perpendicular to the machined surface. The machine tool that

traditionally performs this operation is a milling machine.

Milling is an interrupted cutting operation. The teeth of the milling cutter enter and exit the work during each revolution. This interrupted cutting action subjects the teeth to a cycle of impact force and thermal shock on every rotation. The tool material and cutter geometry must be designed to withstand these conditions. Cutting fluids are essential for most milling operations.

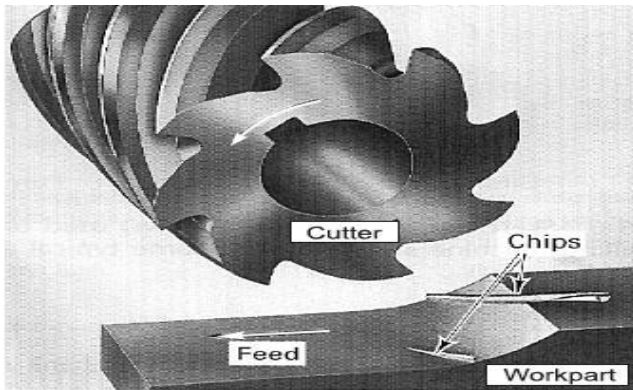


Figure 1.1 Schematic Milling Operation

### 1.3.3 End Mill

The most common cutting tool used with a vertical milling is an end-mill, which looks like a stubby twist drill with a flattened end instead of a point. An end mill can cut into a work piece either vertically, like a drill, or horizontally using the side of the end mill to do the cutting. This horizontal cutting operation imposes heavy lateral forces on the tool and the mill, so both must be rigidly constructed. By making a series of horizontal cuts across the surface of a work piece, the end mill removes layers of metal at a depth than can be accurately controlled to about one-thousandth of an inch (.001").

### Work Piece Material

Work piece Hot Die Steel H-13 is high hot strength, hardness and Good resistance to heat, good hot toughness, high resistance to temperature fatigue and wear in medium heat.

### Chemical Composition of H-13

Chemical Composition	C	Si	Mn	Cr	Mo	V
Percentage (%)	0.35	1.00	0.30	5.00	1.50	0.90

### Selection of Machine

HAAS Surya VF 30 CNC VS milling machine is finalized to carry out the experimentation.

### Selection of Tool

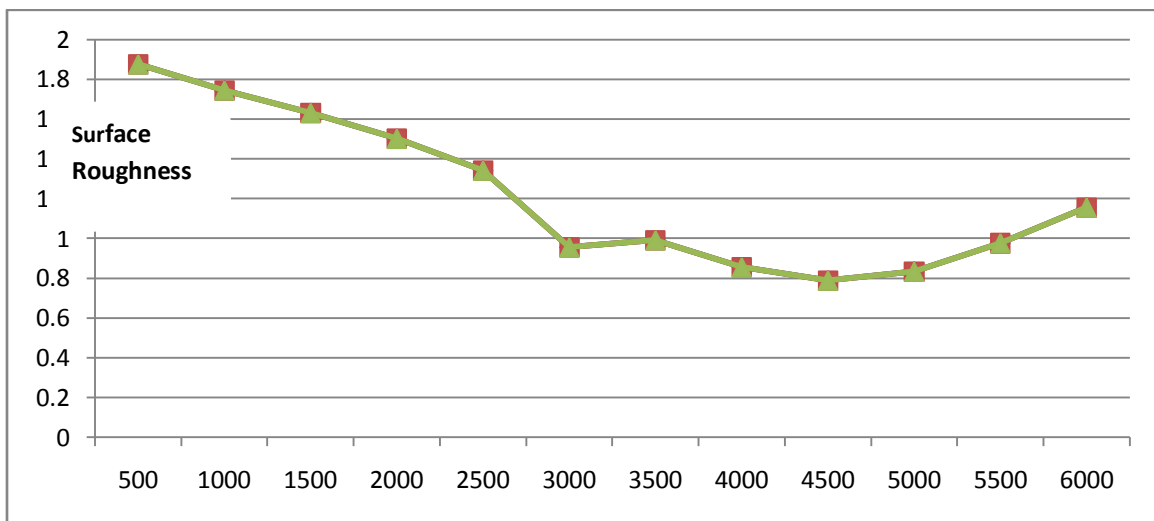
Tool used in the experiment is four flute solid carbide type flat end mill. Dry cutting condition has been recommended for the experimental work. The diameter of the end mill cutter is 10mm.

### 1. Effect of Spindle Speed on Performance Measure

The spindle speed is varied from 500rpm to 6000rpm in steps of 500 units. The values of the other parameters are kept constant and their values are given as Table Feed Rate = 910mm/min; DOC = 1.0mm. The experimentally observed data for the response characteristics for different values of spindle is given in Table 4.1. Figure 4.2 shows the scatter plots of spindle speed versus response characteristic. The value of surface roughness though reduces as the spindle speed goes on increasing.

Table 4.1 Spindle Speed versus Surface Roughness

S. No	Spindle Speed (rpm)	Surface Roughness ( $\mu\text{m}$ )
1.	500	1.876
2.	1000	1.745
3.	1500	1.632
4.	2000	1.502
5.	2500	1.342
6.	3000	0.956
7.	3500	0.992
8.	4000	0.856
9.	4500	0.789
10.	5000	0.834
11.	5500	0.977
12.	6000	1.156



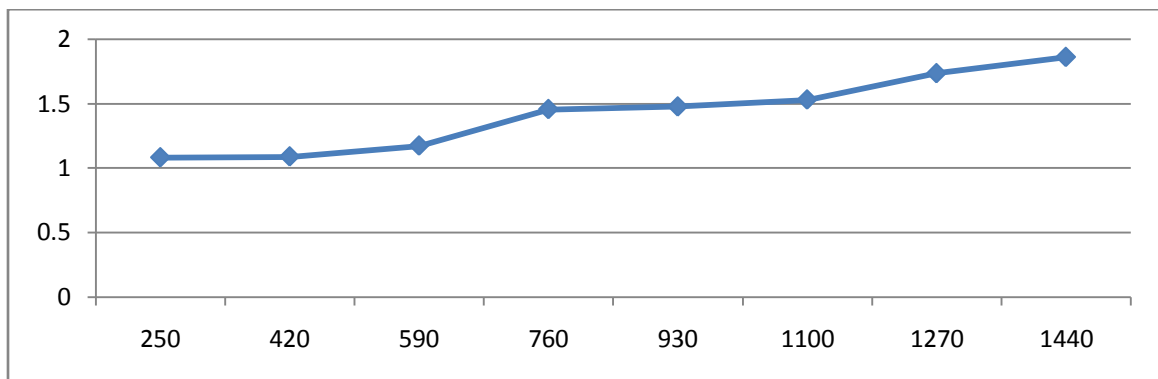
Spindle speed

## 2. Effect of Table Feed Rate on Performance Measures

The table feed rate is varied from 250mm/min to 1440mm/min in steps of 170 units. The values of the other parameters are kept constant and their values are given as Spindle Speed = 4000rpm; DOC = 1.0mm. The experimentally observed data for the response characteristic for different values of table feed rate is given in Table 4.2. Figure 4.3 shows the scatter plots of table feed rate versus response characteristic. The value of surface roughness increases with table feed rate.

Table 4.2 Feed Rate versus Surface Roughness

SR. No	Table Feed Rate (mm/min)	Surface Roughness ( $\mu\text{m}$ )
1.	250	1.082
2.	420	1.089
3.	590	1.173
4.	760	1.456
5.	930	1.476
6.	1100	1.530
7.	1270	1.734
8.	1440	1.860



Surface roughness v/sFeed rate

### 3. Effect of Depth of Cut on Performance Measures

The doc is varied from 0.3mm to 1.7mm in steps of 0.2 units. The values of the other parameters are kept constant and their values are given as Spindle Speed = 4000rpm; Table feed rate = 923mm/min; Step Over = 1.0mm; Coolant Pressure = 1.34b/inch<sup>2</sup>. The experimentally observed data for the response characteristics for different values of doc is given in Table 4.3 & Figure 4.4 shows the scatter plots of doc versus response characteristic. The value of surface roughness shows a little decrease in start but then increases rapidly.

Table 4.3 Depth of Cut versus Surface Roughness

Sr. No.	Depth of Cut (mm)	Surface Roughness ( $\mu\text{m}$ )
1.	0.3	0.576
2.	0.5	0.566
3.	0.7	0.489
4.	0.9	0.351
5.	1.1	0.325
6.	1.3	0.578
7.	1.5	1.443
8.	1.7	1.620

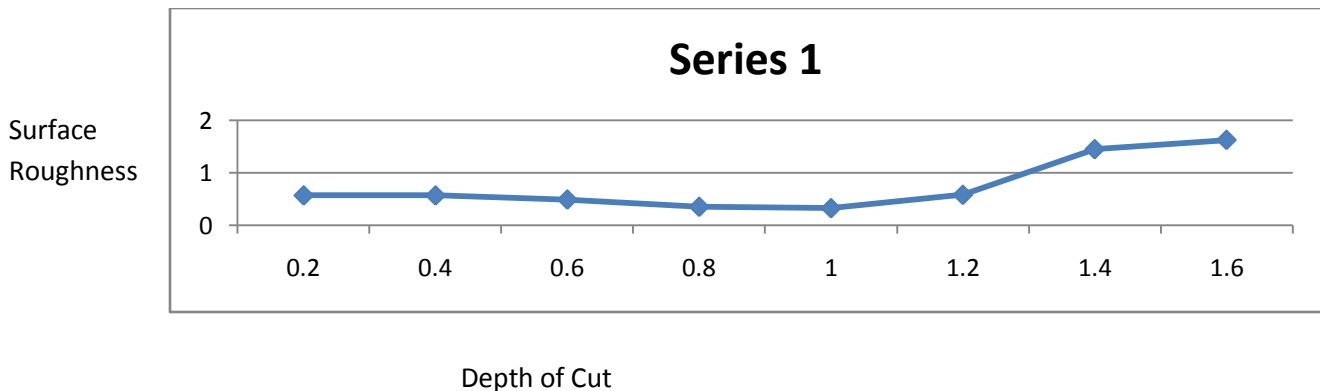


Figure 4.4 Depth of Cut versus Response Surface Roughness



## Conclusion

In which we can see that basically we have three parameter cutting speed, depth of cut and feed rate so in this case we change all the parameter one by one and find the output and in which our output is surface roughness or we can say find the minimum surface roughness first we are change the cutting speed and we find out at limiting range of cutting speed we can decrease surface roughness after that it goes to increase and same output we find in both feed rate and depth of cut means we can say when we start increase the value of the parameter our surface roughness goes to decrease to the limiting value after that it goes to increases so in this case we find out a suitable value of cutting speed, feed rate and depth of cut and we can decrease the surface roughness .