

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 5, May 2017

# Optimization of Milling Process Parameters of HSS Using Taguchi Parameter Design Approach

Dr.Ch.S.Naga Prasad

Professor & Principal, Department of Mechanical Engineering, GIITS Engineering College, Aganampudi,  
Visakhapatnam (DT), A.P, India.

**ABSTRACT:** Manufacturing industries attempt to make high quality products at lower cost to remain competitive in the market. The products may be made using various manufacturing methods, such as machining, etc. milling is among the most common machining processes used to make planar surfaces with faster material removal and good surface quality.

The imperative objective of the science of metal cutting is the solution of practical problems associated with the efficient and precise removal of metal from workpiece. It has been recognized that the reliable quantitative predictions of the various technological performance measures, preferably in the form of equations, are essential to develop optimization strategies for selecting cutting conditions in process planning.

In this thesis experiments will be conducted to improve the surface finish quality of aluminum alloy work piece by using carbide tips. The type is bull nose tip. A series of experiments will be done by varying the milling parameters spindle speed, feed rate and depth of cut. The spindle speeds are 3500rpm, 3000rpm and 2000rpm. The feed rates are 200mm/min, 300mm/min and 400mm/min. Depth of cut is 0.2mm and 0.3mm and 0.4mm.

Taguchi method is used to study the effect of process parameters and establish correlation among the cutting speed, feed and depth of cut with respect to the major machinability factor, surface finish. Validations of the modeled equations are proved to be well within the agreement with the experimental data.

## I. INTRODUCTION

Milling machine is one of the important machining operations. In this operation the work piece is fed against a rotating cylindrical tool. The rotating tool consists of multiple cutting edges (multipoint cutting tool). Normally axis of rotation of feed given to the work piece Milling operation is distinguished from other machining operations on the basis of orientation between the tool axis and the feed direction; however, in other operations like drilling, milling, etc. the tool is fed in the direction parallel to axis of rotation. The cutting tool used in milling operation is called milling cutter, which consists of multiple edges called teeth. The machine tool that performs the milling operations by producing required relative motion between work piece and tool is called milling machine. It provides the required relative motion under very controlled conditions. These conditions will be discussed later in this unit as milling speed, feed rate and depth of cut. Normally, the milling operation creates plane surfaces. Other geometries can also be created by milling machine. Milling operation is considered an interrupted cutting operation teeth of 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 bear the above stated conditions. Depending upon the positioning of the tool and work piece the milling operation can be classified into different types.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 5, May 2017



## II. LITERATURE REVIEW

### Optimization of process parameters for resharpened HSS drill Using Taguchi Methods

The objective of the present work is to optimize process parameter such as cutting speed, feed, and point angle. Taguchi methods are widely used for design of experiments and analysis of experimental data for optimization of processing conditions. The research contributions are classified into methodology for investigation and analysis, input processing conditions and response variables. This paper focuses on the optimisation of drilling parameters using the Taguchi technique to obtain minimum surface roughness (Ra) and maximum tool life. A number of drilling experiments were conducted using the L16 orthogonal array on a double spindle drilling machine. The experiments were performed on hardened boron steel using HSS twist drills. Analysis of variance (ANOVA) was employed to determine the most significant control factors affecting the surface roughness and tool life. The cutting speed, feed rate and point angle were selected as control factors. After the sixteen experimental trials, it was found that the point angle was the most significant factor for the tool life and that the feed rate was the most significant factor on the surface roughness. The results of the confirmation experiments showed that the Taguchi method was notably successful in the optimisation of drilling parameters for better surface roughness and tool life.

## III. METHODOLOGY

### Taguchi Method

Taguchi Method is developed by Dr. Genichi Taguchi, a Japanese quality management consultant. The method explores the concept of quadratic quality loss function and uses a statistical measure of performance called Signal-toNoise (S/N) ratio. The S/N ratio takes both the mean and the variability into account. The S/N ratio is the ratio of the mean (Signal) to the standard deviation (Noise). The ratio depends on the quality characteristics of the product/process to be optimized. The standard S/N ratios generally used are as follows: - Nominal is Best (NB), Lower the Better (LB) and Higher the Better (HB).

In this project the experiments are designed with the help of taguchi L9 orthogonal array. The software used for DOE (Design of experiment) is Minitab17. The project contains many processes which are described one by one in the methodology respectively.

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 5, May 2017

### Input parameters and their levels

Selected input Parameters

PROCESS PARAMETERS	LEVEL1	LEVEL2	LEVEL3
CUTTING SPEED(rpm)	2000	3000	3500
FEED RATE (mm/rev)	200	300	400
DEPTH OF CUT(mm)	0.2	0.3	0.4

### IV. EXPERIMENTAL INVESTIGATION

The experiments are done on the CNC milling machine with the following parameters:

**CUTTING TOOL MATERIAL** –cemented Carbide Tool

**WORK PIECE MATERIAL** – aluminum alloy

**FEED** – 200mm/min, 300mm/min, 400mm/min

**CUTTING SPEED** – 2000rpm, 3000rpm, 3500rpm,

**DEPTH OF CUT** – 0.2mm, 0.3mm, 0.4mm

**EXPERIMENTAL PHOTOS**



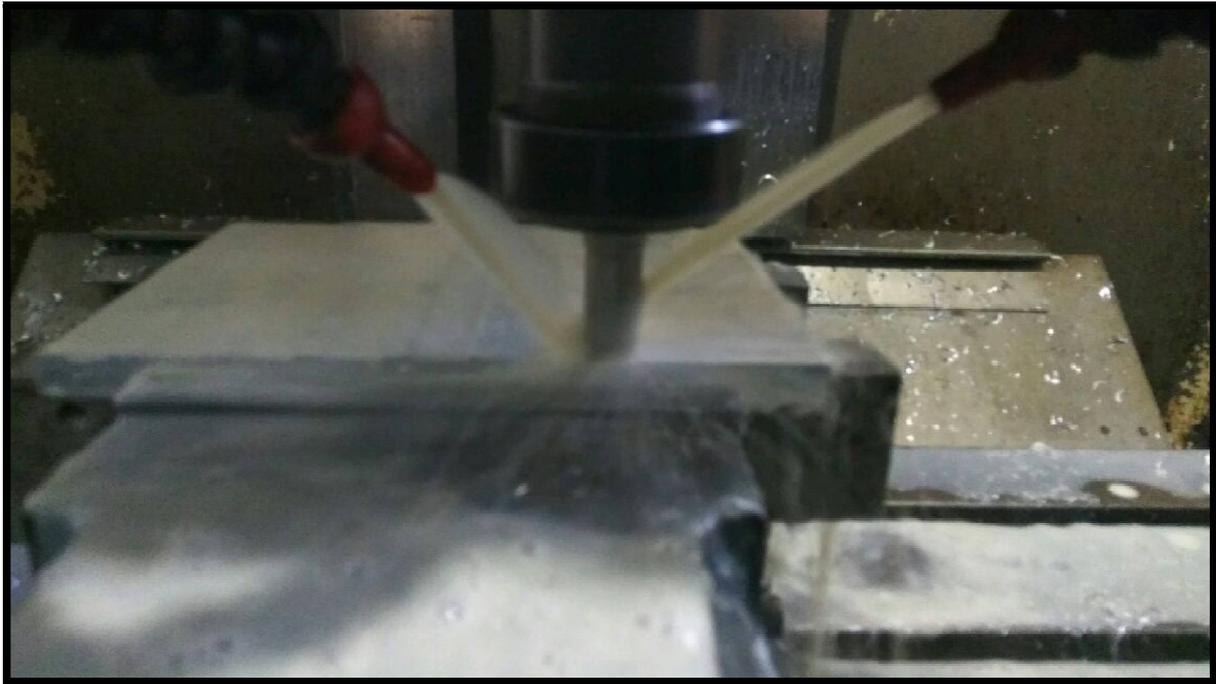
**CNC milling machine**

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 5, May 2017



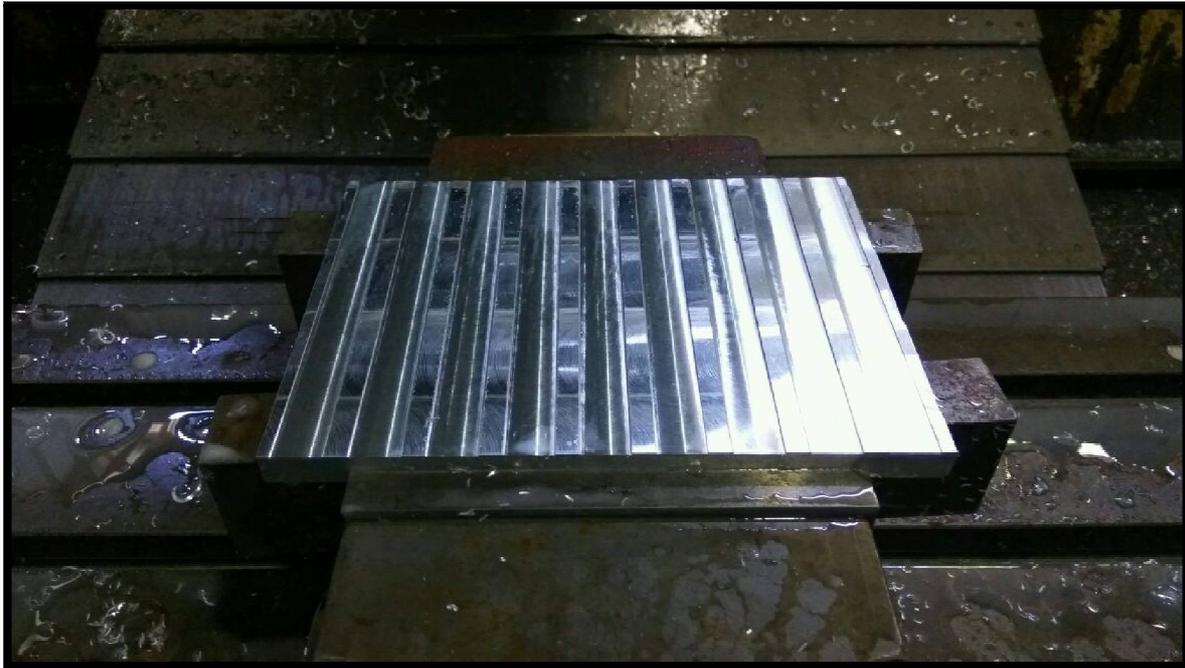
**Machining process**

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 5, May 2017



Work piece

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 5, May 2017

PROCESS PARAMETERS	LE VEL1	LEVEL2	LEVEL3
CUTTING SPEED(rpm)	2000	3000	3500
FEED RATE (mm/rev)	200	300	400
DEPTH OF CUT(mm)	0.2	0.3	0.4

JOB NO.	SPINDLE SPEED (rpm)	FEED RATE (mm/min)	DEPTH OF CUT (mm)
1	2000	200	0.2
2	2000	300	0.3
3	2000	400	0.4
4	3000	200	0.2
5	3000	300	0.3
6	3000	400	0.4
7	3500	200	0.2
8	3500	300	0.3
9	3500	400	0.4

### SURFACE FINISH VALUES

JOB NO.	SPINDLE SPEED (rpm)	FEED RATE (mm/min)	DEPTH OF CUT (mm)	Surface finish (R <sub>a</sub> ) μm
1	2000	200	0.2	1.09
2	2000	300	0.3	1.15
3	2000	400	0.4	1.24
4	3000	200	0.2	1.91
5	3000	300	0.3	2.21
6	3000	400	0.4	2.56
7	3500	200	0.2	3.12
8	3500	300	0.3	2.94
9	3500	400	0.4	2.87

### V. INTRODUCTION TO TAGUCHI TECHNIQUE

- Taguchi defines Quality Level of a product as the Total Loss incurred by society due to failure of a product to perform as desired when it deviates from the delivered target performance levels.
- This includes costs associated with poor performance, operating costs (which changes as a product ages) and any added expenses due to harmful side effects of the product in use.

#### Taguchi Methods

- Help companies to perform the Quality Fix!
- Quality problems are due to Noises in the product or process system
- Noise is any undesirable effect that increases variability
- Conduct extensive Problem Analyses
- Employ Inter-disciplinary Teams
- Perform Designed Experimental Analyses
- Evaluate Experiments using ANOVA and Signal-to noise techniques

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 5, May 2017

## Defining the Taguchi Approach

- Noise Factors Cause Functional Variation
- They Fall Into Three “Classes”
  - 1. Outer Noise – Environmental Conditions
  - 2. Inner Noise – Lifetime Deterioration
  - 3. Between Product Noise – Piece To Piece Variation
- The Point Then Is To Produce Processes Or Products The Are *ROBUST AGAINST NOISES*

## VI. CONCLUSION

In this thesis an attempt to make use of Taguchi optimization technique to optimize cutting parameters during high speed milling of aluminum alloy using cemented carbide cutting tool.

The cutting parameters are cutting speed, feed rate and depth of cut for milling of work piece aluminum alloy. In this work, the optimal parameters of cutting speed are 2000rpm, 3000rpm and 3500rpm, feed rate are 200mm/min, 300mm/min and 400mm/min and depth of cut are 0.2mm, 0.3mm and 0.4mm. Experimental work is conducted by considering the above parameters. Cutting forces, surface finish and cutting temperatures are validated experimentally.

By observing the experimental results and by taguchi, the following conclusions can be made:

To get better surface finish, the optimal parameters are spindle speed – 3500rpm, feed rate – 200mm/min and depth of cut – 0.4mm.

## REFERENCES

1. Optimization of milling process parameters of en33 using taguchi parameter design approach mr. Dhole n.s. 1 , prof. Naik g.r 2 , mr. Prabhawalkar m.s. 3.
2. Optimization of process parameters of CNC Milling machine for mild steel using Taguchi design and Single to Noise ratio Analysis ANIL CHOUBEY1 , VEDANSH CHATURVEDI2 , JYOTI VIMAL.
3. OPTIMIZATION OF MILLING PROCESS PARAMETERS - A REVIEW mihirhakorbbhai Patel\*
4. Optimization of Input Process Parameters in CNC Milling Machine of EN24 Steel 1Balinder Singh, 2Rajesh Khanna, 3Kapil Goyal, 4Pawan Kumar
5. Selection of Optimum Process Parameters in High Speed CNC End-Milling of Composite Materials Using Meta Heuristic Techniques – a Comparative Study Pare, V., Geeta, G., Krishna, C.M. Vikas Pare – Geeta Agnihotri – Chimata Krishna\*
6. G. Petropoulos, I. Ntziantzias, C. Anghel, A predictive model of cutting forces in milling using Taguchi & response surface techniques, a proceeding of 1st International Conference on Experiments/Process/ System Modelling/Simulation/Optimization, Athens, 6- 9 July, 2005
7. C. C. Tsao, Grey–Taguchi method to optimize the milling parameters of aluminum alloy, International Journal on Advanced Manufacturing Technology (2009) 40:41–48
8. K.-D. Bouzakis1, R. Paraskevopoulou1, G. Giannopoulos, Multi-objective optimization of cutting conditions in milling using genetic algorithms, Proceedings of the 3rd International Conference on Manufacturing Engineering (ICMEN), 1-3 October 2008, Chalkidiki, Greece
9. Dalgobind Mahto and Anjani Kumar, Optimization of Process Parameters in Vertical CNC Mill Machines Using Taguchi’s Design of experiments, ARISER Vol. 4 No. 2 (2008) 61-75

## BIOGRAPHY



DR.CH.S.Naga Prasad received his M.Tech Degree on Heat power Refrigerator and AC from JNTU, Anantapur in 2002 and Ph.D on IC Engines (Thermal Engg) from JNTU, Hyderabad in 2011. He is currently working as Professor & Principal in Gonna Institute of Information Technology and sciences, Aganampudi, Visakhapatnam, A.P, INDIA.