Effects of tool Overhang on Selection of Machining Parameters and Surface Finish During Diamond Turning

Vinod Mishra, Gufran S. Khan, K.D. Chattopadhyay, Keshva Nand, RamaGopal V. Sarepaka

PII: S0263-2241(14)00240-1
DOI: http://dx.doi.org/10.1016/j.measurement.2014.05.019
Reference: MEASUR 2866

To appear in: *Measurement*

Received Date: 26 February 2013
Revised Date: 13 May 2014
Accepted Date: 19 May 2014

Please cite this article as: V. Mishra, G.S. Khan, K.D. Chattopadhyay, K. Nand, R.V. Sarepaka, Effects of tool Overhang on Selection of Machining Parameters and Surface Finish During Diamond Turning, *Measurement* (2014), doi: http://dx.doi.org/10.1016/j.measurement.2014.05.019

EFFECTS OF TOOL OVERHANG ON SELECTION OF MACHINING PARAMETERS AND SURFACE FINISH DURING DIAMOND TURNING

Vinod Mishra [a], **Gufran S Khan**[b], **K D Chattopadhyay**[a], **Keshva Nand**[a], **RamaGopal V Sarepaka**[a]

[a] *Central Scientific Instruments Organisation, Sector 30-C, Chandigarh 160 030, India*

[b] *Indian Institute of Technology Delhi, Hauz Khas, New Delhi 110016, India*

Abstract

In precision machining leading to nano-metric surface finish, selection of the suitable machining parameters is a critical task. To ensure the desired surface quality, one needs to optimally select the machining parametric matrix. Towards this effort, this paper adds another critical parameter in terms of tool overhang. A well-defined set of machining exercises is carried out with different tool overhangs and machining parameters. In this investigation, an attempt has been made to locate the optimum range of tool overhang with minimum tool vibrations. The interaction between tool overhang with other parameters is also thoroughly investigated. Another important focus of this study is to find out the optimum machining parameters for the situations where it is not possible to select an optimum tool overhang. One such situation occurs when a steep concave parabolic surface need to be fabricated. In this case a large tool overhang has to be selected. Power spectral density distribution analysis of surface roughness for different tool overhangs is performed to find out significant parameters and their degree of contribution to surface roughness. Analysis of Variance is also applied to ascertain statistically significant factors contributing to surface roughness. To model the surface roughness, Response Surface Methodology is being used. The model has been verified by conducting a series of experiments and a steep concave parabolic surface is developed by following the predictions of the developed model.

Key words: Tool overhang, Surface roughness, Single point diamond turning, Tool vibration

1. Introduction

The need of nano-metric level of surface finish is increasing day by day in the traditional and emerging engineering sectors of bioengineering, precision engineering, automotive fabrication, consumer products, medical instrumentation and telecommunication industry. In precision manufacturing, finishing of a component is the most critical and expensive stage. Most of the traditional finishing operations are skill dependent, rendering the final shapes in sub-micron range of surface quality. Also, most of the traditional final shapes are simple in nature. For complex shapes with nano-metric surface finish, researchers are exploring various options