

# Experimental Investigation Of Improvement In Surface Finish In Boring Operation Using Passive Damper

Gaurav Saindane

Mechanical Department, University of Pune/STES's Smt. Kashibai Navale College of Engineering/  
Pune, Maharashtra, India

## Abstract

This paper introduces an experimental investigation of improvement in surface finish in boring operation using passive damper. The principle followed in this paper was to improve the surface finish by enhancing the damping capability, minimizing the loss in static stiffness through implementation of passive damper. The newly designed tool has been compared to a conventional tool. The results obtained were found satisfactory and indicate that passive damper can be used for minimizing the effects of vibrations which ultimately results into enhancement of surface finish.

**Keywords:** Boring bar, passive damper, static stiffness, Ra value.

## 1. Introduction

Vibrations are undesirable for structures, due to the need for structural stability, position control, durability (particularly durability against fatigue), performance, and noise reduction. Vibrations are of concern to large structures such as aircraft, as well as small structures such as electronics. Vibration reduction can be attained by increasing the damping capacity and/or increasing the stiffness (which is expressed by the storage modulus). The loss modulus is the product of these two quantities and thus can be considered a figure of merit for the vibration reduction ability. Damping of a structure can be attained by passive or active methods. Passive methods make use of the inherent ability of certain materials (whether structural or non-structural materials) to absorb the vibration energy (for example, through mechanical deformation), thereby providing passive energy dissipation. Active methods make use of sensors and actuators to attain vibration sensing and activation to suppress the vibration in real time. The attenuation of machine tool vibration is a field of research that has been the concern of many engineers over the past few decades. The driving force behind the ongoing research can be related to the fact that the level of vibration at the tool tip, limits the tool life as well as tolerances and the surface finish obtained by the machining

process. Traditionally, the rate of material removal is reduced to obtain the required tolerances and surface finish. The reduction in rate of material removal reduces the efficiency of the machine, since the component manufacturing time is increased and lower production is obtained from the machine over a period of time. The objective of the vibration attenuation is to improve the dynamic stiffness of the machine tool structure, to increase the rate of material removal and thereby prolonging the life of the tool tip. Acoustic noise emission during the machining process results from the relative motion between the tool tip and work piece. High levels of acoustic noise can cause discomfort in the working environment. The problem is related to the dynamic stiffness of the machine tool structure. By improving the dynamic stiffness of the structure, the level of noise emission from the machining process can be reduced.

## 2. Experimental Procedure

Number of experiments was conducted to analyze the effect of vibration on deflection of boring bar. Boring bar of 16 mm × 16 mm cross-section and 200 mm long of WIDAX make is used. The work piece material used for study is EN9. The boring operations were carried out on a lathe machine. The work piece was mounted using a four jaw chuck. The machining parameters like feed (0.02mm/rev, 0.04mm/rev), depth of cut (1mm, 2mm), etc. were selected based on the manufacturers recommendations and were changed according to the proposed conditions. Also the cutting speed, length of passive damper on boring bar and overhang length was changed. The recommended parameters are shown in Table 1. Boring was carried out for 51mm internal diameter. Passive dampers of Nylon and Polyurethane were used. The profilometer technique used in this study is common in most machine shops. A Mitutoyo SJ-201P apparatus was used. The profilometer has been used to obtain the surface roughness values of the workpieces. The

readings were taken at approximately 120 degree angles and the average value was found out.

### 3. Tables and Figures

Abbreviations used in the following tables are given below: C-Condition, S-Speed, F-Feed, D-Depth of Cut, O-Overhang of the boring bar, M-Material used for Damping, P-Percentage of Overhang Damped, L-Length of Passive Damper.

Table 1: Testing Conditions

C	S (rpm)	F(mm/rev)	D(mm)	O(mm)	M	P	L (mm)
1	100	0.02	1	100	Nylon	3	30
2	100	0.02	1	120	PU	6	72
3	100	0.04	2	100	Nylon	6	60
4	100	0.04	2	120	PU	3	36
5	120	0.02	2	100	PU	3	30
6	120	0.02	2	120	Nylon	6	72
7	120	0.04	1	100	PU	6	60
8	120	0.04	1	120	Nylon	3	36



Fig. 1 Boring bars



Fig. 2 Boring bar with passive damper



Fig. 3 Workpieces

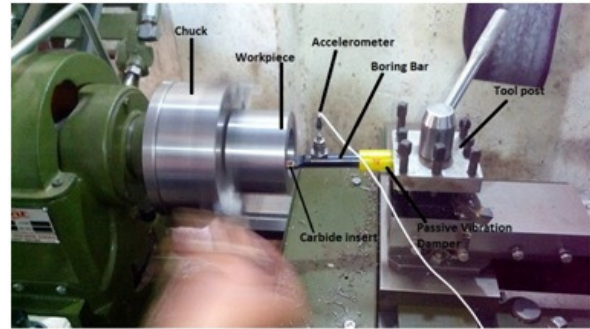


Fig. 4 Installation of boring bar with passive damper and accelerometer on lathe machine

Table 2: Results

C	Ra	Ra Values	Ra
	Values without Damper (µm)	with of Polyurethane (µm)	Values with damper of Nylon (µm)
1	2.60	3.16	3.21
2	2.61	3.36	3.45
3	2.69	3.33	3.29
4	2.33	3.29	3.15
5	2.47	3.31	3.26
6	2.72	3.12	3.35
7	2.90	3.41	3.48
8	2.82	3.24	3.32

### 4. Conclusions

An innovative method is proposed to reduce the deflection of the boring bar in boring operation. Passive dampers are also relatively cheaper than other damped boring bars. The results show significant improvement in surface finish with the use passive dampers. It can therefore also be concluded that passive damping has a good effect in improving surface finish in boring operation.

### References

- [1] Lorenzo Daghini, Andreas Archenti, and Cornel Mihai Nicolescu "Design, Implementation and Analysis of Composite Material Dampers for Turning Operations" World Academy of Science, Engineering and Technology vol 53(2009).
- [2] B. Moetakef-Imani, N.Z.Yussefian "Dynamic simulation of boring process" International Journal of Machine Tools & Manufacture vol 49 (2009) pp 1096–1103

[3] L. Andr en and L. H akansson Active “Vibration Control of Boring Bar” Vibrations Department of Signal Processing School of Engineering Blekinge Institute of Technology August, 2004

[4] Zhiwei Xua, Michael Yu Wangb, Tianning Chen “Particle damping for passive vibration suppression: numerical modeling and experimental investigation” Journal of Sound and Vibration vol 279 (2005) pp 1097–1120

[5] Kanase Sandip S, Patil Jaydeep S, Jadhav Sainand M “Improvement Of Ra Value Of Boring Operation Using Passive Damper” The International Journal Of Engineering And Science (IJES) Volume2 Issue 7 Pages 103-108 2013 ISSN(e): 2319 – 1813 ISSN(p): 2319 – 1805

[6] Lonnie Houck, Tony L. Schmitz, K. Scott Smith “A tuned holder for increased boring bar dynamic stiffness” Journal of Manufacturing Processes Vol.13 (2011) pp 24–29

[7] Dai Gil Lee, Hui Yun Hwang, Jin Kook Kim “Design and manufacture of a carbon fiber epoxy rotating boring bar” Composite Structures Vol 60 (2003) pp 115–124

[8] Norikazu Suzukia, Kohei Nishimurab, Ryo Watanabea, Takashi Katoa and Eiji Shamotoa “Development of novel anisotropic boring tool for chatter suppression” vol 1 (2012) pp 56 – 595th CIRP Conference on High Performance Cutting 2012

[9] M. H. Migue, L.Rubio, J.A.Loya, J.Fernandez-Saez “Improvement of chatter stability in boring operations with passive vibration absorbers” International Journal of Mechanical Sciences vol 52 (2010) pp 1376–1384.

