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Characterization of TOOLOX® 44 as tooling material

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Introduction

Vibration is still a major limiting factor

A recent study made on cylinder head production within the Renault group, where the yearly production is three million parts, the cost for machining vibration has been estimated at 0.35 euro per cylinder head

Resistance to machining vibration (forced and chatter) is a consequence of lack of stiffness and/or damping

Introduction

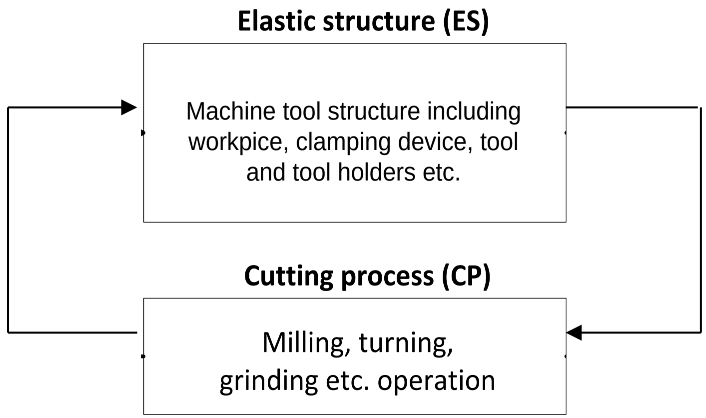
At KTH IIP research has been showing that the most effective way to obtain a robust machining system is to act on the machine tool elastic structure rather than the selection of cutting parameters.

Enhancing the structure allows to enlarge the window of stable cutting parameters giving the possibility to improve the material removal rate witholding (or even improving) surface quality. [1,2]

[1]Lorenzo Daghini, Improving Machining System Performance through Designed-in Damping, Phd Thesis, 2012

[2]Amir Rashid, A. Rashid, On passive and active control of machining system dynamics, Stockholm: Royal Institute of Technology, KTH Production Engineering, 2005.

Robust machining system



Processes not affected by external or internal disturbances

- operator handling the machine
- material variations
- time factors
- **machining vibration**

TOOLOX ® 44 comparison

Two identical end-mills have been compared (1 toolox and 1 conventional) via:

1)Experimental modal analysis (EMA) for extracting the dynamic properties

2)Machining tests

EMA

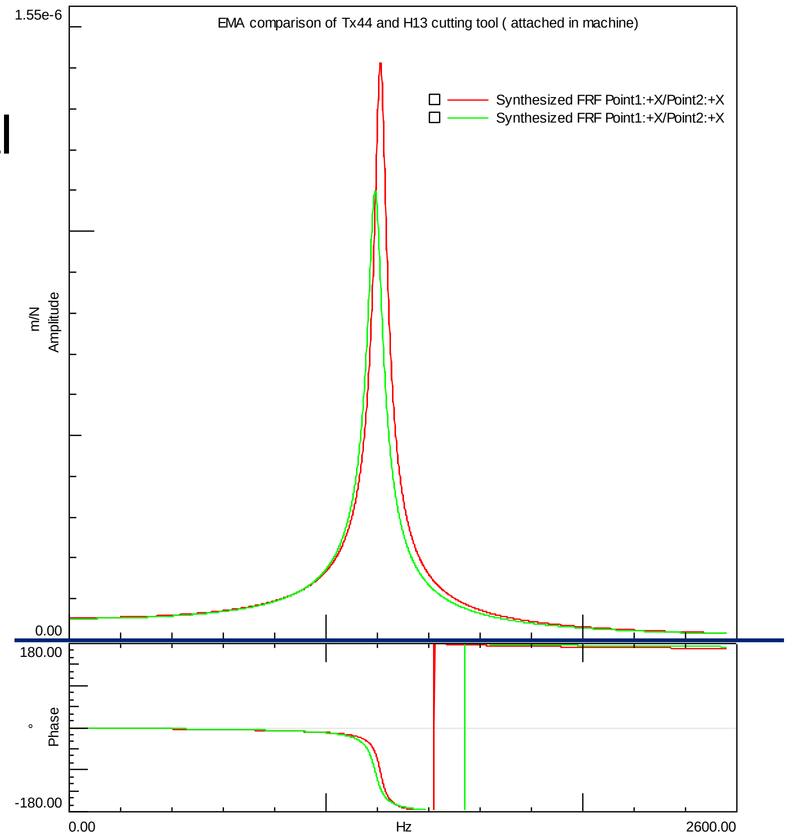
TOOLOX=green
Conventional =red

TOOLOX showed higher mass (m) than the conventional

This would imply a

lower natural frequency.

$$\omega_n = \frac{1}{2\pi} \sqrt[2]{\frac{k}{m}}$$

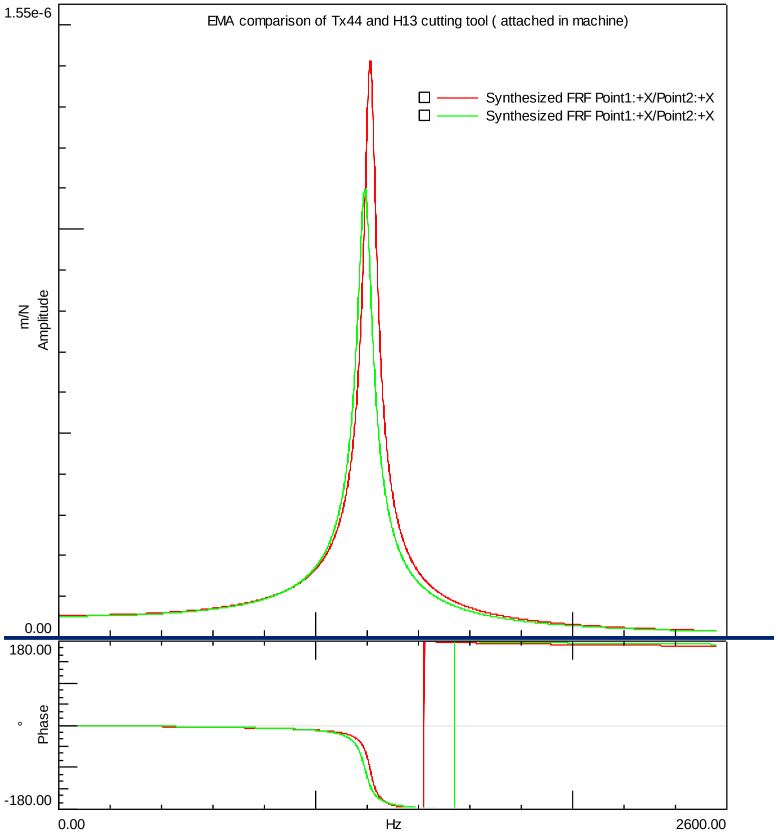


EMA

TOOLOX=green
Conventional =red

Both tools share the same
 natural frequecy. Meaning that
Stiffness (k) is higher for the
TOOLOX tool holder

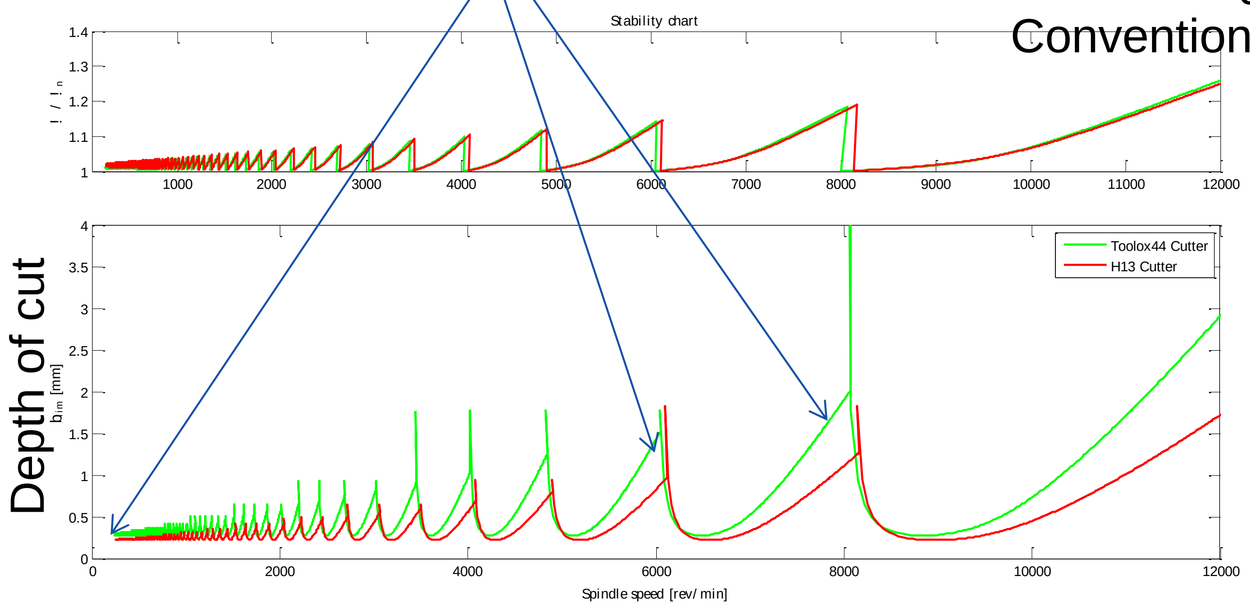
$$\omega_n = \frac{1}{2\pi} \sqrt[2]{\frac{k}{m}}$$



Stability diagram (SLD)

The SLD calculated on the base of the EMA
Shows that TOOLOX allows a higher depth of cut
At any given cutting speed

TOOLOX=green
Conventional =red

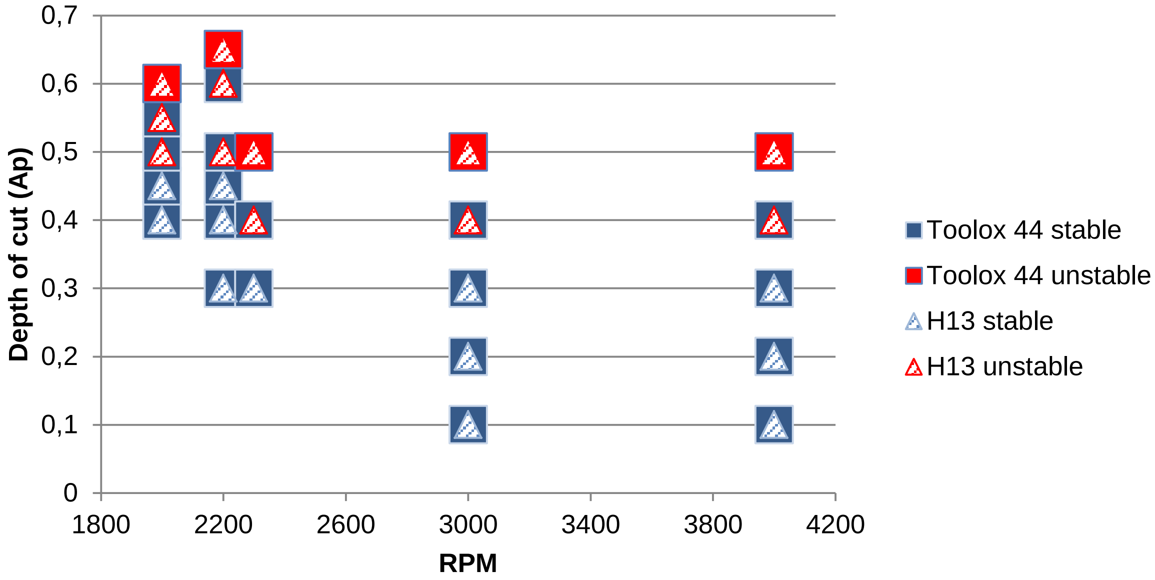


Spindle speed

Machining tests

Machining tests confirmed the SLD

The TOOLOX tool holder was able to machine in stable conditions at higher removal rates



Conclusions

TOOLOX ® 44 allows to improve the MRR and the surface quality of the produced part.

PV	6.773 µm		PV	3.595 µm
RMS	1.318 µm		RMS	0.357 µm
R_a	1.102 µm		R_a	0.287 µm

Figure 4.7: Comparison of Surface roughness (Left) H13 Ap-0.5mm Rpm-2000 (Right) Toolox 44 Ap-0.5mm Rpm-2000.

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