

Advanced Machining Processes

Quiz 4

Name: _____ **Solution** _____

1. An increase in **corner radius** does what to the following:

- a) **specific energies** and therefore the orthogonal equivalent cutting and thrust force components?

Specific energies (u_C and u_T) increase as \bar{h} increases, which occurs as r_c/d increases. This provides a small to moderate effect on force magnitude.

- b) the **ratio** of F_{Rad} to F_{Lon} ?

The equivalent lead angle $\bar{\psi}$ (the direction of F_T , where $F_{Rad}/F_{Lon} = \tan \bar{\psi}$) increases as r_c/d increases. This effect is strong.

2. Regarding equivalent lead angle:

- a) By definition, $\bar{\psi} = \tan^{-1}\left(\frac{F_d}{?}\right)$. What is the ‘?’?

F_f

- b) For boring, what is the tooth-local force ratio inside the ‘ \tan^{-1} ’ function?

$F_{Rad} \cdot F_{Lon}$

- c) For face milling, what is the tooth-local force ratio inside the ‘ \tan^{-1} ’ function?

$F_{Lon} \cdot F_{Rad}$

3. Multi-tooth machining, such as often used in boring, has advantages and disadvantages:

- a) In terms of **feed rates (of different types)**, what is the productivity advantage of multi-tooth machining?

For N_t teeth, the material removal rate (MRR) increases, while maintaining the same feed per tooth, to N_t times the MRR achieved with that same feed per tooth.

- b) **Briefly**, what is a positive aspect regarding the global coordinate system (x - y) force components in an **ideal boring** operation?

Under ideal conditions, meaning no runout, $F_x = F_y = 0$ due to complete force balancing in the x - y plane

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4. In boring:

a) What does **radial** runout **primarily** affect?

Surface Finish

b) What does **axial** runout **primarily** and **secondarily** affect?

Forces (primarily) and Surface Finish (secondarily)

5. In face milling:

a) What can be said about the x - and y -force component signals as related to spindle angle, **under ideal conditions**, and what are the two causes of this behavior?

They vary periodically at the tooth period. The variation is caused by both the inherent intermittent nature of face milling as well as the process kinematics (i.e. tooth orientation / cutting direction changing with angle as the tooth sweeps across the workpiece surface during cutter rotation).

b) Why, **under ideal (no runout) conditions**, does variation exist in the x - and y -force component signals when $D_t \leq W_w$ and $N_t \geq 4$, even though a linear force model predicts them to be constant with spindle angle?

Size Effect

6. What makes end milling different from face milling with a large depth of cut?

Helix angle (wrap) causes the tooth angle to vary with axial position.