
بسم الله الرحمن الرحيم

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Finite element analysis of ultrasonic cutting in one direction

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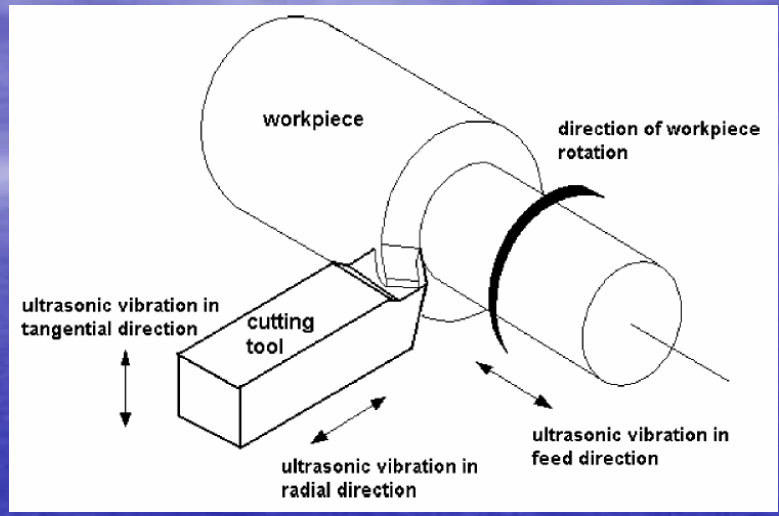
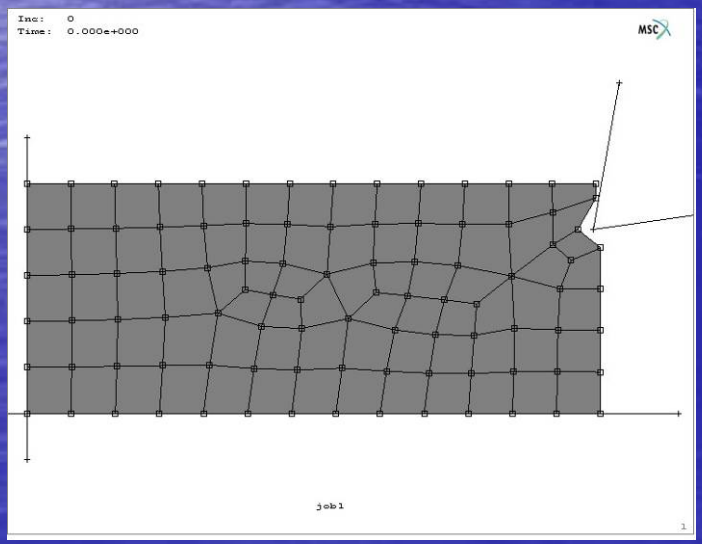
Discussions

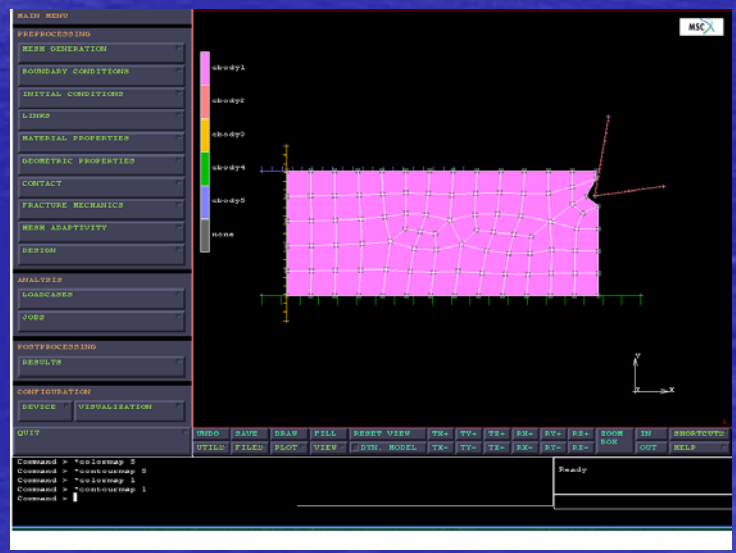
1. Introduction
2. Process simulation
3. Simulation result and FE analysis
4. Conclusion

1. Introduction



Two-dimensional modeling

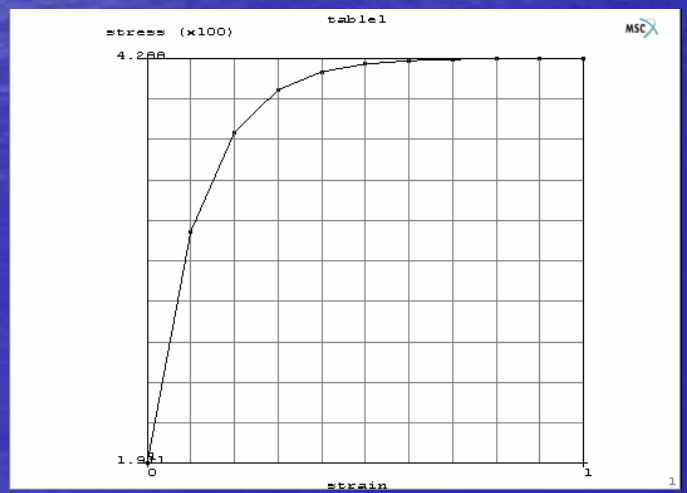




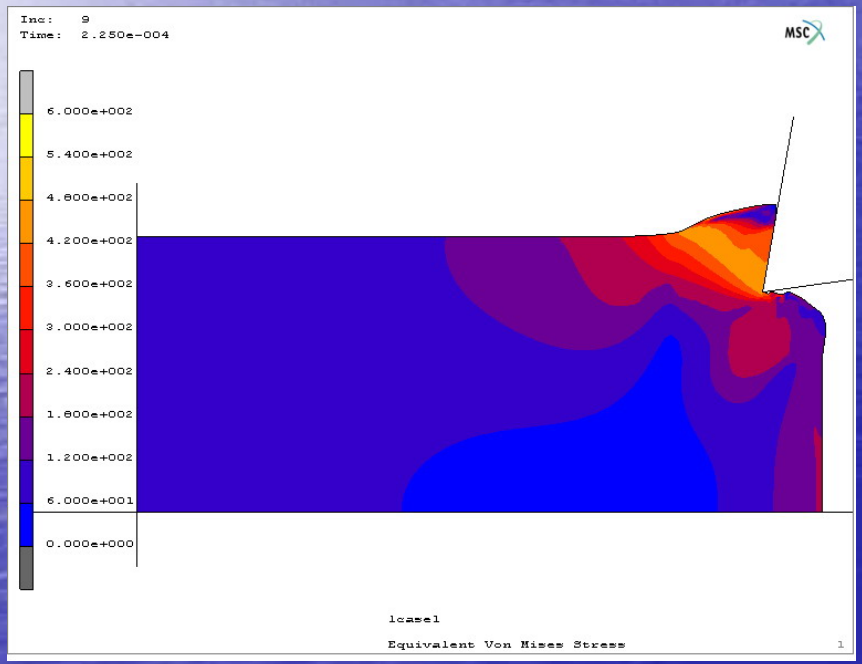
Mechanical property Al 6111-T4

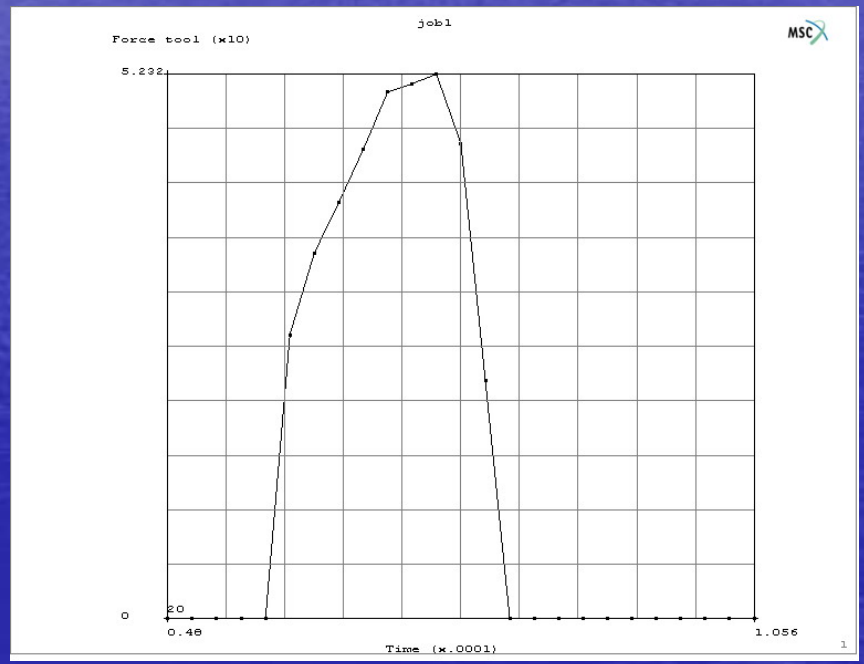
	E	ν	ρ
Al	71	0.33	2.7e-6

Stress-Strain diagram for Al 6111-T4



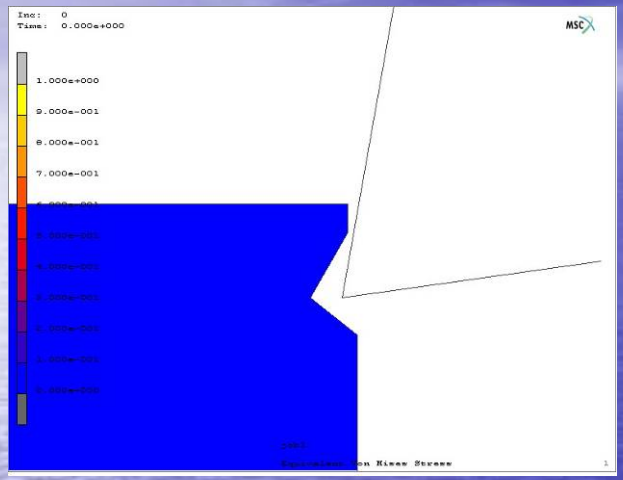
3. Simulation result and FE analysis



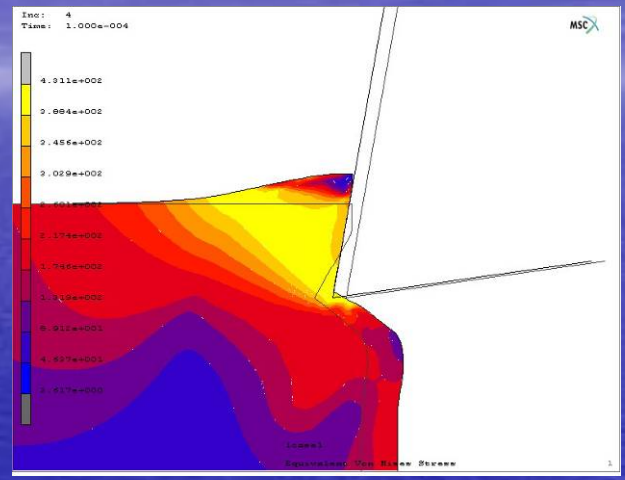


Stress and machining force in one cycle of ultrasonic cutting

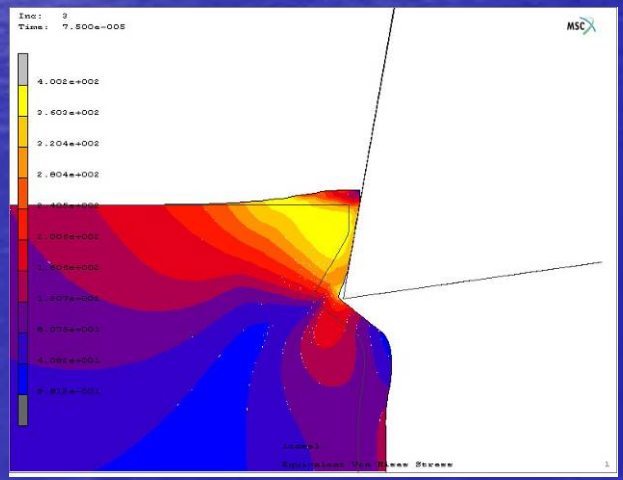
The way of engagement between tool and workpiece in ultrasonic vibration cycle



a) start

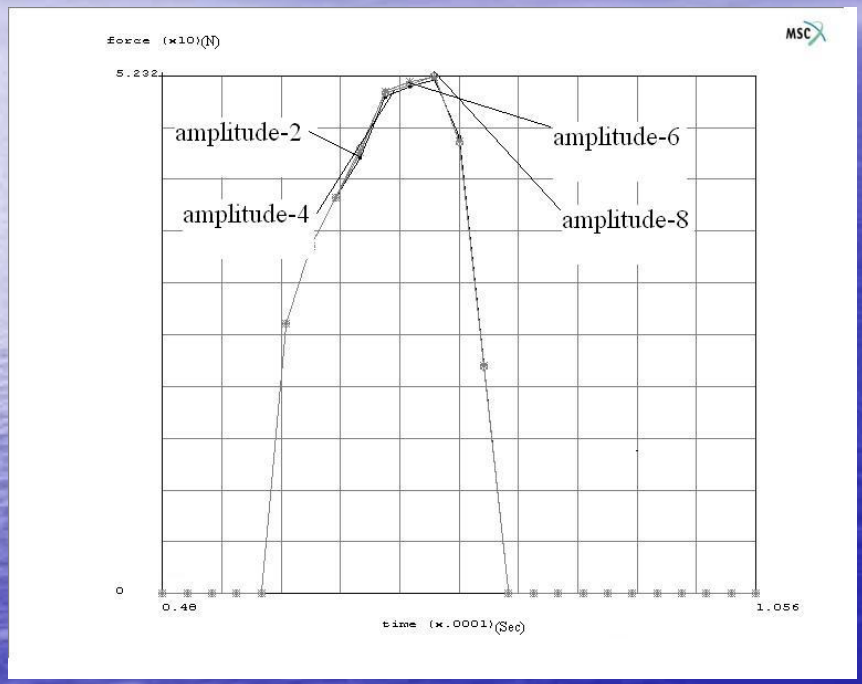


c) Remove tool from workpiece

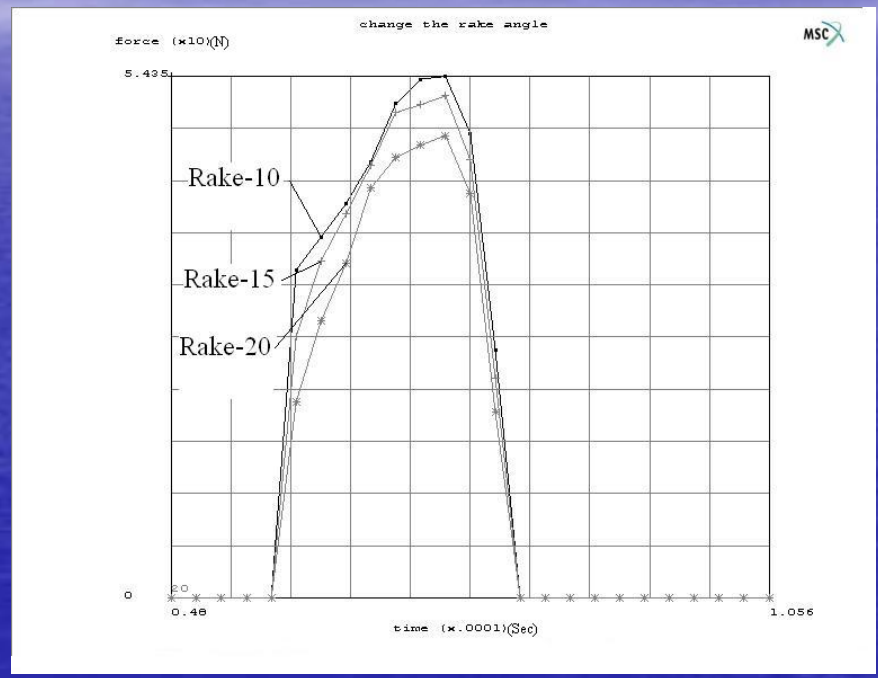


b) engagement between tool and workpiece

Exerted stress on the tool and machining force due to the change in tool geometry

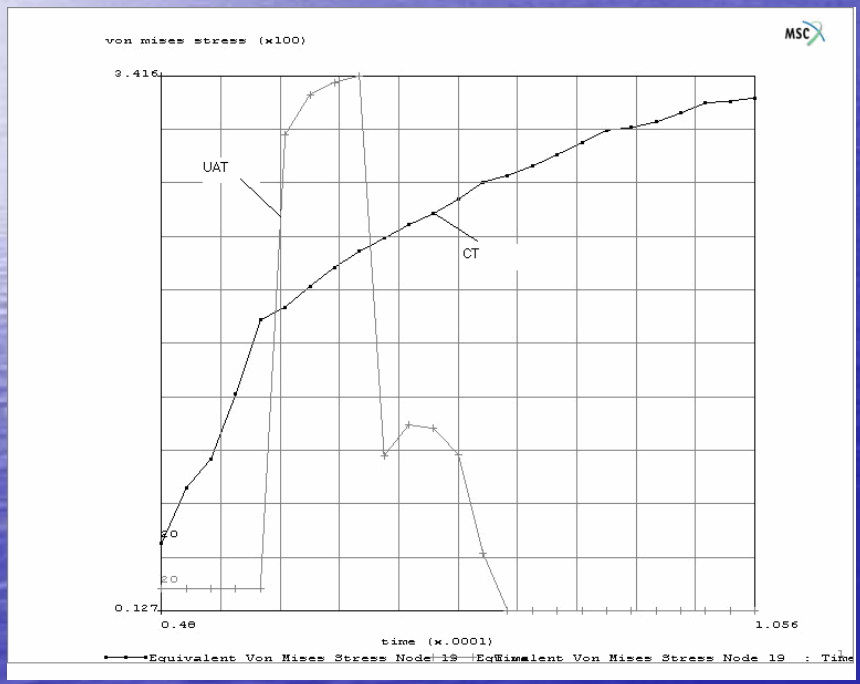


a) The influence of clearance angle on the force

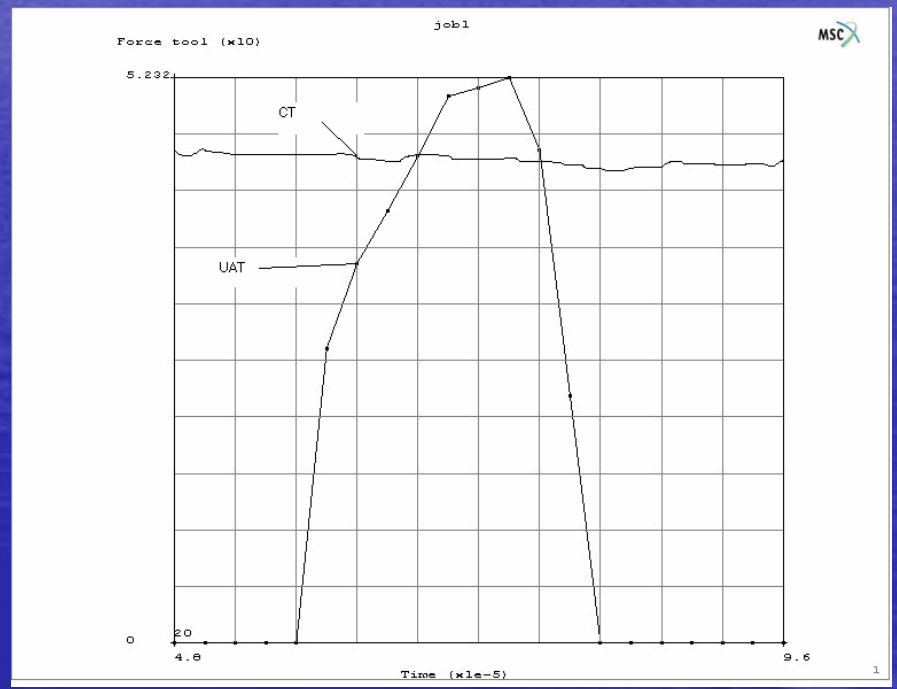


b) The influence of rake angle on the force

Workpiece stress and machining force in traditional turning and ultrasonic cutting

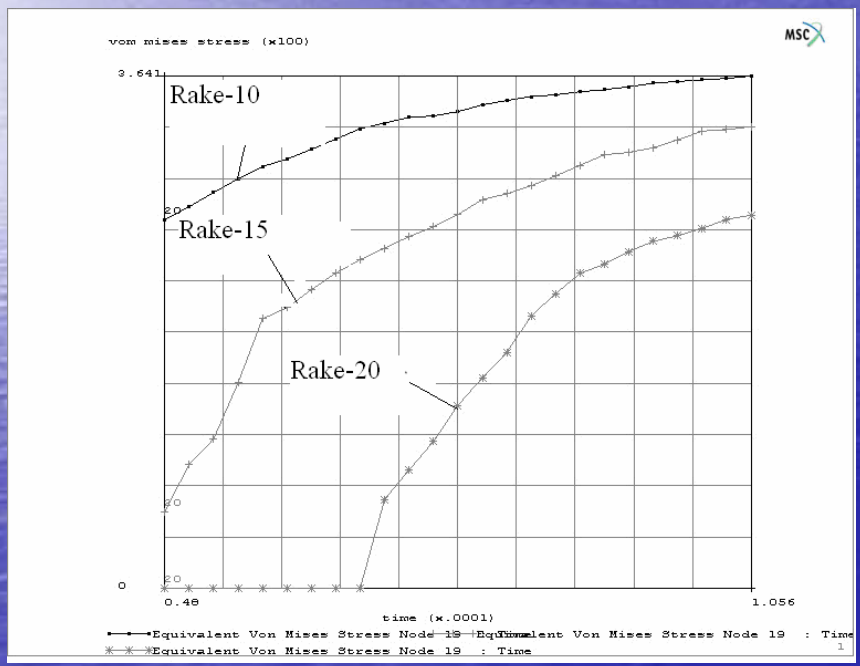


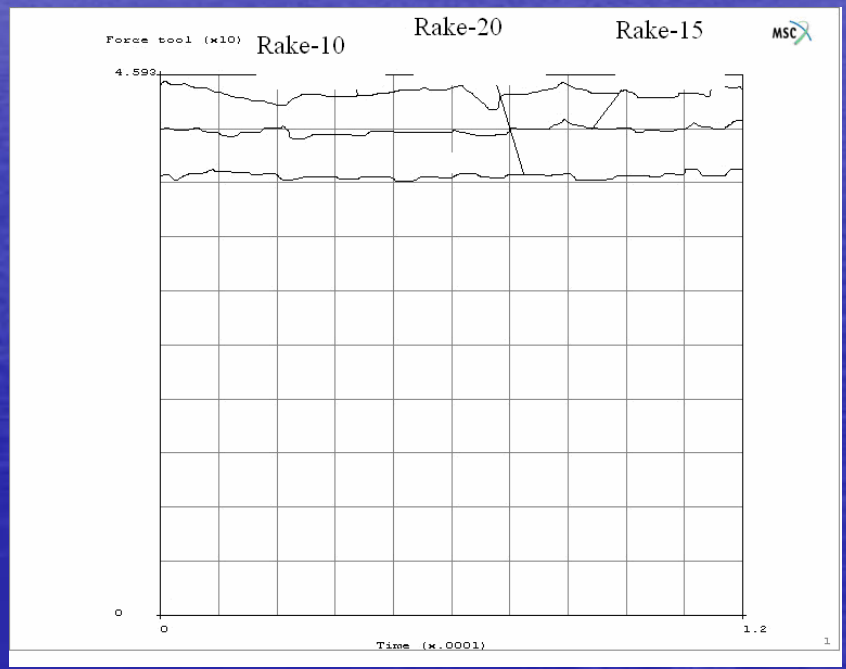
a) Workpiece stress



b) Machining force

Workpiece stress and machining force due to the change in tool geometry in traditional turning.

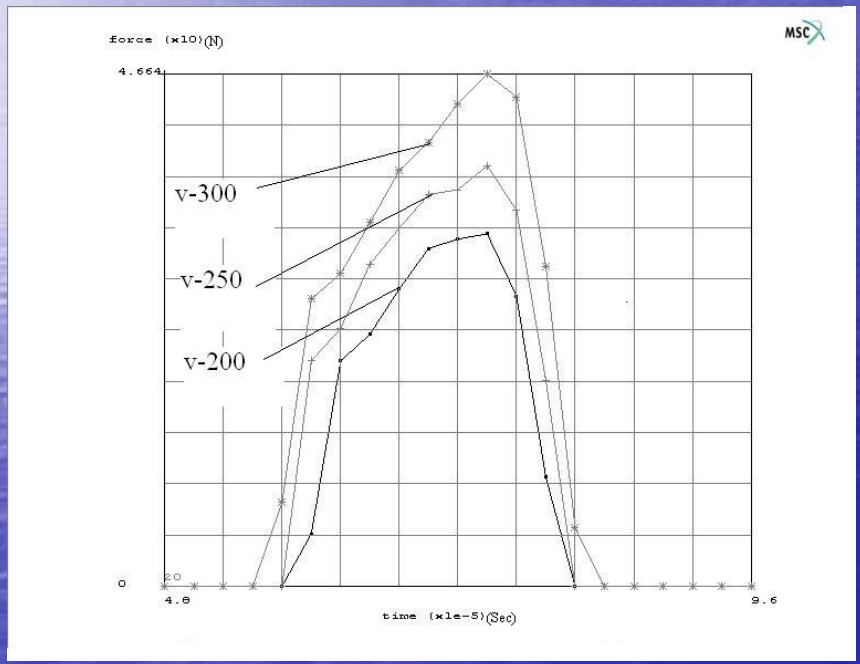




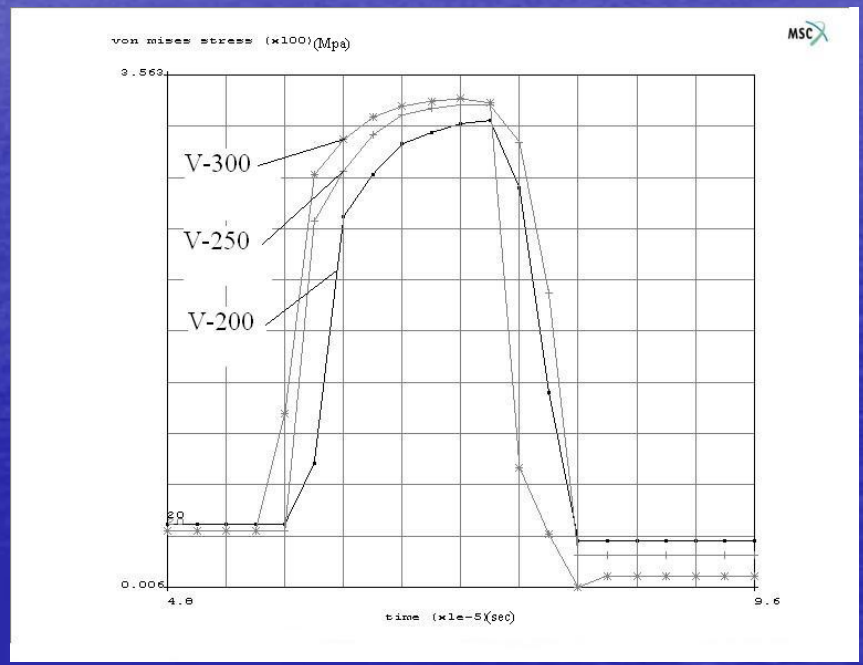
a) The influence of rake angle on the stress

b) The influence of rake angle on the force

The effect of cutting speed on cutting force and workpiece stress in ultrasonic cutting.

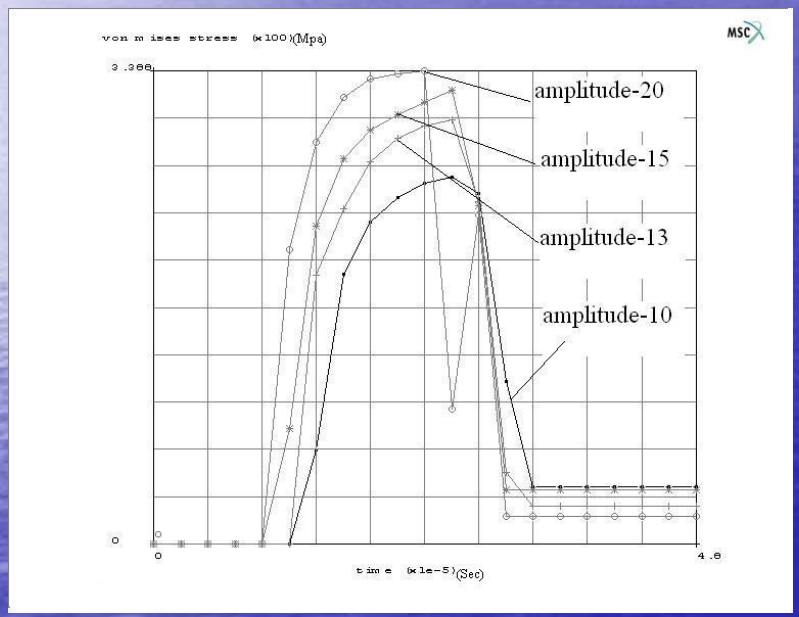


a) The effect of cutting speed on cutting force

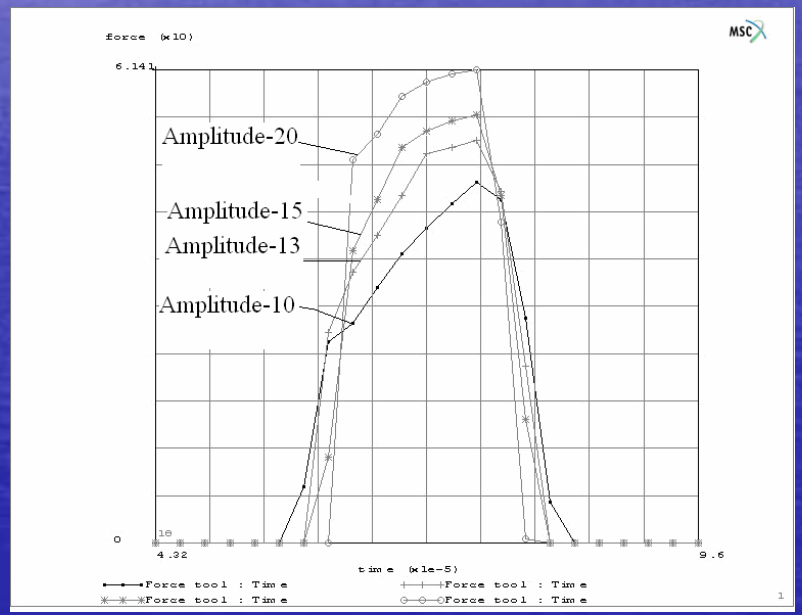


b) The effect of cutting speed on workpiece stress

The effect of ultrasonic vibration amplitude on cutting force and workpiece stress in ultrasonic cutting.



a) The effect of ultrasonic vibration amplitude on workpiece stress



b) The effect of ultrasonic vibration amplitude on cutting force

4. Conclusion

- 1. In ultrasonic cutting process, tool periodically comes into contact with the workpiece.
- 2. In ultrasonic cutting process, force, when tool meets the workpiece increases up to a maximum value and decreases thereafter down to zero, which indicates that the machining force in ultrasonic is less than that of the traditional cutting.
- 3. In ultrasonic cutting process, the stress developing in the workpiece increases to its maximum value and then decreases to zero, which implies that the workpiece's stress is lower in ultrasonic cutting than that of the traditional cutting.
- 4. In ultrasonic cutting process, machining force depends heavily on the cutting speed. The greater the cutting speed, the nearer the machining force magnitudes would be to those of the traditional machining.
- 5. Tool clearance angle has no influence on machining force.
- 6. Tool rake angle inversely affects the machining force, i.e. by increasing the tool rake angle, machining force decreases.
- 7. The time of contact between tool and workpiece in ultrasonic cutting process is less than that of traditional cutting. This fact boosts tool cooling and retards the creation of build-up-edge thus increasing the tool life.

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Thank You