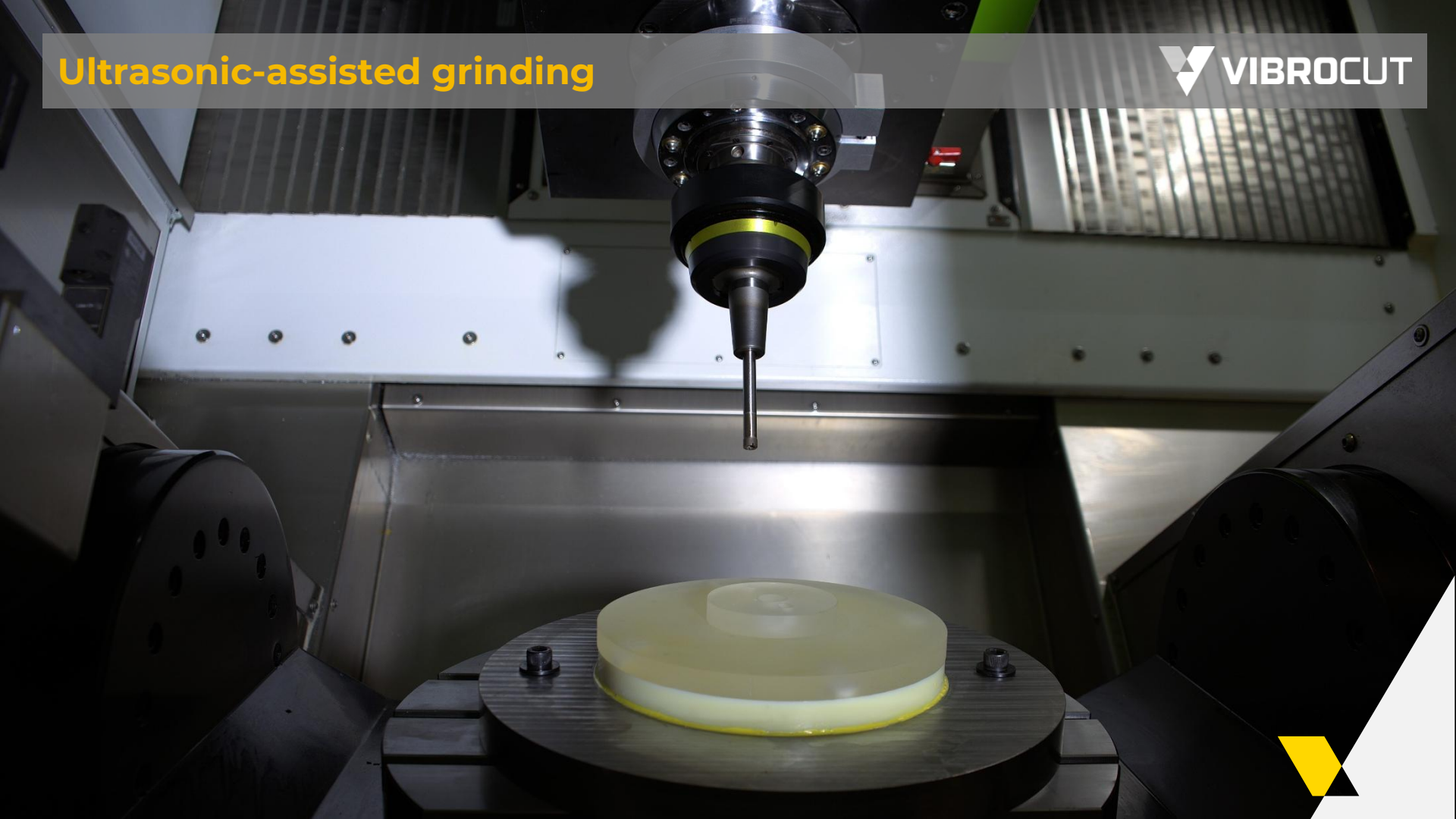


Ultrasonic-assisted grinding

 VIBROCUT



Classification of technology

Manufacturing process:

- Grinding
(drilling / coordinate grinding)

Mode:

- 1-dimensional (longitudinal)

Frequency:

- High frequency (>16,000 Hz) - Ultrasound

Generation:

- Resonant

Orientation to process kinematics:

- Various

Objective: Shifting of process
process boundaries and limitations



Quality










Process reliability



Productivity

Physical mechanisms and technological effects

 Material effect	Defined removal through micro-hammering	 Increase in productivity
	Reduction of process forces	 Improvement in quality (roughness and edge chipping)
 Friction	No clogging of the grinding tools	 Increased tool life
	Reduced tool wear	 Increasing process reliability
 Kinematics	Multi-axis movement	 Cost savings
	Self-sharpening of the abrasive grains	

Application for deep drilling of quartz glass (wafer chucks etc.)

- Material: Quartz glass
- Drill bit / depth: Diamond $\varnothing 4\text{mm}$ / 180 mm
- Cutting values: $v_f = 5\text{...}8\text{ mm/min}$; $n = 5,000\text{ rpm}$
- Ultrasound parameters: $u_{sf} = 17.15\text{ kHz}$; $\hat{A} = 3.5\text{ }\mu\text{m}$

➤ **Problem:** Unstable process

Customer benefits

- ✓ Process-safe deep drilling possible
- ✓ Glass cores remain undamaged
- ✓ Feeder increase of 60% possible



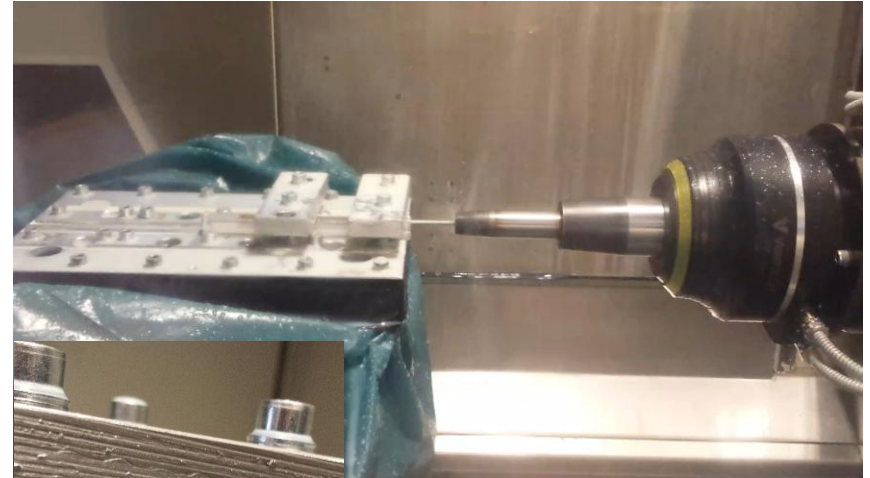
Improved process reliability



Increase in productivity and
Feed rate increase > 50%



Increase in component quality



Application for grinding quartz glass (wafer chucks etc.)

- Material: Quartz glass
- Tool: Diamond grinding tool $\varnothing 10\text{mm}$
- Cutting values: $v_f = 120\text{...}200\text{ mm/min}$;
 $a_p = 0.2\text{ mm}$; $n = 4,547\text{ rpm}$
- Ultrasound parameter: $f_{US} = 18.5\text{ kHz}$; $\hat{A} = 4\text{...}12\text{ }\mu\text{m}$

➤ **Problem:** Low productivity

Customer benefits

- ✓ Process force reduction 56%
- ✓ Potential for increasing the cutting value



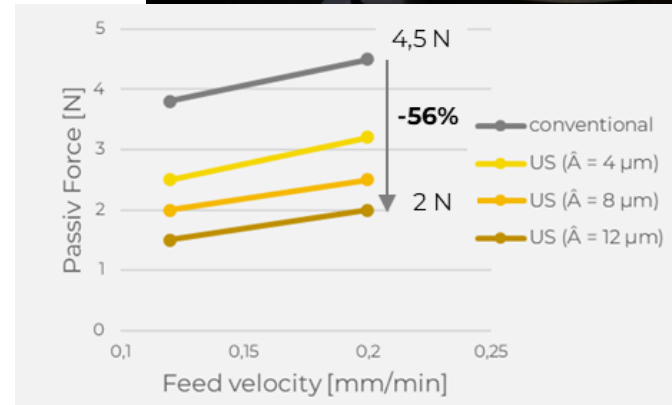
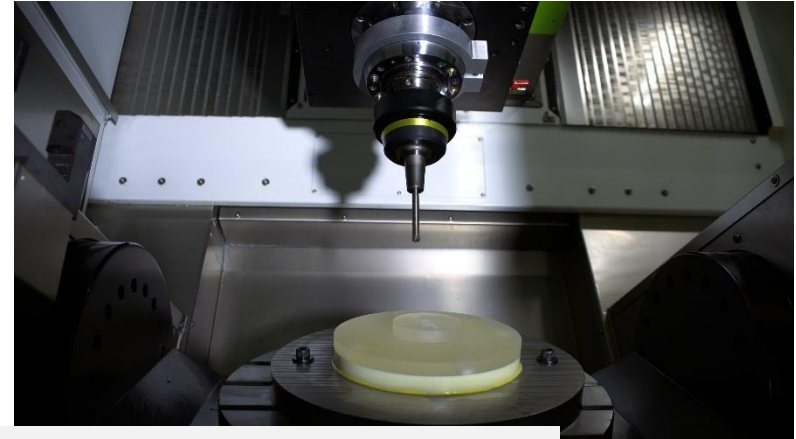
Improved process reliability



Increase in productivity and
Feed rate increase > 100%



Increase in component quality



Ultrasonic-assisted grinding

Application for grinding ceramics (sealing elements etc.)

- Material: Aluminum oxide ceramic Al_2O_3
- Tool: Diamond grinding tool $\varnothing 10\text{mm}$
- Cutting values: $v_f = 300\text{...}500 \text{ mm/min}$;
 $a_p = 0.06 \text{ mm}$; $n = 4,547 \text{ rpm}$
- Ultrasound parameters: $f_{US} = 18.5 \text{ kHz}$; $\hat{A} = 4\text{...}12 \mu\text{m}$

➤ **Problem:** low productivity

Customer benefits

- ✓ Process force reduction 56%
- ✓ Potential for increasing the cutting value



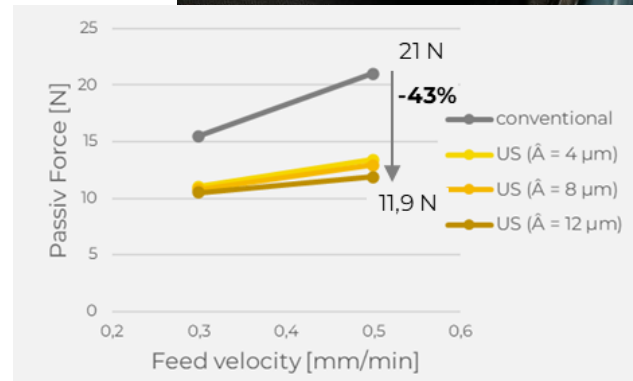
Improved process reliability



Increase in productivity and
feed rate increase > 100%



Increase in component quality



Advantages of grinding hard materials with VibroCut *ultrasonic*



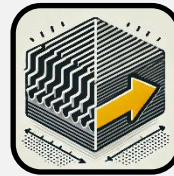
Increase in productivity



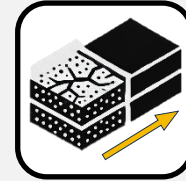
Increasing process reliability



Increasing the
tool life



Improvement of the surface
quality



Reduction of microcracks and
chipping

ROI < 1 year

ROI-calculator: <https://vibrocut.de/en/cost-savings-with-vibrodrill-ultrasonic/>

ROI < 1 year



Increase productivity



Increase tool life



Improved surface quality



Greater process reliability



Reduction of microcracks



Avoidance of rejects

Calculation example for increasing the feed rate



Hourly machine rate: 75 €/h



Planned occupancy time: 4000 h/year
500 shifts/year



Proportion of main time loops to cycle time 80%
Increase in cutting values 20...100%

ROI < 1 year

Feed rate increase	Productivity increase	Savings per machine
20%	13,3%	39.900 €
50%	26,7%	80.100 €
100%	40%	120.000 €

<https://vibrocut.de/en/cost-savings-with-vibrodrill-ultrasonic/>

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*"VibroCut combines
technique and technology
for hybrid machining"*