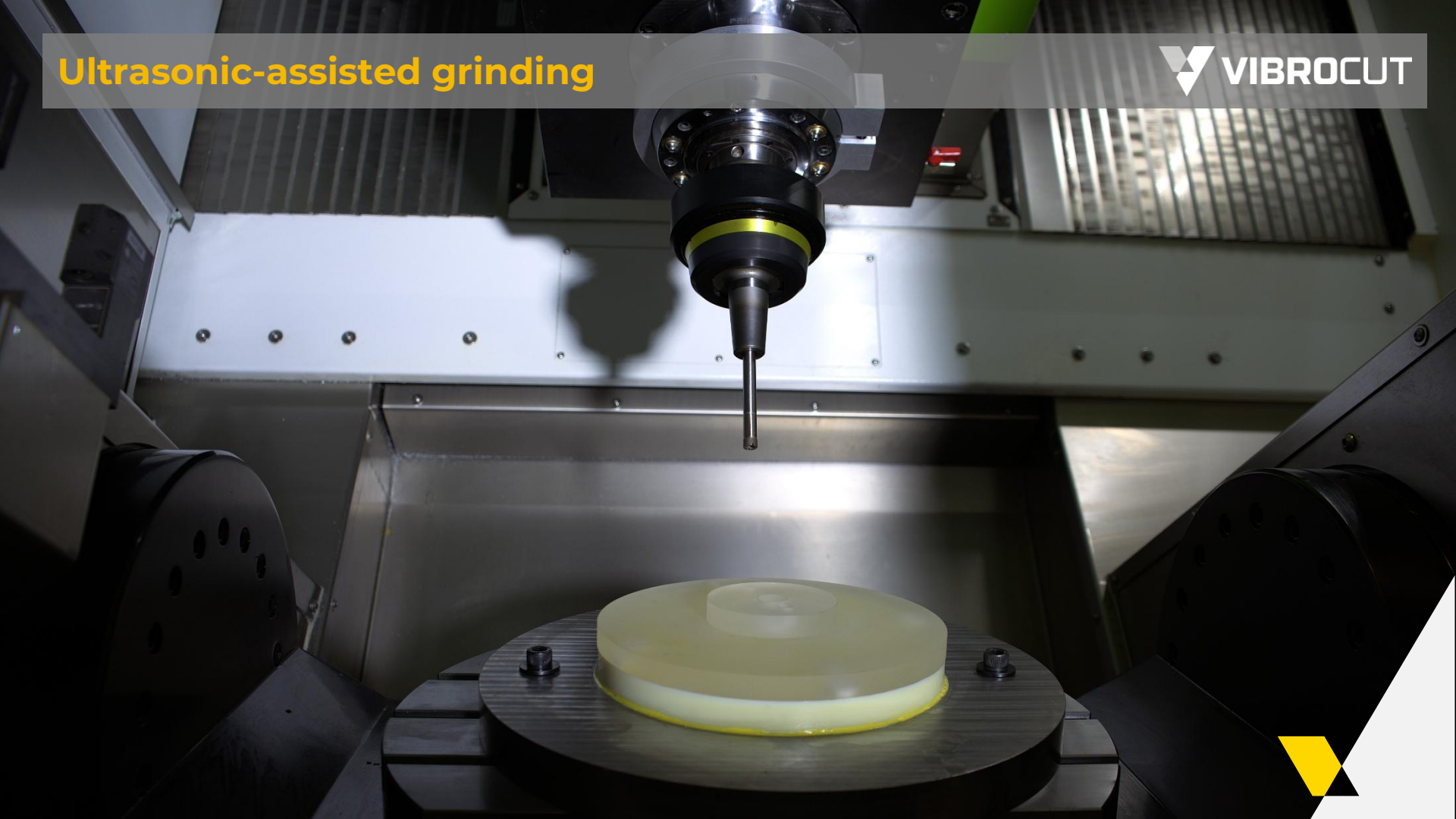
Ultrasonic-assisted grinding



Ultrasonic-assisted grinding

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**

Ultrasonic-assisted grinding

Physical mechanisms and technological effects

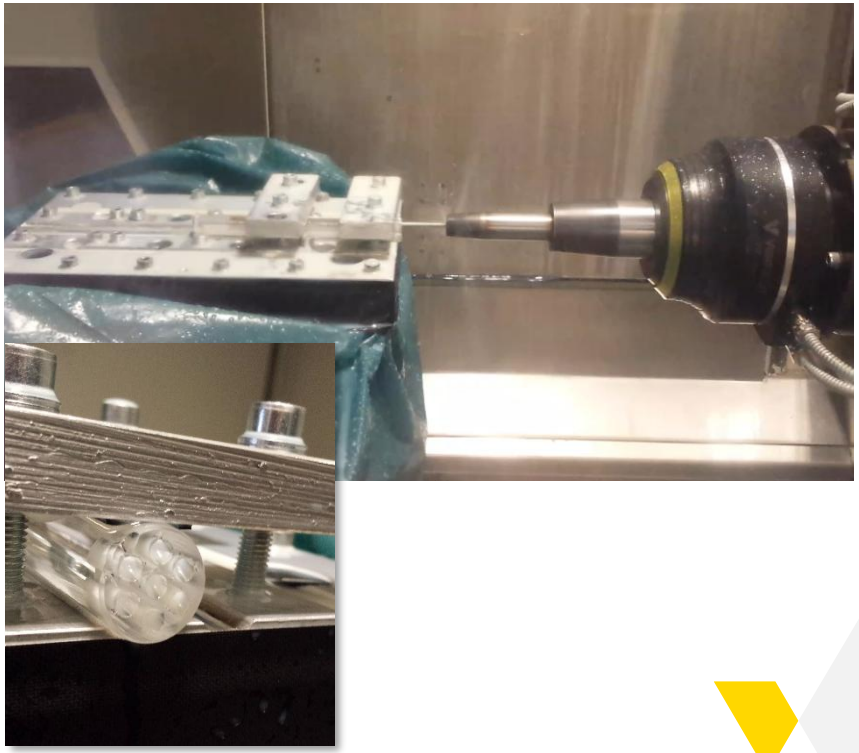
Material effect	Defined removal through micro-hammering	Increase in productivity
	Reduction of process forces	Improvement in quality (roughness and edge chipping)
Friction	No clogging of the grinding tools	Increased tool life
	Reduced tool wear	Increasing process reliability
Kinematics	Multi-axis movement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

Ultrasonic-assisted grinding

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

- Material: Quartz glass
- Drill bit / depth: Diamond Ø4mm / 180 mm
- Cutting values: v_f = 5...8 mm/min; n= 5,000 rpm
- Ultrasound parameters: $_{US}f$ = 17.15 kHz; Â = 3.5 µm

➢ **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%

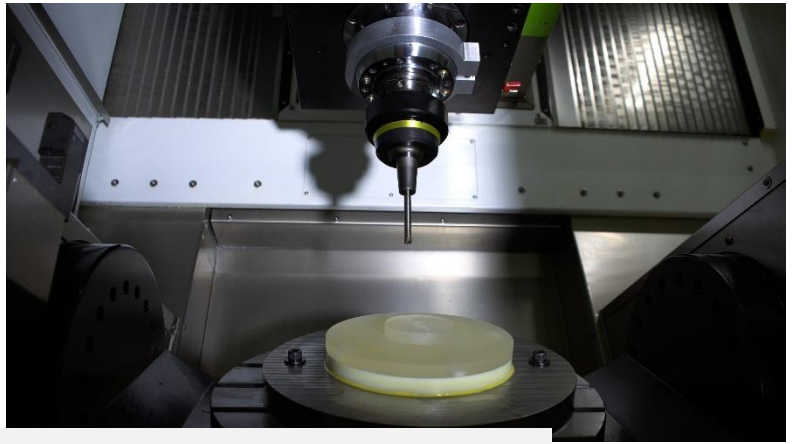
Increase in component quality

Ultrasonic-assisted grinding

Application for grinding quartz glass (wafer chucks etc.)

- Material: Quartz glass
- Tool: Diamond grinding tool Ø10mm
- Cutting values: v_f = 120...200 mm/min; a_p = 0.2 mm; n= 4,547 rpm
- Ultrasound parameter: f_{US} = 18.5 kHz; Â = 4...12 µm

➢ **Problem:** Low productivity



Customer benefits

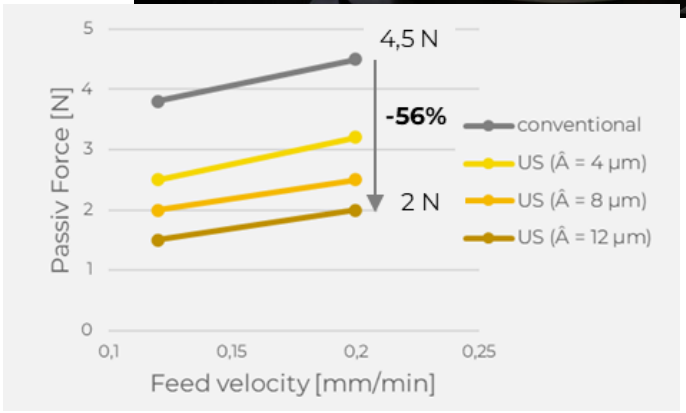
✓ Process force reduction 56%

✓ Potential for increasing the cutting value

Improved process reliability

Increase in productivity and Feed rate increase > 100%

Increase in component quality

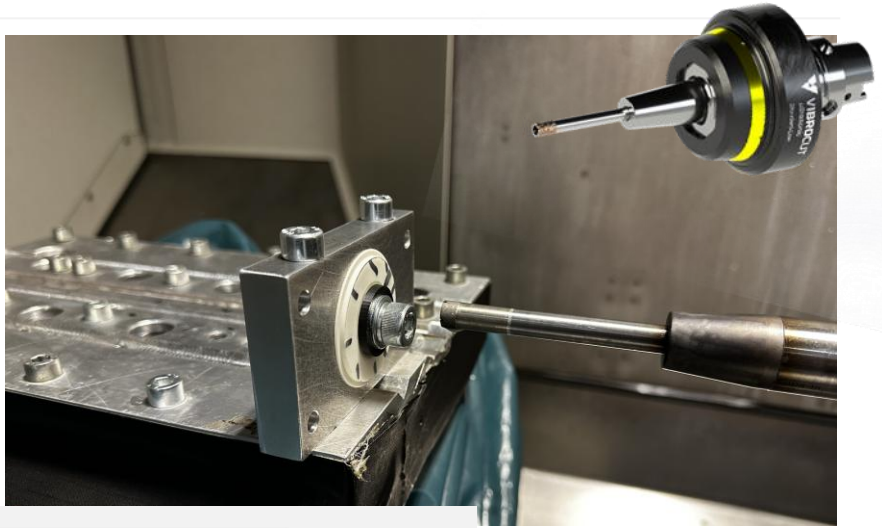


Ultrasonic-assisted grinding

Application for grinding ceramics (sealing elements etc.)

- Material: Aluminum oxide ceramic Al O_{23}
- Tool: Diamond grinding tool Ø10mm
- Cutting values: v_f = 300...500 mm/min; a_p = 0.06 mm; n= 4,547 rpm
- Ultrasound parameters: $_{US}f$ = 18.5 kHz; Â = 4...12 µm

➢ **Problem:** low productivity



Customer benefits

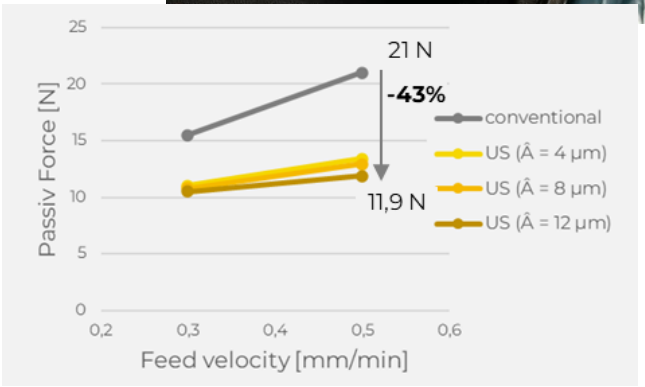
✓ Process force reduction 56%

✓ Potential for increasing the cutting value

Improved process reliability

Increase in productivity and feed rate increase > 100%

Increase in component quality



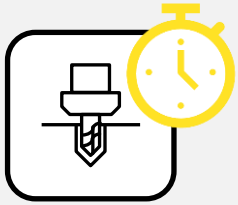
Ultrasonic-assisted grinding with VibroCut *ultrasonic*

VIBROCUT

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/

Ultrasonic-assisted grinding with VibroCut *ultrasonic*

VIBROCUT

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/

VibroCut – Hybdrid machining

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"VibroCut combines technique and technology for hybrid machining"