# WHITEPAPER

## Vibration-assisted turning with VIBRO*turn*

### Chip flow problems in turning processes

In turning, the chip breaking problem has not yet been solved reliably. When machining materials with ductile material behavior, this leads to the formation of long helical and tangled chips. Insufficient chip breaking causes process uncertainties along the chip flow – this results in damaged surfaces, tool breakage (**1**) and clamping errors (**2**). In addition, chip packings form in the work area, causing a risk of collision (**3**) and restricting removal from the lathe by chip conveyors and thus automation (**4**). As a result, process stops for manual chip removal are necessary, which reduce machine availability and lead to a risk of injury for the machine operator.

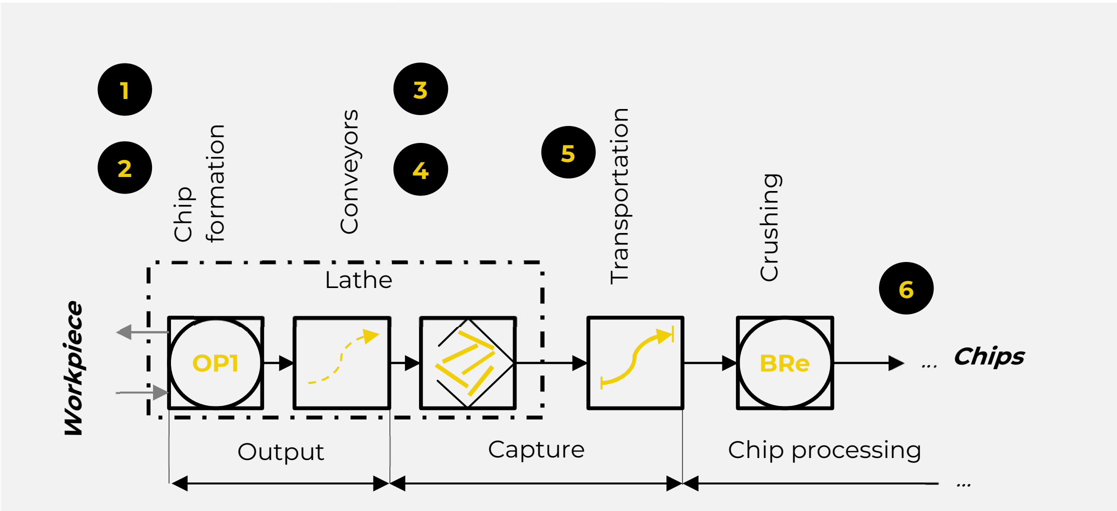


*Figure 1: Chip flow and chip breaking cycles*

In addition, the low chip volume results in additional effort during transportation (**5**). The result is inefficient chip processing (**6**).

### Use of VIBRO*turn* for internal and external turning of steel

A VIBRO*turn* tool holder was used to investigate chip formation and the influence on chip lengths during internal and external turning on a tempered steel made of C45 (1.0503). For this purpose, VIBROturn was integrated into a turret lathe with a driven tool location (VDI 40). An insert (DNMG 150616) was used for this. The test setup shows the basic principle of vibration-assisted turning with VIBRO*turn* and the setting options for the chip shapes using a simple machining example. A defined vibration form is generated in feed direction by the tool holder, thus generating predetermined breaking points in the chip. The tool holder is driven by the tool shaft of the turret. Vibration assistance in the test setup was provided in



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feed direction with vibration amplitudes of 0.08-0.11 mm in a frequency range of 13-65 Hz. The VIBRO*turn* system was operated via the NC control system.

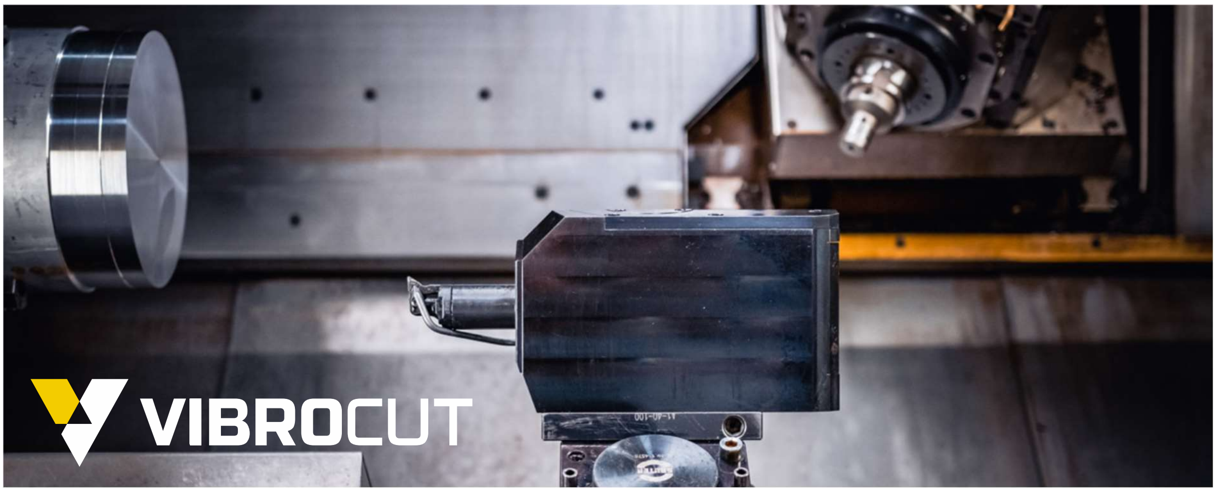


*Figure 2: VIBROturn with boring bar for internal machining*

By using the VIBRO*turn* tool holder, chip formation can be specifically adjusted. If the vibration amplitude is greater than the feed rate, interruptions of the cut occur which directly lead to an interruption in chip formation and therefore to short broken chips. The chips with a vibration amplitude of 0.11 mm show correspondingly identical chip lengths, which become shorter at a higher frequency. Improved chip breaking behavior is also achieved if no interruptions of the cut are generated. The thickness of the chip is changed periodically to create predetermined breaking points in the chip. The test series without interruptions of the cut with a vibration amplitude of 0.08 mm shows that the chips break primarily at the predetermined breaking points. The resulting chips therefore consist of one or two pieces of the periodic elements, the length of which can be shortened again using the frequency.

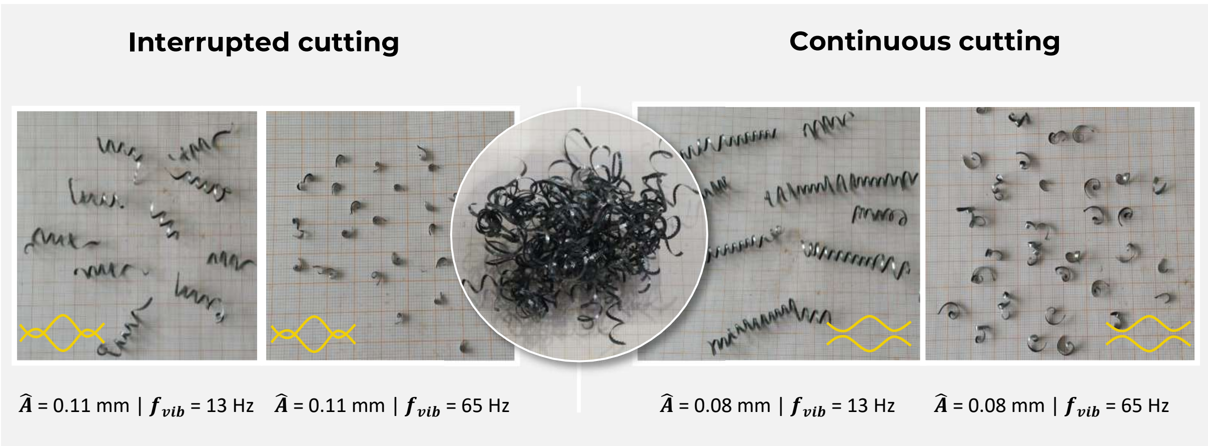


*Figure 3: Influencing chip breaking with VIBROturn (conventional chip shape - center)*



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## Customer benefits

The advantage for the user is a stable and economical chip breaking behavior, with a high robustness against influencing variables such as tool wear or batch variations. Process reliability and machine availability during turning increase significantly. Since the conventional turning process is superimposed, the vibration assistance is cycle time neutral. Machine downtimes caused by chip breaking have an impact on the economic efficiency of the turning process. By considering the loss of utilization, the potential savings of VIBRO*turn* can be calculated. Figure 4 shows that with machine downtimes of 4 min/h due to chip breaking, an annual saving of € 34,000 per equipped machine tool can be realized.

**Cost savings with VIBRO*turn***

**Calculation example internal turning**

- Machine hour rate: 85 € / h
- Planned occupancy time: 6000 h / year, 750 shifts / year
- Chip breaking caused machine downtime: 2 – 6 min / h

| Downtime due to chip breaking | Usage loss per year | Downtime costs per machine |
| --- | --- | --- |
| 2 min / h | 200 h (3,3 %) | **17,000 €** |
| 4 min / h | 400 h (6,7 %) | **34,000 €** |
| 6 min / h | 600 h (10 %) | **51,000 €** |

*Figure 4: Example calculation for avoiding machine downtimes due to chip breaking*

Another essential advantage of VIRBO*turn* is the increase in process reliability. In many applications, automation of the production process is not possible due to problematic chip breaking. By safely breaking chips, VIBRO*turn* enables automated and unmanned operation of the lathe. Figure 5 summarizes the advantages of using vibration-assisted turning.

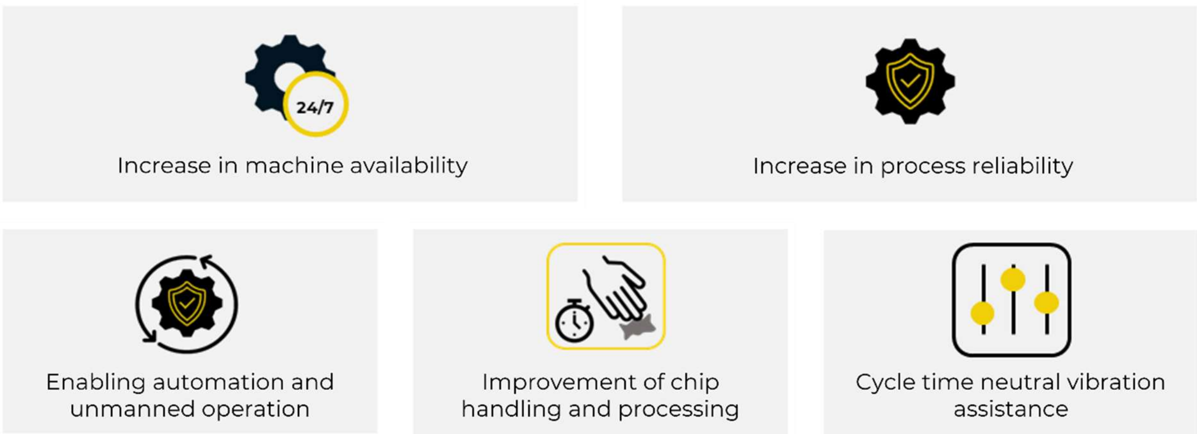


*Figure 5: Advantages of vibration-assisted turning*



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## Further information

VIBRO*turn* is a patented system developed by VibroCut GmbH. We act as a product and technology provider as well as an integration partner for the use of vibration-assisted machining in your production. We sell our vibration systems as tool holders for equipping new and existing machines and offer related services.


*Figure 6: Tool holders L-Line and T-Line*

The VIBRO*turn* tool holder causes the cutting edge of the tool to vibrate in a defined manner, which is aligned with the feed axis of the turning process. The driven location of the turret is used to generate the vibration. The vibration frequency can then be programmed directly in the NC code via the turret drive. Solutions with an additional self-sufficient drive can be implemented on a customer-specific basis. The innovative, robust design of VIBRO*turn* enables unique vibration parameters.
Due to the innovative drive concepts, customers can choose between different vibration directions. The T-Line and L-Line each enable vibration movement across or along the tool axis in the turret. With the arrangement of the tools and the vibration directions, all common operations ranging from longitudinal, facing, or grooving processes to centric drilling on lathes can be superimposed with a vibration. Both new and existing machines can be equipped with different sizes via the standardized tool holder interfaces such as VDI or BMT.

Feel free to contact us directly or find more information on our website:

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