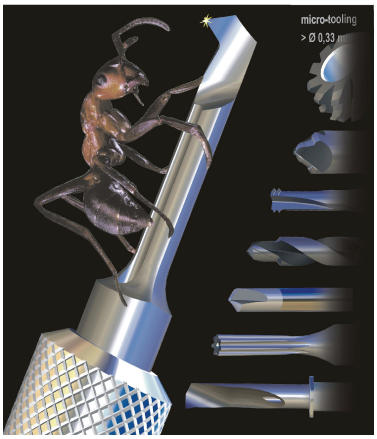
NEWS

Tool systems for interior boring and testing of ultra precise turned parts



The miniaturization of turned parts, specially by inside machining, demands completely new tool philosophies and concepts. At this point, the "scaling down" of proven tool shapes and their cutting geometry has come up against physical limiting factors. This affects turning tools in particular, as they work with only one cutting edge and therefore are not only loaded with axial and radial forces but laterally as well. Frequently, the loads change during the machining process: for example while changing the feed direction, the depth of cut, or with interrupted cuts.

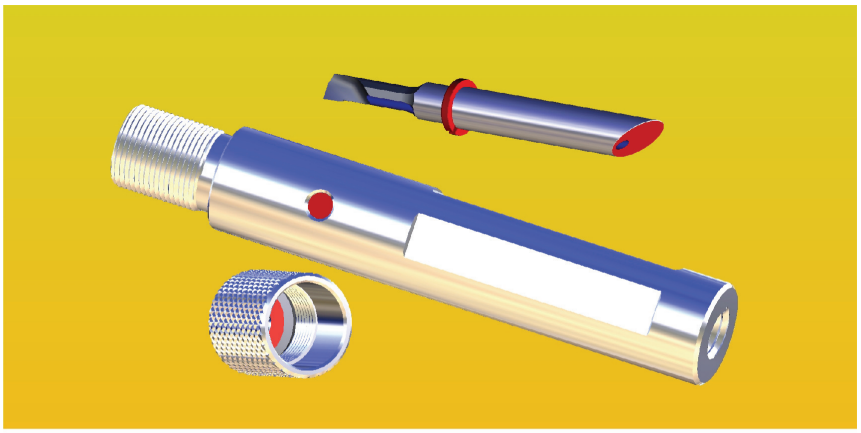
Status quo !

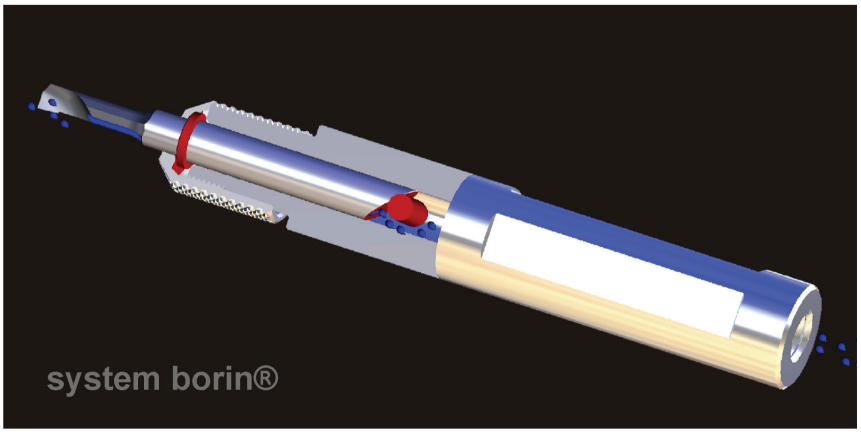
If you scaled a boring operation with an tool neck diameter of 3 mm (0.12 in), at a dressing depth of cut of ap=0.05 (0,002) and a feed of 0.025 (0,001) per tool revolution, to a tool neck diameter of 0.3 mm (0.01 in), therefore with a relation 10:1, the following cut values would result:
depth of cut 5 µm (0,2 µin);
feed 2.5 µm (0,097 µin) per revolution; 80,000 rpm instead of 8,000 rpm;
cutting edge radius 4 µm (0,155 µin) instead of 0.04 mm (0,0015 µin);
thickness of the hard material 0.15 µ (0,006 µin) instead of 1.5µ (0,06 µin); etc.
Seeing that the resulting sizes cannot be produced unconditionally, or are simply not available, it is necessary to look for other solutions. It is also unrealistic to produce a turning chip with a cross section of 2.5 µm x 5 µm (0,097 µin x 0,194 µin) because the cutting edge would be pushed away with these feed values and the tool would eventually break.
Smaller cutting edge roundings, considerably less notching in the cutting edge area, optimized cutting edge and chip space geometries, are needed at this point. They are required for giving the tool a better rigidness and for reducing the cutting force, as well as the passive forces with lateral effects.
Due to these measures, the operating conditions for depth of cut, feed, and cutting speed, can be influenced in the desired direction.
In connection with this, we are facing great challenges on the machine side, too. On the one hand, extremely high numbers of revolutions are called for, on the other hand great smoothness of running in all ranges of revolutions.
The chucking of the work piece plays an underestimated part, too. Particularly in the high frequency ranges of revolutions the chucking force varies due to the resulting centrifugal forces. Moreover, more and more turned parts obtain an asymmetry during the machining, and therefore the center of gravity of the mass alters. These unbalances resulting as a consequence have an influence on the unidirectional lateral forces affecting the turning tool. The vibrations originated between the work piece and the boring tool can possibly intensify in the tool neck and at the interface to the tool holder. The boring system borin® of Hobe GmbH offers a perfect structure of the chain 'tool edge - tool neck - tool holder'.

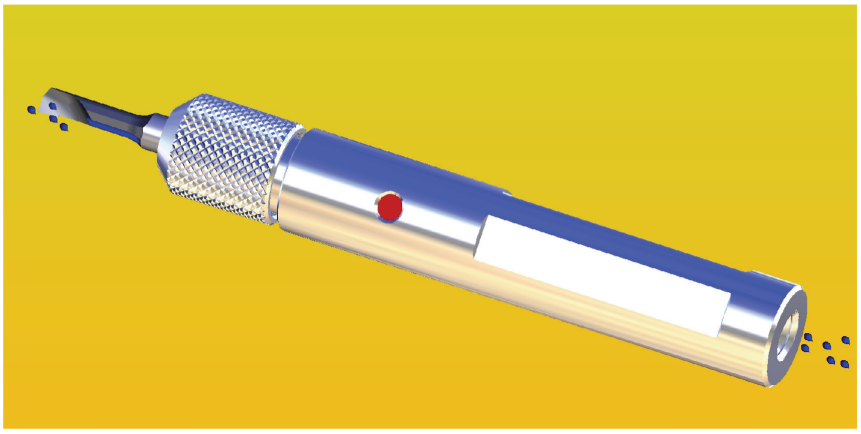
The tool system **borin®**, derived from **bor**e and **in**ternal, was developed for the rationalized boring of miniature bores. Its remarkable features are the small, precise dimensions in combination with the internal coolant feeding through the modular holder. The size and the number of disturbing edges are reduced to a minimum. The tool holder can be fitted directly on the machine or into standard clamping devices. The change of the hard metal insert in the holder is carried out by hand without further tools.

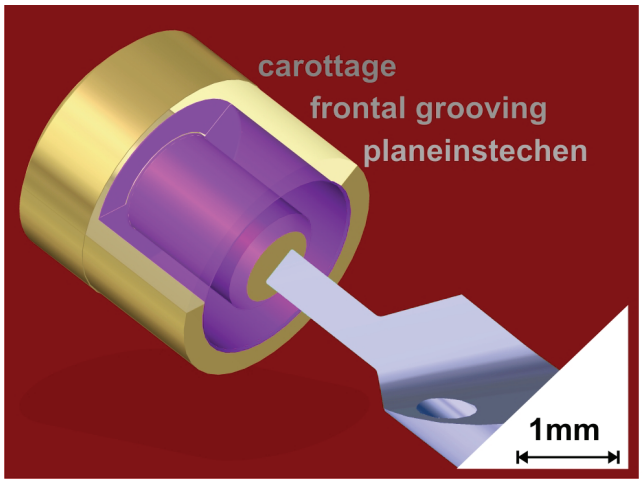
The modular tools are suitable for bores from a diameter of 0.3 mm (0.01 in) up. Given the precision of the modular tools and the special seating in the modular holder, a general repeatability of ±5 µm is guaranteed for the tool change. Therefore, a new measurement of the axial and radial position of the edge as well as the adjustment of the tip height after tool change can be dropped.

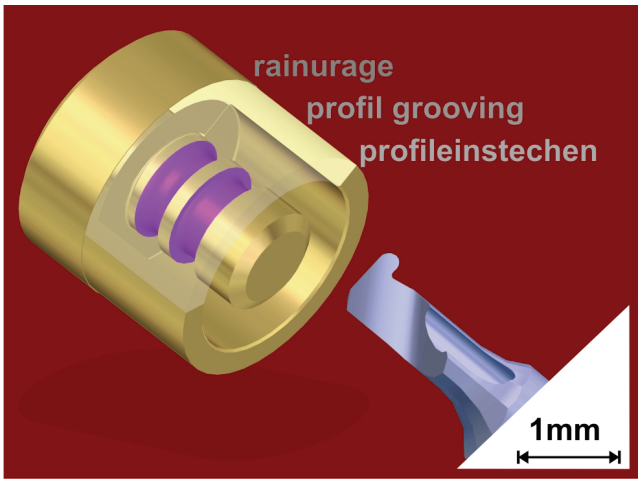
The system is also particularly suitable for minimum volume lubrication. Along with a standard range of products comprising about thousand positions in the diameter range of 0.4 mm (0,016 in) to 8 mm (0.31 in) we produce special adapted tools, too. This is the case specially for bores smaller than 2 mm (0.08 in). The cutting geometries, the chip removal flutes, the internal coolant feeding, and the coatings are adapted to the respective requirements. To achieve this, the user for the most part puts details of the manufacturing drawing at our disposal indicating the material and the type of machine.
In contrast to many other systems, all faces of every surface of the cutting inserts are finished through fine grinding, and the cutting edges are additionally finished through precision grinding with a defined geometry (no vibratory finishing). As the distance of the cooling channel to the cutting edge is smaller than 1 mm (0.04 in), the jet of coolant can enter even in the smallest bores and does not only reach the plan side of the turned part. It is not possible to make a statement about the smallest machining diameter. It strongly depends of the material machined, the machine machined on, and above all, the shapes and the quality to be turned. With the grinding process it is definitively possible to produce diameters of 0.05 mm (0.002 in). Tools for profile turning with a profile height and a neck diameter of 0,15 mm (0.01 in) each have already been produced.

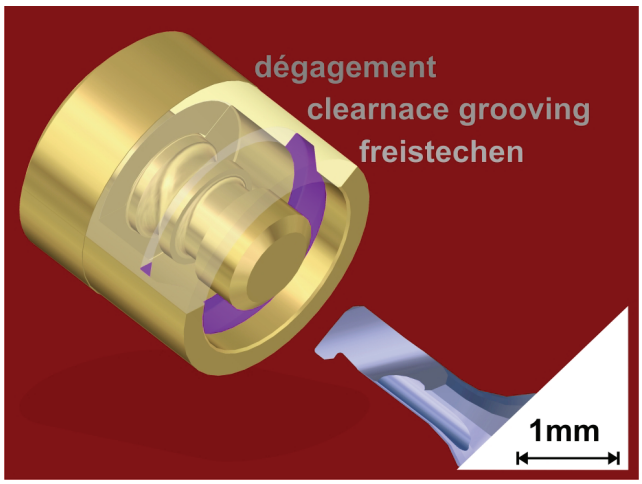


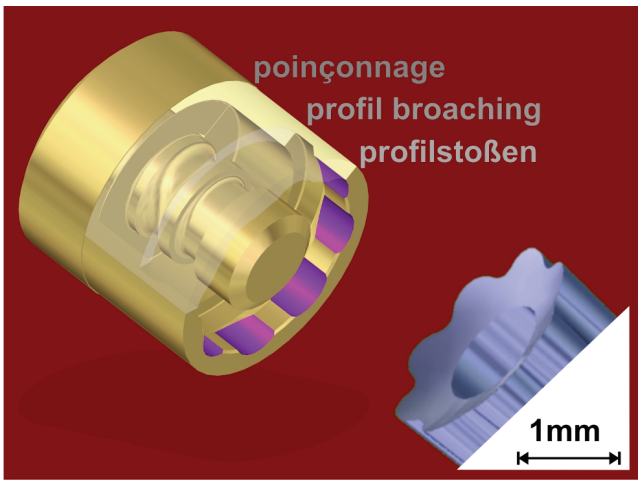










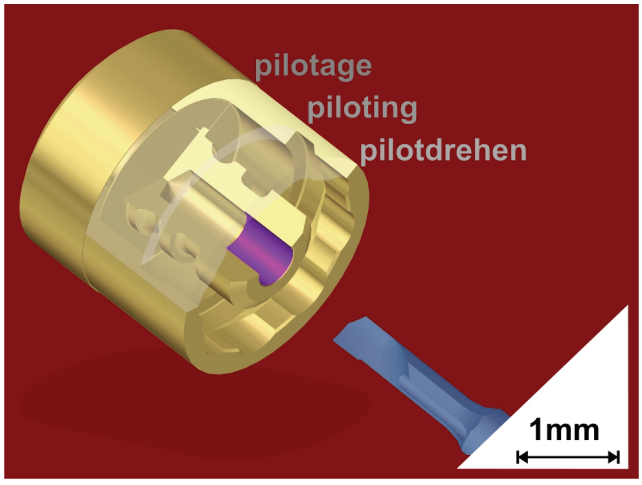


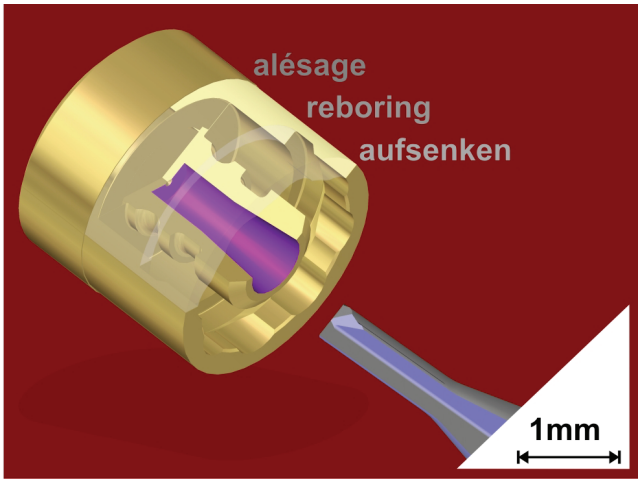
The spinin® system

The hard metal modular tools **spinin®**, derived from **spin** and **in**ternal are the ideal supplement to the boring tools described above.
For the pre-machining, we offer spot drills with a cross cutting edge of only 0.03 mm (0.001 in). Pinpoint centering is absolutely necessary for the following drilling with very small tool diameters.

Additionally, we offer a modular system with a whole series of special tool types. The Ø3 (0.116), Ø4 (0.155) and Ø6 mm (0.233 in) modular shanks for the spinin® system are extremely straight and round, and their diameter is IP 3 tolerated. The advantage of having all the pre-machining tools and turning tools, or finishing tools, produced form one source, consists in the possibility to establish all the machining sequences and methods perfectly for the most difficult operations. Only the optimal coordination of the individual processes frequently brings the desired machining results..

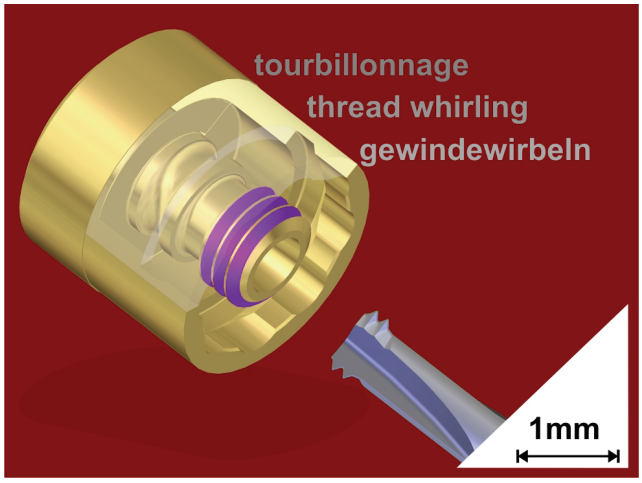
The spinin® system

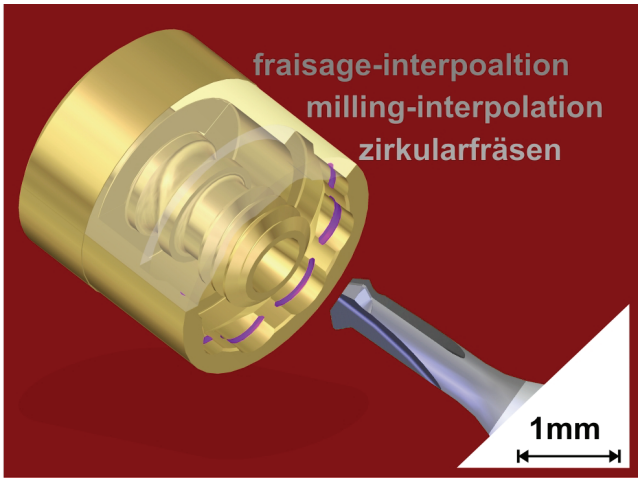




The tourin® system

The hard metal modular tools **tourin®**, derived from the French **tour**billoner (whirling) and **in**terne (internal) expand the range of products for the production of rotationally symmetric shapes. Tools for internal whirling and internal milling interpolation round off the product range. We offer a standard range for thread milling or whirling from size M1 up to size M4. We deliver reverse chamfer or countersink tools starting from Ø 0.95 mm (0.037 in).
For the pre-machining of chambers in small bores we develop and produce tools for milling interpolation to customer requirement. This application is used more and more since the machining of chambers with turning tools produces long chips, and the exit of the bore is blocked by the tool's neck. The smallest milling tools are suitable for the penetration of a Ø1 mm (Ø 0.039 in) bore and have a tool neck of 0.33 mm (0.013 in). At this point, as you can imagine, a precise coordination with the possibly following turning tool is required.
Not only must the diameter and the longitudinal position be coordinated in a range < 0.01 mm (0.004 in) but the flank angles and the edge radiuses of the forming tools as well.





probin®

For testing close to production of internal profiles, plug gauges are still frequently used. With the **probin®** system, derived form **prob**e and **in**ternal, probe tips can be seated in the borin® system if their admission shanks are identical with this system.

The main applications for this rapid check are internal shapes such as hexagon sockets, rounded toothings, threads, cylinders and also non-circular shapes (!).

Quo vadis ?

Micro work pieces, exotic materials and complex shapes, determine the future of the tool and machine culture. As mentioned above, the machine tools, the clamping tools, and the machining tools, must be adapted more and more to the produced pieces. It is even possible that the hitherto used machining sequences are not longer practicable. New concepts, sequences and cutting tools are required. In this, most manufacturers of standard products meet their limits. Since they cannot simply scale down the dimensions of their vast variety of products to maintain the well-worn processes, more and more special micro tools are used. Innovative manufacturers of tools that have been tackling this problem for a long time, and also have the corresponding developing and manufacturing possibilities for a "complete range", will not have to complain about a shortage of tasks in the future.

Hobe GmbH
D-88255 Baienfurt
+49 (0)751 56092-0
+49 (0)751 49305
Germany
www.hobe-tools.de