Modern manufacturing companies are paying more and more attention to hard material and high precision turning. The KAAST UHP 450 CNC lathe is designed specifically for this growing market.

The industry’s accuracy and surface quality requirements are always difficult to fulfill by suppliers with today’s standard equipment. The turning process can usually deliver the appropriate surface roughness while staying within budget, but can’t always produce the required quality. The best solution lies in the use of a hard material, high precision lathe. The desired results can now be achieved solely by the turning process, without the extra cost and time spent to include grinding. These benefits are similar in the hard turning sector. Parts with harder materials like 60 HRC are difficult to machine with normal production machines, but the KAAST UHP 450 masters these applications without any problems. It provides dimensionally accurate parts immediately in one setting. The ever-increasing demands of tight tolerances are difficult to meet, but the UHP 450 meets required mass production accuracies in the low single-digit micron range, depending on the material and part quality.
One challenge facing turning experts is processing hard workpieces with excellent finishes and accurate dimensions, as efficiently as possible. A new kind of lathe meets this challenge head on, holding to the highest standards.

KAAST is more than a machine tools supplier for the metalworking industry, but also a developer of new innovative machine types. The company designed this high precision lathe from a platform concept, which has lead to more powerful systems. The KAAST development team, lead by Hartmut Kastor, spent only twelve months developing the Ultra-high Precision project (UHP), a next-generation turning machine for the ultra-fine and hard turning markets.

The core of the new UHP concept originated from the KAAST Alpha-turn 450 Plus series. Parts of the machine have been revised, adapted and optimized, and among other things, the entire drive system has been completely renewed. This specialized machine type has evolved from what was originally a solid all around machine, so its practicality holds its own amongst the lathe market’s top dogs.

The first generation has been firmly established among other German suppliers in the market of engine control components for medium-speed gas and diesel engines. The machine is used in this context for precision turning of the sealing surface on the valve seat ring. In the same chucking, the fit for the press fit is also rotated in the cylinder head. Another demanding aspect is the required form and position tolerances of the materials used. The valve seat rings are composed of highly heat-resistant, wear-resistant materials such as stainless 60/40, and/or bimetallic, that is, high-temperature resistant base material such as 1.4718. Stellite on cobalt or nickel is also welded on the wear-resistant layer. Machining these material systems is complex and demanding. This process is already running from the area of hard turning. These material combinations, as well as the form and position tolerances, place extreme demands on the turning:

- rotational accuracy of ≤ 10 microns;
- roundness accuracy of ≤ 10 microns;
- straightness of ≤ 6 microns;
- diameter tolerance of ≤ 15 microns.

This stable, high-quality machine, combined with special material suitable for cutting materials makes processing such demanding parts not only possible, but economical and efficient.

High-resolution control encoder meets the optimal timing for precision turning

With specifications derived from the application, the new UHP machine’s system has been verified and confirmed to be suitable for this particular application. The target was to reach all the request parameters with a machine capability index (cmk-value) of at least 1.67. The UHP has met all expectations of this aptitude test. The latest generation of KAAST CNC lathes has also been equipped with a built-in high-precision Mitsubishi spindle, which provides extremely smooth running. This quiet operation guarantees a low-noise cut image, leading to high workpiece surface quality.
The high-precision encoder of the controller clock in a unique resolution for a machine of this class. This provides the necessary precision. The machines are operated by the Mitsubishi M70-V control.

Flexible automation systems allow unmanned production

The spindle runout moves at a highly-accurate value of 0.8 microns. Working under a peak load brings 11 kW of power and a maximum torque of 70 Nm to the workpiece.

Another highlight of the UHP is that the M70-V controller is integrated with Mitsubishi drives. A high-precision encoder clocks it in a unique resolution for a machine of this class: This provides the necessary precision. The machines are operated by the Mitsubishi M70-V control.

A Methanite-cast frame and linear guides with generously sized rollers are used in the system for better absorption of micro vibrations. The machine dimensions of 1.6 m × 2.6 m make this machine very compact compared to most others in the stable microfinishing space fields, whose needs never shorten in terms of accuracy and surface quality. The technical requirements relating to surface quality are mostly the responsibility of the grinding machine manufacturer. In the past, workpieces were initially pre-machined and then ground to their final dimensions. This process double linked but tended to be a time-consuming as well as relatively costly production chain. The optimization of this process (depending on the application) can be demonstrated very clearly with the UHP by KAAST. This high-precision lathe is one of the most important competitive advantages offered as it enables the user to machine parts up to grinding quality.

Another plausible example of very high-quality machining performance resulting from the use of a UHP machine was displayed by a customer who produces a well-known German automotive product. This customer provided a technical evaluation analysis which was performed during an even greater challenge relating to the qualitative requirements for other processing tasks. The Challenge: the precision turning of extremely thin-walled workpieces. The wall thickness of approximately 1.3 mm raised challenges with specifications as follows:

- high-precision roundness of the bores of ≤ 5 microns
- straightness of ≤ 5 microns
- diameter tolerance for the bore of ≤ 8 microns;
- permitted depth of roughness Rz of no more than 2 microns.

For this processing task a UHP machine of the second generation was used. To meet the requirements described, this machine was equipped with a pneumatic clamping system that has been modified and improved: The minimum selectable clamping pressure was then no more than 2 bar at most and the Repeating amounted to a value of <2.5 microns. Here the difficulty was to find the balance between the required clamping pressure and the occurring cutting forces: On the one hand the component is not to be braced with respect to roundness and cylindricity, on the other hand, the clamping pressure is not due to the centrifugal forces to lose.

The results obtained with these changes confirm the qualitative improvement of the machine, for all parameters of the required equipment capability index were (cmm ≥ 1.67) reached and significantly exceeded in some cases. Optionally, the machine can be equipped with an external encoder. This brings two significant benefits: It allows firstly to increase machine accuracy, and secondly, the use of an in-process measurement with
**HIWIN-linear guide ways**

Special characteristics of the linear guideway series RG

The new RG series from Hiwin features a roller as the rolling element instead of steel balls. The roller series offers super high rigidity and very high load capacities. The RG series is designed with a 45-degree contact angle. Elastic deformation of the linear contact surface, during load, is greatly reduced thereby offering greater rigidity and higher load capacities in all 4 load directions. The RG series linear guideway offers high performance for high-precision manufacturing and achieving longer service life.

**Construction of the RG series**
- 4-row recirculation roller bearing
- 45° contact angle
- The roller retainers prevent the rollers from falling out when the carriage is removed
- Different sealing variants, depending on application area
- Six connection options for grease nipples or grease adapters

**Advantages**
- Free of play
- Replaceable
- High precision
- Very high load capacity
- Low displacement force also with high preload

**Dimensions of the block**

<table>
<thead>
<tr>
<th>Series Size</th>
<th>Installation dim. [mm]</th>
<th>Dimensions of the block [mm]</th>
<th>Load Ratings [N]</th>
<th>Mass [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H1 T1 N W B B1 C L1 L K1 K2 G M × l T H2 H3 Cdyn C0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RGH25HA</td>
<td>40 5,5 12,5 48 33,0 6,5 50 81,0 114,4 21,50 7,25 12,0 86,6 × 8 9,5 10,30 10,0 31900 73400 0,75</td>
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<tr>
<td>RGH30CA</td>
<td>45 6,0 16,0 60 48,0 10,0 60 71,0 109,8 23,50 8,00 12,0 98,8 × 10 9,5 9,50 10,3 31900 82100 0,90</td>
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<td></td>
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</table>

Sample parts of materials which are hard to machine and have been made on the KAAST UHP: high-precision valves and valve seat rings of hard metal alloys.
Technical data

- For turning high precision parts
- Suitable for Microfinish and mirror turning
- Optional for automation solutions, for efficient mass production
- Suitable for hard turning
- High process reliability

Standard M 70 V control
- 8.4” LCD screen
- CF card slot
- NAVI Lathe / contour programming through dialogue

Fanuc Compatible
- Coordinate workpiece
- Canned cycles for drilling operations
- Canned cycles for turning operations
- Canned cycles for threading
- Customers macro
- Extended program editing during processing
- External notifications
- G10
- 256 K program memory
- Data input/output interface
- Ball screw pitch error balancing
- Work piece list on length and diameter
- Absolute encoder

Standard configuration:
✓ CNC Mitsubishi M70 V Navi Lathe
✓ High-end main spindle Built-In type with ≤ 0.8 µm run-out
✓ Pre-tensioned ballscrews with internal cooling
✓ High-accurate pneumatic 3-jaw chuck Ø 150 mm
✓ Automatic 10-position tool turret
✓ Tailstock with programmable quill
✓ HWMN linear roller guideways
✓ High pressure coolant pump
✓ Chip type chip conveyer (chip exit height 810 mm)
✓ Automatic central lubrication
✓ Integrated oil separation (cascade system)
✓ Electronic handwheel
✓ Interface for bar feeder
✓ LED working light
✓ 3 color signal light
✓ Double foot switch for chucking
✓ Double foot switch for tailstock quill
✓ Hard jaws, Soft jaws (1 set)
✓ Auxiliary service tools
✓ Operation manual

Optional configuration:
■ Collet chuck
■ Automatic parts catcher
■ Door-automation

### Technische Spezifikationen UHP-Turn 450

**Machine capacity**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Turning diameter over bed</td>
<td>450 mm</td>
</tr>
<tr>
<td>Max. Turning diameter over slide</td>
<td>280 mm</td>
</tr>
<tr>
<td>Max. workpiece diameter</td>
<td>280 mm</td>
</tr>
<tr>
<td>Max. workpiece length</td>
<td>330 mm</td>
</tr>
<tr>
<td>Chuck size</td>
<td>150 (opt.175) mm</td>
</tr>
<tr>
<td>Spindle bore</td>
<td>45 mm</td>
</tr>
</tbody>
</table>

**Main spindle**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed rpm</td>
<td>6000</td>
</tr>
<tr>
<td>Power (peak) kW</td>
<td>11</td>
</tr>
<tr>
<td>Spindle nose</td>
<td>A2-5</td>
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</table>

**Travels & feeds**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-axis travel mm</td>
<td>150+10</td>
</tr>
<tr>
<td>Z-axis travel mm</td>
<td>350</td>
</tr>
<tr>
<td>Feed X/Z-axis m/min</td>
<td>24</td>
</tr>
<tr>
<td>Work feed X / Z-axis m/min</td>
<td>10</td>
</tr>
</tbody>
</table>

**Tool changer**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Number of tool positions Stck.</td>
<td>10</td>
</tr>
<tr>
<td>Tool diameter mm</td>
<td>20</td>
</tr>
<tr>
<td>Shank boring bar mm</td>
<td>25</td>
</tr>
<tr>
<td>Change time (tool neighbor) sec.</td>
<td>0.5</td>
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</tbody>
</table>

**Tailstock**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quill mm</td>
<td>80</td>
</tr>
<tr>
<td>Adjustment mm</td>
<td>210</td>
</tr>
<tr>
<td>Taper</td>
<td>MK3</td>
</tr>
</tbody>
</table>

**Weight and dimensions**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank capacity l</td>
<td>120</td>
</tr>
<tr>
<td>Dimensions (LxWxH) mm</td>
<td>1900x1300x1800</td>
</tr>
<tr>
<td>Weight kg</td>
<td>2700</td>
</tr>
<tr>
<td>Item-No.</td>
<td>1630149</td>
</tr>
</tbody>
</table>

High precision spindle with 6.000 rpm, 11 kW and precision of ≤ 0.8 µm
"Finally, it is only the mind that makes technology come alive."

Johann Wolfgang von Goethe (1749 - 1832)