Press information

Worldwide Success Through Clever Design Optimization

The (Success) Story of SIMTEK's AX System

The development of a modular tooling system for the internal machining of smallest bores - consisting of single-edged solid carbide cutting inserts and toolholders - dates back to the mid-1980s, a time when tools for very small bore diameters were virtually nonexistent on the market. What began as a response to a specific customer request evolved over decades into a system that is now considered a flagship product in SIMTEK's portfolio and is regarded by many users in the field of micro-machining as a benchmark for quality and design.

A specific practical need as a starting point

The driving force behind the development was the need to create a tool for internal machining of a 6-mm bore. "At that time, there were no tools that small—or at least, hardly any workable solutions for such diameters," says Norbert Seifermann, co-founder and CEO of SIMTEK, describing the initial situation. For him, however, this request presented an opportunity to put into practice a tool concept he had been thinking about for quite some time.

Prior to the founding of SIMTEK, the first prototype was created on a milling machine at Seifermann's former employer: First, a teardrop-shaped tool shank was manufactured to be clamped into a toolholder. The tool neck and cutting edge were then ground. The standard design that followed the prototype - based on a sintered bar with a characteristic teardrop shape and a clamping screw from the rear - served as a groundbreaking design principle that laid the technological foundation for the later evolution of SIMTEK's current AX system.

The Birth of the SIMTEK Solution: Optimization Potential Put into Practice

As market acceptance grew over the years, so did the demands placed on this new type of tool, and design-related limitations began to emerge. After founding SIMTEK in 1994, Seifermann therefore devoted himself to the systematic further development of the system - once again prompted by a specific customer requirement. He identified a key area for optimization in the mounting length: "We needed a solution in which the cutting insert could be mounted deep enough within the toolholder to prevent vibrations and tool breakage during high extensions",

SIMTEK Präzisionswerkzeuge GmbH
Mössingen, Germany
Fon.: +49 (0) 7473 9517-0
Mail: info@simtek.com
Web: www.simtek.com

Press contact:

Domenico Laurenza
Marketing
Fon.: +49 (0) 7473 9517-120
Mail: marketing@simtek.de

PRX Agentur für Public Relations GmbH
Ralf M. Haaßengier
Kalkhofstraße 5
70567 Stuttgart
Phone 0711/71899-03/04
ralf.haassengier@pr-x.de
www.pr-x.de

Seifermann recalls. Consequently, the insertion depth into the toolholder was set accordingly high, ensuring that the tool remains steadily guided even during large extensions.

Another significant modification concerned the shape of the bar: “Since sintered shapes, while generally more cost-effective to manufacture than ground systems, are never exactly identical due to manufacturing tolerances, they typically require a multi-point support. Such a multi-point contact can significantly shorten the service life of the toolholder and affect the repeatability of the cutting edge position during tool changes,” explains Seifermann. A tool change could thus have a direct impact on the manufactured dimension.

For this reason, SIMTEK decided to use a cylindrically ground bar in combination with a cylindrical bore in the toolholder. The resulting large contacting area of the cutting insert extends the service life of the toolholders and leads to a significant increase in repeatability from cutting edge to cutting edge. “With our current system, the machine operator can remove a tool and insert a new one without noticeably affecting the cutting edge height or the radial position,” explains Seifermann.

The SIMTEK Principle of Repeatability

However, the key design optimization is located at the rear end of the bar. Instead of a lateral clamping area, as used in many systems, the bar runs diagonally. This diagonal ensures the exact alignment of the tool during insertion. “Thanks to the beveled rear surface, the tool practically positions itself. You slide it in, align it with the stop pin, and then secure it with the screw,” says Seifermann, describing the principle.

According to the AX's developer, this concept offers a decisive advantage over lateral clamping solutions. Even slight misalignments or tolerances can affect the tool’s position in those systems. With the beveled solution, however, the cutting insert itself ensures precise alignment, while the screw merely generates the clamping force. As a result, the tool’s position remains essentially independent of the tightening torque.

Market Success Through Repeatability

According to Seifermann, it is precisely this high level of repeatability that plays a key role in the widespread market acceptance of SIMTEK’s AX system. If repeatability is low, the machine must be set up again after every tool change, which takes time and reduces productivity. In this context, Seifermann recalls a customer who had initially switched to a different tool but returned to SIMTEK’s AX solution after a few months. “The

SIMTEK Präzisionswerkzeuge GmbH
Mössingen, Germany
Fon.: +49 (0) 7473 9517-0
Mail: info@simtek.com
Web: www.simtek.com

Press contact:

Domenico Laurenza
Marketing
Fon.: +49 (0) 7473 9517-120
Mail: marketing@simtek.de

PRX Agentur für Public Relations GmbH
Ralf M. Haaßengier
Kalkhofstraße 5
70567 Stuttgart
Phone 0711/71899-03/04
ralf.haassengier@pr-x.de
www.pr-x.de

customer noticed that the machines' daily output was declining. After returning to our AX solution, output returned to its usual level—for us, clear evidence of just how strongly repeatability affects productivity," recalls Seifermann.

SIMTEK's AX system has now established itself among many users worldwide as a groundbreaking product in terms of quality and its process-stabilizing design. "Through ongoing communication with our international sales partners, we regularly receive very positive feedback on our AX system - from a wide variety of industries," the SIMTEK founder reports. There are now also several systems on the market based on a comparable design principle. "The large number of similar solutions on the market confirms to us that the system works very well with this design. We see this as validation of our experience and conviction," Seifermann states confidently.

Further Development: ME Clamping System for Toolholders

The patented ME clamping system for toolholders (European Patent No. 2 992 988) represents a further stage of developments. Thanks to its force-fit tool clamping, it offers tremendous stability, especially with long extension lengths. "With our ME solution, the clamping nut lies flat against the entire surface of the shank, so that the connection behaves as if it were machined from a single piece," explains Seifermann. The collet is an integral part of the holder; the nut performs solely the clamping function without causing any relative movement between the bar and the holder. According to SIMTEK, this design allows operations with extensions of up to ten times the tool shank diameter to be performed with stable clamping.

From 6.0 mm to 0.3 mm

What began in 1985 with a tool for machining a 6-mm bore has since evolved toward significantly smaller diameters. In SIMTEK's current standard product line, the range extends down to a tool for boring diameters starting at 0.3 mm. "The smallest size, which has a 4-mm shank, is a world unto itself and is actually no longer visible to the naked eye," says Seifermann.

This development is driven by the ongoing miniaturization of components across various industrial sectors—from hydraulics and pneumatics to applications such as the boring of fuel injectors, where small cylindrical geometries with tight tolerances are required. As of now, the SIMTEK product line offers nearly 1,500 AX tool variants. These include CBN tools for hard turning with bore diameters starting at 1.0 mm, as well as tools featuring 3D-lasered chip-forming geometries.

SIMTEK Präzisionswerkzeuge GmbH
Mössingen, Germany
Fon.: +49 (0) 7473 9517-0
Mail: info@simtek.com
Web: www.simtek.com

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Marketing
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ralf.haassengier@pr-x.de
www.pr-x.de

Laser Machining as the Next Step in Development

“From a design perspective, the AX system is practically fully developed today. We see further development potential mainly in cutting-edge finishing - and here, above all, through the use of laser technology,” says Seifermann. Unlike conventional grinding, laser technology can create chip angles all around the cutting edge - even in areas where grinding processes reach their limits due to manufacturing constraints.

This development is driven by increased demands on chip control, such as the growing use of lead-free materials due to the REACH Regulation or the increasing automation of machining processes. Cost pressures to eliminate subsequent processes - such as rework or post-processing inspections - also contribute to this trend. “This is exactly where our 3D-lasered chip-forming geometries come into play: increasing process reliability by optimizing chip control,” says Seifermann, describing the key advantage.

Many customers are already relying on lasered solutions, particularly in the area of customized tools. The advantages are clear: the laser process offers virtually endless possibilities for ideally adapting the cutting edge geometry to the machining process and its specific requirements. “The results of our lasered tools are so impressive that we’ve already added the first geometries to our standard product line,” says Seifermann, pleased with the development. “However, when it comes to introducing lasered tools into our standard product line, we’re still a long way from reaching the end of the development process.”

Technical Evolution Rather Than Revolution

The development history of the AX system demonstrates how the targeted optimization of performance-determining parameters - such as shank length, fitting quality, and centering - can result in a solution that is valued by numerous users in the market as a benchmark for high performance. The combination of a cylindrical bar, an enlarged mounting length, and a self-centering bevel enables high repeatability, which pays off especially during frequent tool changes and with large extensions.

With the ME clamping system, the concept has been expanded to include a solution for particularly demanding applications. From today’s perspective, the interface between the tool and the holder is unlikely to undergo any fundamental changes; future development efforts are expected to focus more on optimizing cutting edge geometries, for example through modern laser machining technologies.

((Infobox))

SIMTEK Präzisionswerkzeuge GmbH
Mössingen, Germany
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Mail: info@simtek.com
Web: www.simtek.com

Press contact:

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Marketing
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Mail: marketing@simtek.de

PRX Agentur für Public Relations GmbH
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ralf.haassengier@pr-x.de
www.pr-x.de

AX at a Glance

- Approximately 1,500 standard items in 6 (shank diameter) sizes (A04, A05, A06, A07, A08, A10)
- Machining in bores with a minimum diameter of 0.3 mm and a maximum minimum diameter of 20.0 mm
- Main applications: boring, grooving, threading, chamfering, copy turning, axial grooving
- AX serves as the basis for countless customized solutions

((Images))



Image 1: Size comparison of the simturn AX (Image source: SIMTEK AG)

Caption: The cutting edge of SIMTEK's smallest AX tool, designed for boring bores from Ø 0.3 mm on, is barely visible to the naked eye.

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Image 2: simturn AX for manufacturing and boring of bores(Image source: SIMTEK AG)

SIMTEK Präzisionswerkzeuge GmbH
Mössingen, Germany
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Marketing
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ralf.haassengier@pr-x.de
www.pr-x.de

Caption: The AX product line now includes approximately 1,500 standard tools - shown here is a variant for manufacturing and boring of bores using just one tool.

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Image 3: Norbert Seifermann (Image source: SIMTEK AG)

Caption: Norbert Seifermann, co-founder and CEO of SIMTEK, developed the tool concept and consistently advanced its development into today's AX system.

Download image: https://pr-x.de/fileadmin/download/pictures/SIMTEK/Norbert_Seifermann_Simtek.jpg

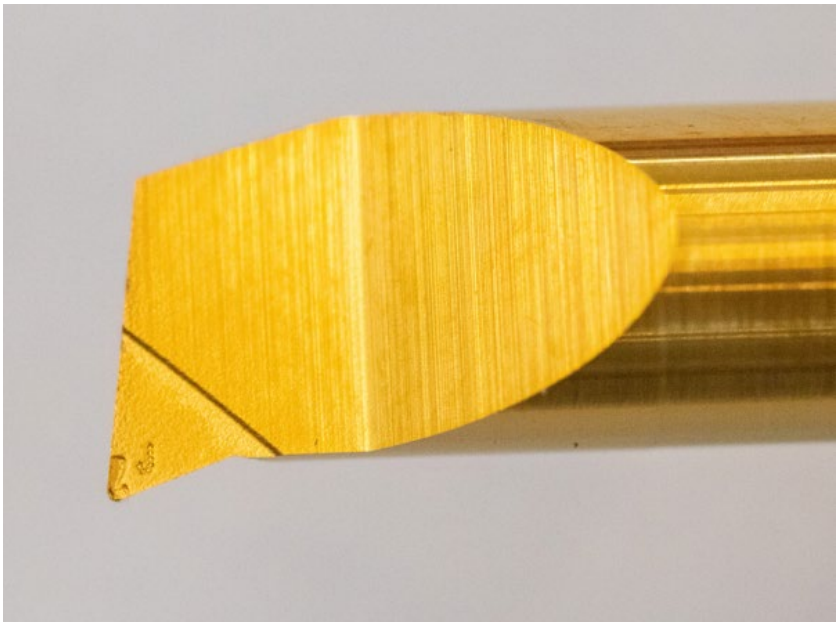


Image 4: 3D-lasered simturn AX (Image source: SIMTEK AG)

Caption: Norbert Seifermann: “From a design perspective, the AX system is practically fully developed today. We see further development potential mainly in cutting edge finishing - and here, above all, using lasers.”

Image download: https://pr-x.de/fileadmin/download/pictures/SIMTEK/simturnAX_Spangeometrie_Makro1.jpg

SIMTEK Präzisionswerkzeuge GmbH
Mössingen, Germany
Fon.: +49 (0) 7473 9517-0
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Phone 0711/71899-03/04
ralf.haassengier@pr-x.de
www.pr-x.de

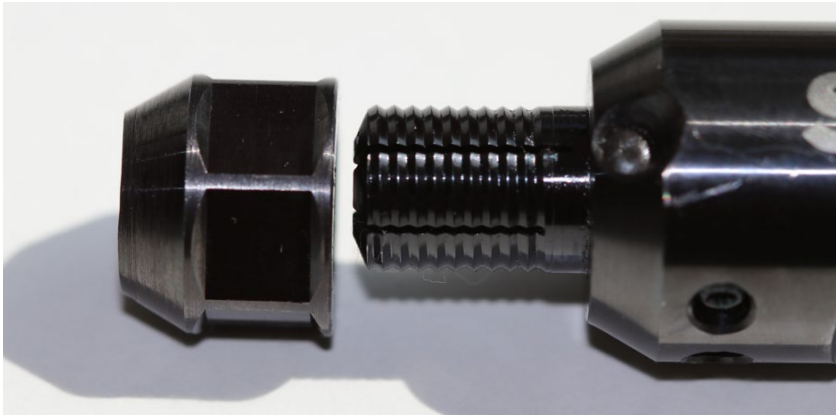


Figure 5: The ME clamping principle (Image source: SIMTEK AG)

Caption: With its patented ME clamping system (European Patent No. 2 992 988), SIMTEK introduced a new stage in the development of toolholders, which offers enormous stability, especially with long overhangs, thanks to force-fit tool clamping.

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About SIMTEK

SIMTEK Präzisionswerkzeuge GmbH was founded in 1994. As a central part of the SIMTEK Group - which currently employs nearly 500 people at six locations worldwide and operates in approximately 50 markets around the globe - SIMTEK is dedicated with great enthusiasm and passion to the development, manufacturing, and distribution of precision tools designed to meet the highest expectations.The extensive standard product range currently includes approximately 11,000 tools for grooving, turning, circular milling, broaching, thread whirling, and polygon milling.
This range includes tools for machining bores with a minimum diameter of 0.3 mm as well as highly complex, multi-row disc milling cutters with a diameter of 200 mm. Thousands of successful custom tool designs testify to the company's extensive development expertise.

For further information, please visit: www.simtek.com

Please provide proof of publication upon reprinting

SIMTEK Präzisionswerkzeuge GmbH
Mössingen, Germany
Fon.: +49 (0) 7473 9517-0
Mail: info@simtek.com
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Marketing
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