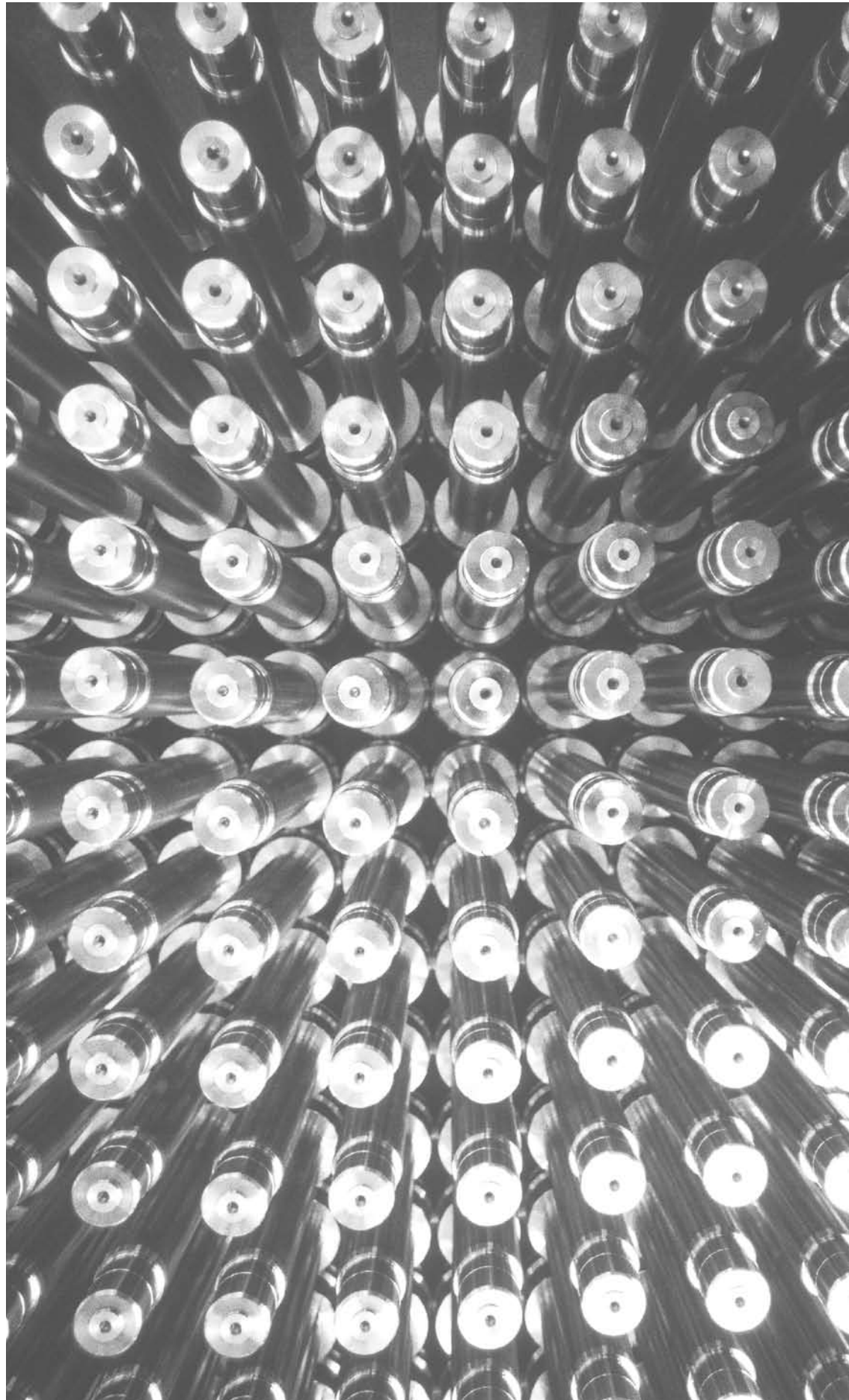


**For the highest
standards**



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For the Highest Standards – 40 Years of Continuous Success

On the occasion of the 40th company anniversary in September 2008, Hahn Präzisionsdrehteile GmbH & Co. KG presented itself in its new factory building in Reudern, Swabia, with sophisticated turning technology at the edge of what is possible today. Especially we wanted to know how the latest purchase of machinery, a SpeedLine INDEX C100 production turning machine, has performed in the real-life environment of a factory that has been using nothing but INDEX lathes exclusively.



Anniversary guest Dr. Bernd Walker, technical director of INDEX-Werke, expressed it to the director of the INDEX presentation center, Jochen Schelenz, this way during a tour through the factory on the occasion of the company's 40th anniversary: "What you see here is the absolute pinnacle of turning technology – more is not possible."

And indeed, the mostly small turned parts coming from a variety of automatic lathes in this plant with 14 employees are manufactured in large quantities at an almost inconceivable level of difficulty and with dimensional, shape and position tolerances of a few microns—accuracies that should actually not be feasible with automatic lathes.

Ralf Hahn, who is managing the company in second generation, and his father, Werner Hahn, have succeeded in long years of tinkering to apply the positive features of cam-controlled INDEX turning machines, such as very short times per piece, reliability and repeatability, to mass production on leading-edge INDEX CNC turning machines while leveraging the advantages of CNC technology for retooling to new parts—both for single and multi-spindle automatic turning machines. The basis of this success story is the company's detailed expertise on the characteristics of all machine elements involved in the machining process and their behavior under temperature fluctuations and other factors influencing the precision.

The knowledge of how each INDEX machine type behaves at various operating states is founded on a steadily growing wealth of experience that Werner and Ralf Hahn have gathered since their apprenticeship and following work at the INDEX plants in Esslingen, Germany.

Years as a problem solver and managing the product group of cam-controlled DG turning machines established the optimum prerequisites, 40 years ago, for Werner Hahn and his wife Heidi, who was responsible for the paper work, to found their own company: "We focused on high quality demanding parts right from the start. We never had to solicit orders; in fact, customers came to us because they noticed there's a company which does something special and gives advice on how to do things better."

Son Ralf had gathered detailed expertise during four years at INDEX in the production of conventional multi-spindle lathes,

For 40 years, Hahn Präzisionsdrehteile GmbH & Co. KG has been producing exclusively on turning machines from INDEX

before he decided in 1990 to join his father's company that was relocated to Wendlingen. Since the move to the new company building in Reudern in 2007, which became necessary for lack of space, approximately 60% of all parts are being manufactured on CNC machines at the Hahn company. Along with six somewhat outdated cam-controlled single-spindle lathes, mostly DG machines and four MS25 multi-spindle lathes which are still being highly productive, the machine park consists of two CNC multi-spindle machines MS32C and B, one GB60, two GB30s, seven ABC turning machines and—added approximately a year ago—one production turning machine SpeedLine INDEX C100.

To be ahead of the competition, the Hahns are not afraid of taking risks and are often among the first users to test a new INDEX design in a demanding real-life environment. This was the case with the ABC machines, the MS32B, and now again with the new machine generation, the INDEX C100. Naturally the INDEX technologists are interested in incorporating the experience gathered here and the suggested improvements in the standard production of their machines—even if some suggestions seem to be excessive for "normal production lathes". The Hahns demand from a CNC production turning machine—in addition to the advantages of modern CNC technology—not only the same performance as from a cam-controlled machine, but also extremely high and reliable continuous precision.

Ralf Hahn says, "We bought the C100 when we were facing production bottlenecks again. After the seven ABC machines in our company, we decided it was the time to enter the next generation of INDEX machines. The C100 is better suited for the ever more complex small parts that we build than the ABC series. Apart from that, we didn't have a machine with a Y-axis yet. Now we are able to fulfill tasks that were possible on the ABC machines only conditionally with driven tool holders. Off-center cutting with the Y-axis on the main and counter spindles is really a great thing for some parts. By working with several tools in a total of 3 turrets simultaneously, the



Company founder Werner Hahn with his cam-controlled turning machines that are still highly productive



From left to right: Company boss Ralf Hahn and Jochen Schelenz, director of the INDEX Presentation Center, at the production turning machine INDEX C100 with the prototype of the chuck for thin-walled parts developed for Hahn

machine is faster and more versatile. This is added by the full reverse side machining on the counter spindle."

But the INDEX C100 promises even more: a kinematic highlight is the "SingleSlide" guide system developed by INDEX, which is designed to enhance the machining accuracy even further—a point that Ralf Hahn is particularly interested in, of course.

The tool slide for the X and Z motions consists of a single part and moves the turrets thanks to an innovative double scissors kinematic design not on roller guides but on surface sliding guides. The virtually wear-free sliding pair consists of full-hardened mild steel plates (guides) and coated sliding

elements (tool carriers). This design combines the known benefits of sliding guides, such as good damping properties and high rigidity, with acceleration and rapid mode performances which so far had been implemented in machine tools only on the basis of linear roller guides.

Ralf Hahn says, "We manufacture very complex parts with tolerances down to 5 µm on our CNC turning machines. This is only possible by leveraging our long experience with cam-controlled turning machines.

Although the C100 was quickly ready to operate, it initially produced less accurate parts than on the existing ABC machine despite identical tools. Above all, the clamping device for



The part from lead-free aluminum profile material is manufactured on the C100. The rear and front diameters have 0.008 mm tolerances. The front bore cutout has a 0.02 mm tolerance, while the rear cutout on the opposite side has a 0.009 mm tolerance.



The seemingly impossible has been achieved for this part from free-cutting steel on the ABC machine: wall thickness 0.15 mm, hole depth 29 mm, a coil at the dome (0.06 mm diameter tolerance).



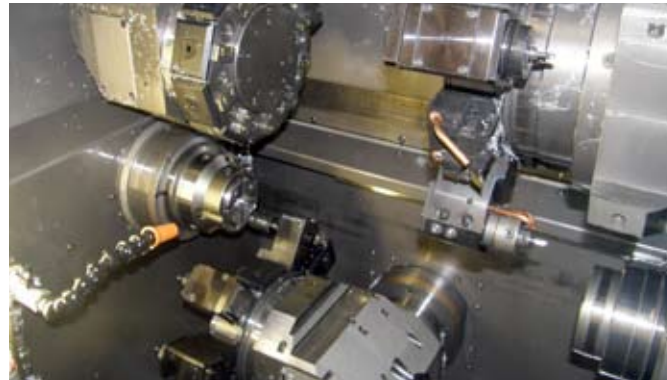
This component was originally composed of two parts. The large stud was manufactured as a turned part and welded on by the customer. Now the part, including a second stud, is manufactured completely on an ABC machine.



This part is machined on an ABC machine from round material 16MnCr5 completely from the solid. All edges must be slightly chamfered by milling. The hole in the web has a 0.01 mm tolerance.



From left to right: Werner Hahn and INDEX regional sales director Helmut Horner in front of a production turning machine INDEX ABC



View of the C100 working area in which Part 1 is manufactured

gripping a diameter with an 8 μm tolerance was unsuitable for our thin-walled part: it deformed the part and failed to clamp it properly. Every few parts, the tolerated dimensions were different, sometimes larger, at other times smaller."

Fortunately, the INDEX technologists always have an open ear to such a demanding customer if something is not performing the way it is supposed to do. For, when the two Hahns are happy with a machine, says INDEX regional sales manager Helmut Horner, it can be considered a benchmark for all other customers.

Werner Hahn agrees, "For all those 40 years, we have remained loyal to INDEX, because they are close by and because their customer service has always worked well, among other things. Together, we gradually optimized the C100 to the level that we need."

And that level is extraordinarily high. For this reason, each machine is used without an exhaust and with oil as cooling lubricant at Hahn. When it turned out with the C100 that the temperature compensation in the CNC control was not working satisfactorily, an oil cooler was retrofitted here as well, a rear panel against draft was attached, and—as for all ABC machines used in the company—the temperature compensation was disabled all together.

Ralf Hahn says, "When the new ABC machines arrived here several years ago, each was behaving differently. After the third or fourth ABC, we knew what to do to make them perform identically. I can control the oil temperature in the oil cooler to drive the machine to minus or plus, looking for the point where it remains constant. For the C100, I now know pretty accurately what influence the clamping of the Y-axis quill has and how the individual turrets behave, to the extent that I can run the machine without supervision for three, four hours. I wouldn't be so sure what the compensation function in the control would do during this time. When manufacturing in the micron range, there might be some off-tolerance parts, and I wouldn't notice it—unless I check all of them. But that is

too expensive."

Werner Hahn adds, "To manufacture at a micron tolerance level, the machine must not have any uncontrolled temperature response; it must be kept at a constant temperature at all times. This applies to cam-controlled machines the same as for CNC turning machines.

But there was more demand for optimization: because the thin-walled part (Part 1) was initially deformed when clamped in the counter spindle so it could not be secured properly, Mr. Schelenz—in cooperation with a manufacturer of clamping devices—designed a chuck (Fig. 3) that solved the problem when it was finally implemented without restricting the working area.

The next issue was the size of the main spindle chuck.

Werner Hahn, "No doubt the C100 is conceptually a superb machine. But concerning the best tool sequence in a machine, today's design engineers over the years have neglected many of the experiences made during the time of cam-controlled machines. The dimensions of quick-change chucks are much too large for machining filigreed small parts, and the wide slots required for vulcanizing are not suitable. Additionally, it is almost impossible with this system to make a special collet with vulcanized clamping elements. Collets with 4 slots, which are often required, are not possible at all. For applications such as ours, they should use DIN collets: they can be made as small as required. Then also the spindle head becomes smaller, and we are coming much closer to small workpieces."

Helmut Horner says, "Today's collets are designed as a flexible quick-change system with a 1 mm clamping stroke to allow changing collets quickly and covering a larger range of clamping. Therefore, they are rather big and pose problems for the filigreed boring and grooving tools used by Hahn on small workpieces. For this reason, we developed a considerably smaller chuck with steel collets, in cooperation with a manufacturer of clamping devices, which can be adapted to the spindle nose of the C100 like every other clamping devices.

This solution developed for Hahn is now available to all INDEX customers."

Even the C100's counter spindle was realigned on site with high precision, because accurate alignment is of paramount importance for such a thin-walled part. Otherwise, 3 to 4 μm wobbling traces would be visible on the outside diameter.

Ralf Hahn says, "This would simply not be acceptable for an 8 μm diameter tolerance. Overall, I am now pretty satisfied. Although the C100 doesn't yet reach the outstanding accuracy of our ABC machines, it shows potential for improving the temperature control and dimensional compensation. Because the machining capabilities of the ABC machine are limited despite exhausting all the tricks in reverse-side machining from the turret spindle, I won't buy another one in the future. We have also parts requiring extensive reverse side machining; this is more time-consuming with the ABC. The C100 has the advantage of the full counter spindle that is very convenient for machining with one or two turrets without restrictions. Due to the tooling arrangement, the machine is much faster with complex parts, and one can design the programs completely differently. We know now what's required; therefore the next C100 we will order will meet our demands more closely."

Another interesting information from Helmut Horner: If you don't need so many tools and don't have any parts that allow saving time by parallel machining with a third turret, you can purchase a C100 machine with two turrets—one upper and one lower turret—from 2009. Without the third turret, the two tool carriers offer the same ranges of travel.

Hahn Präzisionsdrehteile GmbH & Co. KG



The move in 2007 to its new building marks another high point in the 40-year company history of Hahn Präzisionsdrehteile GmbH & Co. KG. The neighboring property is already included for future expansion.

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