

Swiss precision meets Beckhoff automation technology

Software CNC controls grinding machine for dental drill production

The high demands placed on dental tools with regard to quality and precision require correspondingly sophisticated mechanical engineering. In order to do justice to these requirements, the Swiss company Monnier + Zahner AG automates its dental drill grinding machines with a PC- and EtherCAT-based control platform from Beckhoff. One example is the M647 CNC dental tool grinding machine with six interpolating axes and HSC functionality.



M647 dental drill grinding machine with automatic loading and unloading device with hopper or drum magazine



To guarantee the high demands placed on dental tools with regard to quality and precision Monnier + Zahner uses PC-based Control from Beckhoff.

Monnier + Zahner, based in Safnern, Switzerland, can look back on many years of experience in mechanical engineering. Until 1972 the company specialized in machines for the production of watchcases. The beginning of a financial crisis in this market segment at that time prompted Monnier + Zahner to apply their know-how in the field of precision machinery to medical and dental technology, among other things. Today this division accounts for approx. 40 % of company turnover. "We have attained a leading position worldwide in dental tools and medical implants such as bone screws and artificial hip joints," says Roland Wälti, Managing Director of Monnier + Zahner.

Precision with tolerances in the micrometer (μm) range

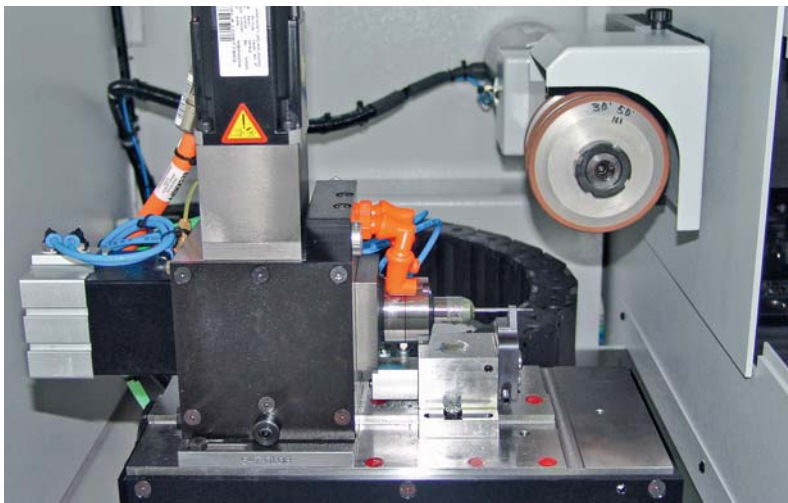
Most solutions from Monnier + Zahner are CNC-controlled special machines. "We do all the development, design and automation ourselves; in other words: we have the entire know-how within the company," emphasizes Roland Wälti. "For the most part, machine parts and components are the only items that we procure from external service providers," adds Heidi Bühler, head of administration at Monnier + Zahner. "Not everyone can design such machines, and not everyone can actually build them. Precision work with tolerances in the μm range requires a highly specialized machine builder," stresses Roland Wälti. "However, the functions of our machines are simple and user-friendly. These functions are factory-installed. The customer can program or parameterize their unique

application. There is also an option to assign up to 10 auxiliary operations to the parts program via NC code."

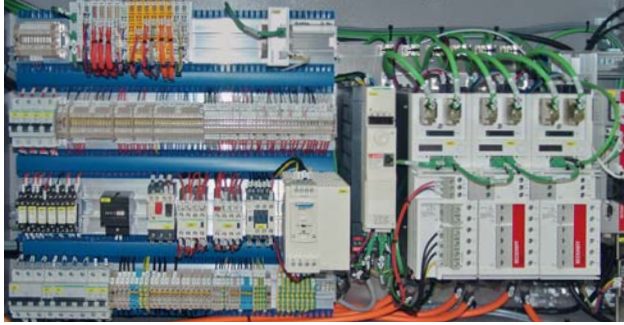
Process optimization: controller relaunch with PC-based control

The controller relaunch was prompted by the discontinuation of the machine controller for a dental tool grinding machine. Martin Wälti, Head of the software department at Monnier + Zahner, recounts: "It wasn't a real CNC back then, but an interpolation module. We looked for a control alternative that matched our requirement profile and decided on Beckhoff. Then came further machines which we equipped with automation technology from Beckhoff, so that we could extend our know-how regarding the use of TwinCAT PLC and TwinCAT NC PTP step by step."

The M647 dental tool grinding machine has six interactive axes, which are synchronously driven. The highly precise dental drills are ground in the work area. A three-axis handling device feeds the blanks to the grinding process and also removes the finished tools and sets them down after machining. "The biggest challenge lay in transferring or integrating the functions from the old controller, which had been developed over many years, into the new controller," reports Martin Wälti. If something grows over many years, then as a rule you always base it on what already exists, thereby often accepting compromises. In using the new controller we



The M665 grinding machine for round dental tools has six interactive axes, which must be driven synchronously. The very precise circular tools are ground in the work area.



Control cabinet of the M647 with AX5xxx EtherCAT Servo Drive, EK1110 EtherCAT couplers, EtherCAT I/O and TwinSAFE terminals

3-axis handling device for the grinding machine



have optimized and restructured all the features. Of course, all functions are now cleanly separated, because previously the entire controller was a single Windows application, including the user interface."

Complete CNC system from Beckhoff

The interaction of controller and Drives on the machines was also re-evaluated by Monnier + Zahner. "We use the AX5000 EtherCAT Servo Drives and servomotors, in which the position encoder is integrated

into the motor," explains Martin Wälti. TwinCAT CNC software runs on a Beckhoff C6920 Industrial PC while operation takes place using a CP6902 Control Panel. Monnier + Zahner use the Beckhoff EtherCAT Terminals and EtherCAT Box modules as I/O systems. For safety, too, the decision was made to use Beckhoff's TwinSAFE integrated safety technology.

The grinding machines of the type M642-Evolution, M665 and M647, for the manufacture of circular tools and dental drills in different formats, are now universally equipped with the Beckhoff automation platform. Monnier+Zahner AG pay particular attention to the functionality of the machines: precision, with tolerances in the μm range, high yield and availability are the most important criteria.

The benchmark here is the fast interaction of the automation components, to which EtherCAT mainly contributes. "We have now equipped a machine for the first time completely with EtherCAT, which has considerably simplified the electrical structure and increased the process quality," reports Martin Wälti. The networked interaction concerns the Industrial PC, the AX5000 drive controllers and the I/O.

Parameterization instead of NC programming

"The principal reasons for deciding on Beckhoff CNC control were the high flexibility during the development of the application on the basis of IEC 61131-3, the availability of state-of-the-art hardware and software interfaces, the compact, space-saving designs of the components and – very importantly – the price. We didn't have to pay a higher price to optimize the process," says Managing Director Robert Wälti. "Nevertheless, the customer ultimately decides on the acceptance of a fully automated machine. An essential criterion here is whether a semi-skilled worker can also take over the operation of the machine. In order to make this as simple as possible, we have created a special tool with which the user 'develops' the work pieces to be machined in a simple way: they only need to take care of the parameterization, the tool does the rest."

Troubleshooting via the Internet

An important feature of the PC-based controller is the possibility of web-based services. The machines are delivered by Monnier + Zahner in a certain state that the customer cannot change, i.e. the customer does not have the source code and cannot program anything or change functions, apart from the parameterization of the work piece. If an error should occur on a machine, the specialists from Monnier + Zahner can log into the machine controller via the Internet and assist with troubleshooting.

"We have already recorded a number of advantages from the Beckhoff control platform," says Managing Director Roland Wälti: "These include the amount of cabling, which is much less than before and therefore less susceptible to failure; the control cabinet has become smaller and the production process has been optimized by decreasing 'dead time.' In addition, the separation of the user interface from the control program has significantly increased the operating reliability and the availability of our machines. Informative diagnostic options permit rapid commissioning. In the future we want to capitalize on even more of this technology's advantages."

Monnier + Zahner AG www.monnier-zahner.ch

Beckhoff Switzerland www.beckhoff.ch