

Open, flexible control and drive technology in special machines  
for the locking systems industry

## Key technology: PC-based control in high-precision key manufacturing with 10 $\mu\text{m}$ accuracy

Millions of people have held keys from Wilka in their hands. Problem-free keys and locking cylinders are taken as a matter of course everywhere, without giving thought to the demanding production processes involved. It may come as a surprise that lock and key products require very efficient and high-precision production technology which, in the process, even compensates for temperature fluctuations of a few degrees. Aumat and AST have opted to develop the corresponding systems to address these needs with PC-based control from Beckhoff, ensuring manufacturing precision of 0.01 mm as required by the key industry, while enabling easy implementation of customized special machinery – all with minimal engineering effort.



Wilm Schadach, from the Beckhoff Rhein/Ruhr office; Achim Ihlefeld, Technical Director of Aumat Maschinenbau GmbH; Manuel Krümmel, Head of Key Production, and Mark Straka, Manager of Electrical Maintenance, both from Wilka Schließtechnik GmbH; as well as Wilfried Wengenroth, Managing Director of AST GmbH (from left to right)



Typical for the key industry and for specialist, Wilka Schließtechnik GmbH in Velbert, Germany, is production of custom orders. Technical Director, Olaf Witte explains: "In a manner of speaking, we mass produce with a lot size of 1. While an order can cover 1,000 identical items, each one is usually different – all the way down to a single order for a duplicate key." Production at Wilka is correspondingly flexible in its structure, with a great variety of special machines as developed by Aumat Maschinenbau GmbH, in Solingen, Germany, together with system integrator, AST GmbH in Wuppertal.

According to Achim Ihlefeld, Technical Director at Aumat, the fundamental requirement for specialized machines is the high degree of precision when machining the key blanks: "The maximum key tolerances lie in the hundredth of a millimeter range. In order to reliably meet this tolerance, the mechanical engineering has to be better by another order of magnitude. This requires the shortest possible control cycle times and servo axes with very high precision. Both of these can be implemented quite well with PC Control from Beckhoff, so that even several parallel milling cycles can be achieved with several



According to the order, the key blanks first receive the desired longitudinal profile and then the notches of the key bit.



In the process, decentralized collection of I/O data via the EtherCAT Box modules, EP1008 and EP2028, directly on-site reduces the required control cabinet space to a minimum.

corresponding servo axes." Tim Themann, software developer at AST, adds: "The precision requirements are so high that even temperature fluctuations of a few degrees can be critical for the machining results. PC Control regulates this influence via continuous temperature monitoring."

#### **Key production line modernized with two stand-alone machines**

The advantages of PC-based control are apparent in a Wilka production line for keys, which – according to AST Managing Director, Wilfried Wengenroth – consists of two stand-alone, specialized machines: "An existing key cutting machine for cutting the key bit was overhauled and equipped with control and drive technology from Beckhoff. Added to this was a profile milling machine, likewise controlled via PC Control, for the milling on the key side. The keys are manufactured to order during the run, first getting the longitudinal profile, then the notches. They are then finally delivered with the associated locks." Achim Ihlefeld adds: "With the two Beckhoff controllers, Wilka benefits from a uniform user interface; if necessary, the company can continue running the second machine without interruption in the case of a machine stoppage."

The cutting machine has nine servo axes while the profile milling machine has 23 servo axes, which are implemented via AX5000 Servo Drives and AM3000 servomotors. Both machines are interlinked and communicate via two gateways programmed in C#. These each run on a C6930 control cabinet Industrial PC (IPC) on the corresponding machine and communicate via ADS with TwinCAT automation software. In addition, the IPCs are in charge of data transfer to the central data server of Wilka. According to Achim Ihlefeld, each milling spindle on the profile milling machine also has its own tool management: "In this way, the four milling spindles manage with 12 cutters each, in order to efficiently carry out the many and varied longitudinal milling operations from the thin master key to the thicker special keys that only fit specified locks of a locking system. Conventionally, hundreds of specific cutters are often provided for this purpose. In our case we avoid this by intelligently coordinating usage of the 48 cutters via the tool management system." Tim Themann adds: "Tool management is implemented via TwinCAT NC I. This way, it is not only possible to select the appropriate cutters, but also to cut ideal lines. Therefore, you can have a smoothed edge between deep and flat milling notches lying next to one another, and the finished key is reliably prevented from improperly catching in the lock cylinder."

#### **Integrated PC Control: the ideal foundation for Industrie 4.0**

"The specialized machines from Aumat have been using PC-based control from Beckhoff since 2005," says Wilfried Wengenroth. "At AST, we've been working with it since 2004. In this context, EtherCAT is also a critical advantage, specifically due to the ability to perform automatic scanning of the system, in particular during initial commissioning. Additionally, EtherCAT offers rapid and convenient diagnostics of all bus devices." Mark Straka, Manager of Electrical Maintenance at Wilka adds: "Our evolved controller landscape is by nature heterogeneous, but we have invested about seven years now making the move to Beckhoff technology. Along with the high computing power, the openness of the system is a vital benefit for us. The older legacy control technology can be integrated without great expense and the higher-level corporate network can be connected



The interlinked key production line designed by Aumat and AST, consisting of a key cutting machine and a profile milling machine, machines key blanks with high precision down to lot size 1.

just as easily. The latter is increasing in importance to ensure that the entire production infrastructure is available via a standard network, from order entry to production, all the way to service.”

In this way, the ideal prerequisite is given for the implementation of Industrie 4.0 concepts. According to Olaf Witte there is one important aspect that should not be forgotten in this regard: “The more production relies on networking, the more serious the potential damage can be in the case of malfunctions. What good does highly flexible, lot size-1-production do when the systems are down? Therefore, system availability and control technology service are becoming even higher priorities for us. In the case of Beckhoff, this works quite well and quickly.” Mark Straka also confirms this: “The speed with which we respond to inquiries is often crucial for us. After all, production downtime can be very expensive. However, this is not only true in the case of service or procuring replacement parts. Just as critical is the speed with which Beckhoff has developed technical innovations over the years and accompanied those innovations with project support. Meanwhile, there is hardly an application that cannot be solved with PC Control. In addition, with the compact and modular system we save up to 50 percent in control cabinet space and about 20 percent in hardware costs compared to conventional PLC technology. Moreover, it is possible to respond rapidly and flexibly to new requirements via EtherCAT Terminals or Box modules, such as for subsequent temperature compensation.”

### Scalable, application-specific automation technology

At the key production line, PC Control handles all automation technology tasks: control of machine operation, HMI for setup and automatic operation, fault message display and data archiving, data handling via gateways as well

as NC-control of the 3-axis milling gantries. Five 3-axis stations controlled by TwinCAT NC I are used for the profile milling machine, while three stations are used for the key cutting machine. Added to this is key transport via 15 transfer stations and the supply of the key blanks with a total of 32 servo axes handled by AX5000 drives with system-integrated safety functions.

This is all controlled via one C6930 control cabinet IPC per machine, which is connected to a CP6902 15” built-in Control Panel for visualization programmed using TwinCAT PLC HMI. According to Wilfried Wengenroth, it offers sufficient power even for future system expansions: “The high computing power and fast control tasks allow us to solve very challenging assignments, such as high-precision drilling control or in the case of broaching machines, tool breakage monitoring implemented via acquisition of the motor current. The TwinCAT Database Server offers additional benefits from PC-based control technology. It can be used to process very large data quantities without reducing the PLC cycle times.” The universal EtherCAT-based data acquisition – either centralized or decentralized depending on your requirements – offers further advantages either via EtherCAT Terminals in the control cabinet or directly on-site in the process via EtherCAT-capable valve terminals and with EP1008 or EP2028 EtherCAT Box modules.

### Considerable savings through One Cable Technology

Since 2014, Aumat machines have consistently relied on the One Cable Technology (OCT) aspect of Beckhoff Drive Technology. It unites power supply and feedback systems in a standard motor cable and significantly reduces hardware and commissioning costs, as Mark Straka confirms: “OCT gives us a tremendous advantage when building a system, in particular due to the reduced labor requirements and sources of potential errors. In addition, the number of cables is cut in half and there is more compact, more scalable cable routing, which by itself makes up about 30 percent of the cost savings.” Wilfried Wengenroth sees two further benefits: “With the very stable data transfer in OCT, EMC is no longer an issue. Another plus is the fact that OCT can be easily and rapidly parametrized. The tremendous savings in work time and material therefore reduce engineering requirements on the part of programmers.”

Further information:

[www.ast-gmbh.com/en](http://www.ast-gmbh.com/en)

[www.umat.com](http://www.umat.com)

[www.wilka.de](http://www.wilka.de)

[www.beckhoff.com/motion](http://www.beckhoff.com/motion)