
SEICHTER
TIRE TESTING SYSTEMS

Tire and wheel testing machine with fast and safe communication

EtherCAT plus Safety runs true

Higher, faster, further... Machine manufacturering company, Seichter was able to implement this Olympic motto in their new tire and wheel testing machine. With the help of innovative PC Control technology from Beckhoff, the machine is significantly more compact than comparable systems and offers minimum cycle times combined with maximum precision. One particularly important aspect is the high-performance EtherCAT communication system. In conjunction with the safety technology, it ensures investment security and high performance potential for future developments.

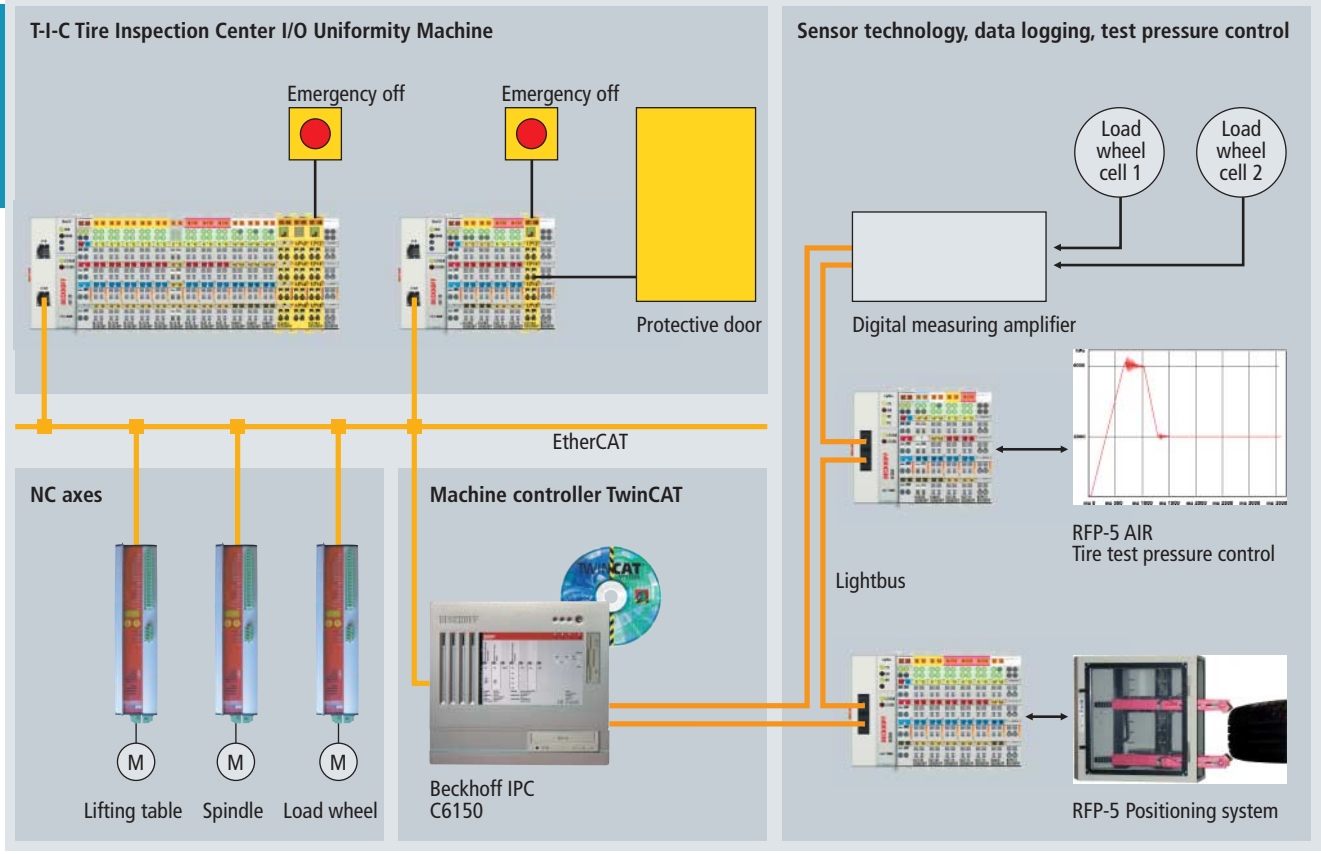
The origins of Hanover-based Seichter GmbH are in reconditioning or retrofitting of tire and wheel testing machines. Technical Sales Manager Siegmar Ahlvers said: "Our main system measures tire geometry – checking surfaces for dents and bulges or constrictions. To this end, we offer capacitive measuring sensors and point laser sensors. Our latest technology is the SMU 'Sheet-Of-Light' measuring unit, a camera system that records a laser line projected onto the tire surface with a rate of up to 2000 images per second and reconstructs a height profile from these data."

In the past, Seichter geometry measuring equipment was designed for installation on third-party machines. These were either specially designed for measuring tire geometry or for measuring the uniformity of the forces between the tire and the road. With the development of its own Tire Uniformity (TU) machine, the company succeeded in becoming a supplier of complete machines. Via a large load wheel, this machine exerts pressures on an inflated tire, simulating road surfaces. It measures the forces or force fluctuations while the tire rotates at 60 rpm (standard, 120 rpm optional). The whole machine is controlled with Beckhoff automation technology consisting of a C6150 Industrial PC for operation, AX2000 Servo Drives, TwinSAFE safety technology, and networking via EtherCAT.

Innovative machine construction and control

The combination of innovative mechanical engineering and high-performance automation technology enabled the development of a TU machine that is without equal in the market. Unique characteristics include the basic machine design as a single unit, leading to significant time savings during transport – the system even fits inside a container – and commissioning. The high-performance and compact control technology plays a significant role. "Compared with competitors, we only need a control cabinet that is about half the size, which can be easily flange-mounted directly on the machine", Siegmar Ahlvers explained.

"Another important point is the fact that our machine has no hydraulic system and therefore requires no oil supply system, which is a significant advantage", said Johann Klassen, who was responsible for the engineering of the TU machine. "We use a total of three servo axes that are controlled via the AX2000 Servo Drive from Beckhoff and TwinCAT NC PTP software for PLC/NC. Thanks to this advanced control technology, we can move axes very precisely and very quickly, and the spindle holding the wheel or the tire can be aligned precisely even with very small rotary motions." The new machine not only does away with expensive hydraulics,



it also uses fewer pneumatic components for control purposes, such as for removing tires from wheel rims after the test procedure. The whole 'tire management' is handled by the three NC drives: The tire is placed in the machine and positioned on the wheel rim. The wheel rim is then closed and the rotary motion is started for the test procedure. The same NC axis is used for precisely adjusting the tire rim width. This makes the machine relatively easy to control, despite the stringent precision and repeat accuracy requirements. A test cycle only takes about 20 seconds. Around 3,000 tires per day can be tested in three-shift operation.

The CP7021 operating panel with touchscreen and additional hardware keys for activating the required action ensures a high degree of operating reliability. Handling is simplified by the flexible panel mount design. Siegmar Ahlvers said: "The option of separating the operating panel and the Industrial PC offers a high degree of flexibility for installing the Beckhoff system, i.e. it can be installed remotely or on a swivelling arm. After all, during commissioning or maintenance it is important to be observe machine movements from the right viewing angle."

"The new design also offers benefits for machine manufacturers", said Johann Klassen. "The Panel can be optimally positioned up to 100 m away from the machine and connected via CP-Link. The fact that the panel can be integrated directly into the control system via CP-Link with a coaxial cable is a particular advantage. Wiring is reduced to an absolute minimum. For panels from other suppliers, the hardware keys usually still have to be wired separately."

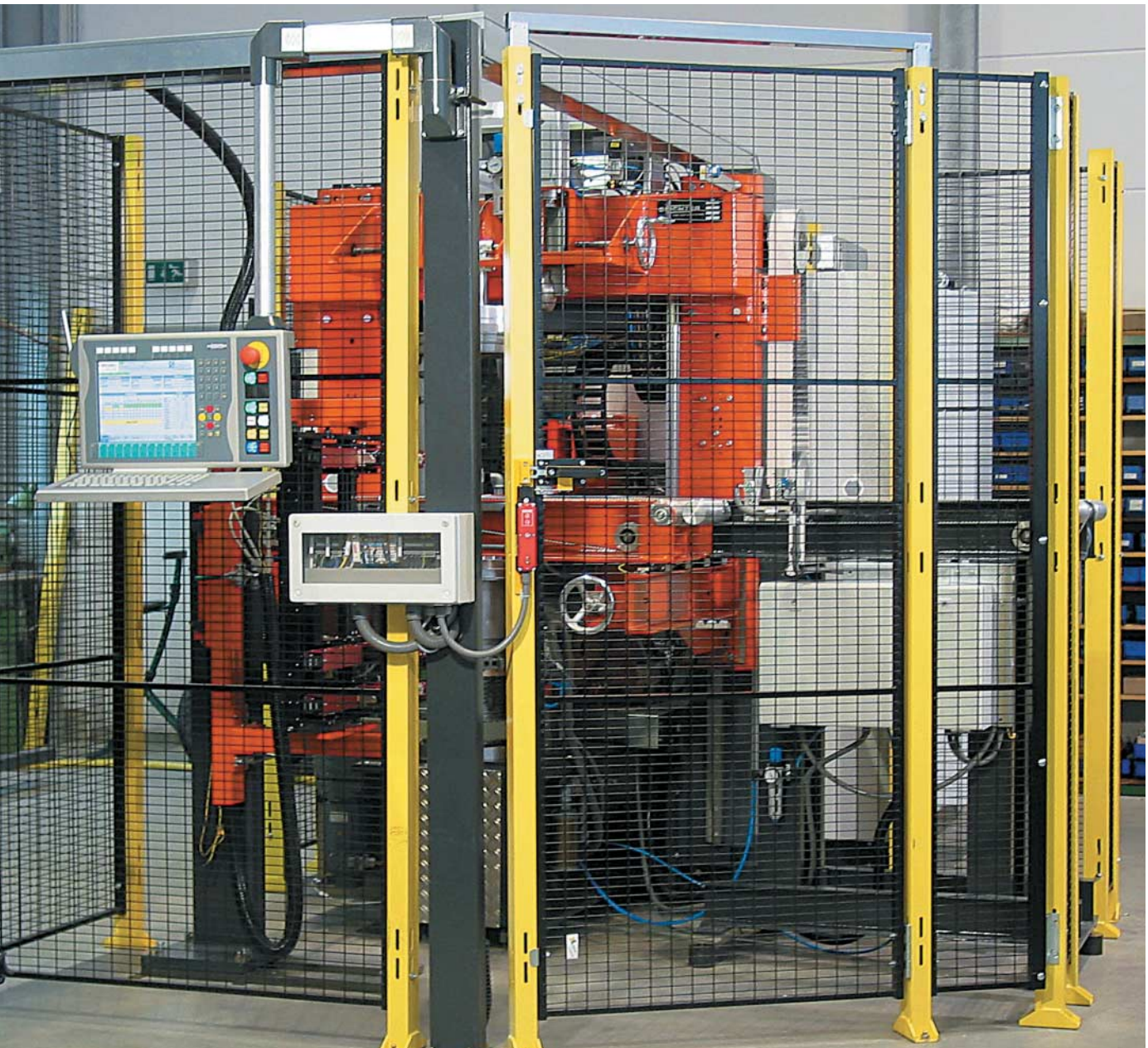
There are further benefits from using the Beckhoff BC2000 Bus Terminal Controller that acts as local mini PLC for controlling the air pressure in the tire. The forces usually have to be measured very precisely, which means that the air pressure in the tire also has to be controlled exactly. A big advantage of the Beckhoff solution is the Lightbus interface of the local controller, which is easy to integrate into the measuring system of the machine in the form of a real-time card (also with Lightbus interface). This component, referred to as RFP-5 AIR (Automatic Inflation Regulator), is also used for reconditioning older machines with often leaky compressed air systems, where the pressure has to be controlled very quickly and precisely during the measurement. Thanks to RFP-5 AIR, the test cycles can be reduced by 1 to 3 seconds.

Fast data for high-performance testing

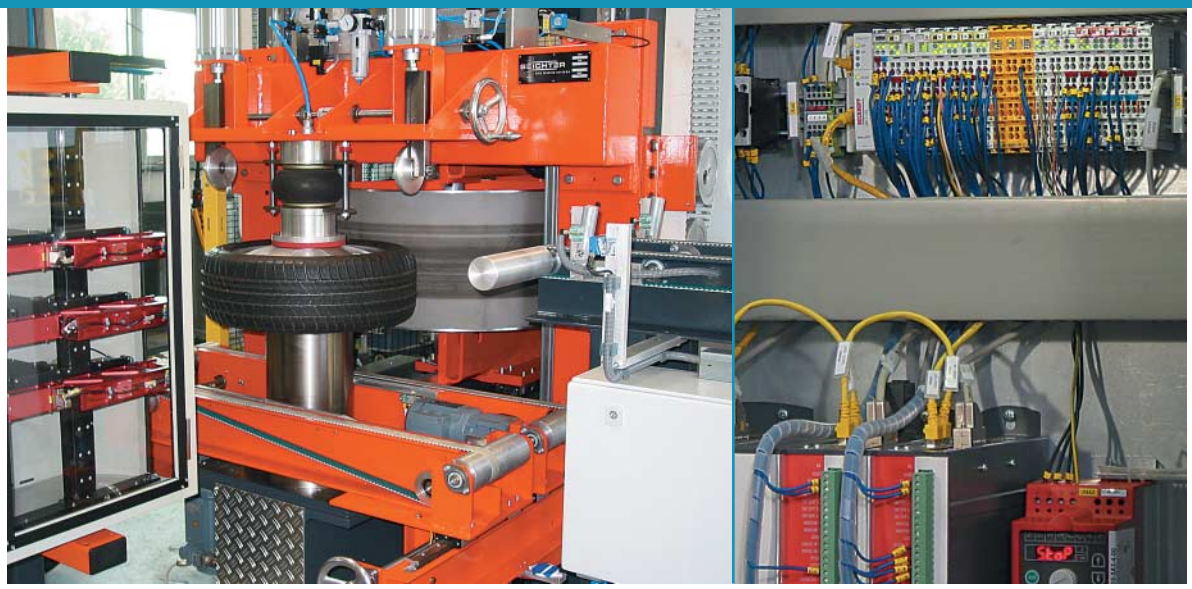
A high-performance data bus is required to get the most out of NC axes. According to Johann Klassen, this generally means that separate communication systems are used within a machine for NC tasks and for control tasks. The Seichter TU machine simplifies things because EtherCAT, with its high transfer rate, is suitable for both applications: "For our machine it is important to be able to control all components relatively quickly, because cycle times of less than 20 seconds require an optimum solution for each control task. NC axes offer better control for simultaneous movements. One example is load setting, which represents a very gentle motion, but must be controlled very precisely. An NC axis with sufficiently fast control offers significant advantages. Our machine has a PLC task cycle time of 2 ms, with further improvements easily made if required." Other movements, such as tire positioning with a speed of more than 1 m/s, also require quick and reliable data communication. Exact positioning is needed at the end of the motion (via a quick-scan light barrier) in order to achieve the required accuracy.

According to Johann Klassen, it was ultimately a combination of factors that led to the decision to use EtherCAT, especially since other Ethernet systems he considered offered significantly lower performance. One of the crucial factors was the potential for future developments: "For historic reasons, the instrumentation is still based on the Sorcus PC card with Lightbus interface. In the medium term, we intend to switch to EtherCAT. EtherCAT is very suitable for this task: It offers simple implementation and high-speed data transport, which is much more critical for measuring tasks than for control tasks. I believe converting the machine to EtherCAT is a future-proof decision."

For Siegmar Ahlvers another important advantage is the flexibility and openness of EtherCAT compared with others fieldbuses: "Pressure to upgrade the instrumentation is increasingly steadily, because some of the measuring amplifiers we used in the past are no longer available. We now develop them in-house based on the CAN bus. Going forward, we will provide a Lightbus-compatible solution, followed by interfacing with EtherCAT. This approach enables us to develop very compact measuring amplifiers, because the associated CAN interface is already integrated in the microcontrollers." According to Johann Klassen, the separation between tried and tested Lightbus-based instrumentation and new EtherCAT con-



State of the art control cabinet technology: EtherCAT and TwinSAFE for fast and safe communication.



trol technology will soon be a thing of the past: "An integrated bus system makes everything much simpler, especially since EtherCAT makes the machine more streamlined, faster and more precise. We already need the short cycle time today. Lower performance would have an impact on precision and repeatability. Precision and low cycle time in conjunction with simplified maintenance through concentration on Servo Drives are crucial sales arguments for us."

Flexible safety easily integrated

A safety fence with safety latch integrated in the TwinSAFE system protects operators of the TU machine from Seichter. TwinSAFE, the safety solution from Beckhoff, integrates safety functionalities into the control architecture. Optimum interaction between standard automation and safety technology results in significantly reduced engineering and hardware costs. The safety functionality can be configured conveniently via the TwinCAT automation software. Together with the TwinSAFE protocol, very flexible, integrated solutions according to SIL3 are possible.

The TU machine offers safety functions in the form of emergency stop and safety fence monitoring, i.e. movements are only possible when the machine is closed. For the connection between the safety components and the EtherCAT network, all the TwinSAFE Bus Terminals need is a small switch box installed directly at the safety fence, from which only a few cables run to the machine. Further safety terminals enable connection of a signalling column, for example. The required logical link of the inputs and the outputs is handled by the KL6904 TwinSAFE logic terminal.

TwinCAT: One software for control and safety tasks

According to Johann Klassen, the safety terminals also offer potential for the future, especially since future machines are likely to be bigger and require more safety functions: "Today, the main benefits result from significantly simplified wiring. The fieldbus replaces a complex, multi-core cable. Thanks to EtherCAT, networking additional emergency stops can be installed at a later stage as required. Emergency stop circuits are often designed in advance so that modifications are required during machine commissioning. The new system makes modifications easy to implement. This is a cost factor that should not be underestimated."

The high degree of integration offered by the TwinCAT world results in cost benefits, because the software editor for configuring the safety functionality is already conveniently integrated. Johann Klassen said: "The fact that we don't have to work with two different software packages makes things much easier for us. Since we were already familiar with TwinCAT software, a simple orientation was sufficient. We were then able to program the safety functions ourselves. While these aren't particularly complex in our case, they nevertheless demonstrate how easy it is to implement safety functionality with TwinCAT."

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→ EtherCAT **www.beckhoff.com/ethercat**
→ TwinSAFE **www.beckhoff.com/twinsafe**