

**Beckhoff Switzerland:**  
**Tailor-made systems at short notice**

# Transformer winding machines with PC control

The transformer winding machines from the company Tuboly are made in Dotikon, Switzerland, and sold worldwide. The winding machines processing the wire or foil for transformers in power stations or for magnetic resonance image (MRI) tomographs meet state of the art requirements. Tuboly produces the winding machines, the customer produces the coils.

## Requirements for customer-specific machines

The winding machines from Tuboly are highly automated. The control calculates the foil feed and the weld points. In conventional winding machines, the operator has to advance the coil, indicate the weld points and then unwind the coil for welding, which is not very time-efficient.

Tuboly produces the winding machines according to customer requirements – each machine is an individual product. Naturally, the basic elements of the construction and the basic software functions remain essentially the same. The operator controls the principal axis with the transformer coil. The control deals with the material supply and with auxiliary axes. For special applications, the response times of the real-time control must not exceed 1 ms.

## Industrial PC with software PLC

For controlling the winding machines, the developers at Tuboly use Beckhoff Industrial PCs with software PLC/NC TwinCAT, whose modular design enables the rapid development of customer-specific solutions. The Industrial PC as a platform enables optimum scaling of the computing capacity according to customer requirements. The costs can thus be optimized. Since the software is based on Windows standards, the visualization and the connection to the network or other pro-

→ The winding machines from the company Tuboly are used worldwide in the production of transformers for power stations. An Industrial PC with software PLC controls the largely automated winding machine. Tuboly produces sophisticated, usually customer-specific machines. The scalable Industrial PCs and object-oriented programming under the Windows operating system enable tailor-made systems to be supplied at short notice.



The winding machine for transformers winds the wire with up to 600 meters per second. Foil feed and welding positions are calculated automatically.

grams can be solved elegantly. Tuboly decided to use the PC control from Beckhoff, because it combines process control, axis control and visualization in a single system.

### Coils from 1 kilogram to 20 tons

The machines of Tuboly can deal with coils with weights between 1 kilogram and 20 tons. The wire is wound with a speed of up to 600 meters per second. The operator controls the process via robust hand switches or pedals. A display provides information and guides him through the process. An Industrial PC with a Pentium III processor with 256 MB RAM controls up to 12 axes. The PC uses Windows NT as the operating system, or optionally Windows 2000 or XP.

The system is defined and the application-specific functions are embedded in the TwinCAT software PLC/NC. The developers from Tuboly program the actual machine function and the visualization. They use the object-oriented programming environment and software modules from previous projects. The TwinCAT system supports the developers with software libraries, e.g. for NC axis positioning. Software development takes approximately one man-month to complete. The winding machine is normally delivered six months after the order is received. If an existing design is used, the delivery time may be reduced to 4 months, depending on the utilization of the production facilities.

### Connection via fiber optic

The sensors and the motor control communicate via the Lightbus. The fiber optic is insensitive to EMC interferences and works reliably even in the harsh industrial environment with welding machines. The modular bus terminal system also enables applications with Profibus, if the customer wishes to use an existing infrastructure. Safety functions such as emergency stop push buttons are controlled directly via the control cabinet.

Customers are not very keen on safety barriers and fences, since they obstruct the workflow. Accordingly, a compromise has to be found through appropriate measures that ensure high productivity, but also the safety of the operating personnel. The process control system or other administrative programs can be integrated via an OPC interface. The Windows operating system provides remote maintenance functions as standard. They are used to establish a connection via the company network or a modem. With conventional PLC controllers, the customer had to purchase an expensive additional module.

### Amortization after eight months

The costs of a new or refurbished winding machine are quickly recovered, in some cases after only eight months. The high degree of automation saves staff costs. Accordingly, the trend is towards fully automated winding machines. Every push button or switch that can be saved reduces hardware and production costs. The software deals with the associated functions. The additional development costs for the software only have to be paid once, and the software modules can often already be reused in the next project.

Since nearly every winding machine represents a new development, developers are often confronted with new problems, mainly in terms of the software. The developers at Tuboly therefore value the close contact with Beckhoff in Switzerland and with the specialists at the German headquarters. Tuboly staff receive little feedback about the operation at the customers, which is a sign of a smooth production process. Usually only mechanical wear and tear parts have to be replaced.



Christoph Müller, manager of electrics and software at Tuboly, operates a transformer winding machine. Operation is largely automated.

→ Tuboly AG [www.tuboly.ch](http://www.tuboly.ch)



#### Key data of winding machines

Wire speed	600 meters/minute
Foil speed	250 meters/minute
Weight of transformer coil	1 kilogram ... 20 tons
Number of controlled axes	2 ... 12
Cycle time	1 ms
Real-time load	approx. 40%
Industrial PC processor	Pentium III, 850 MHz
Main memory (RAM)	256 MB
Operating system	Windows NT/2000/XP