



Folded cooling fins which have been welded to the base

Production line for transformer housings with corrugated tank panels

## PC Control for extreme folding

Beckhoff PC-based control is used in the fully automated Tuboly folding and welding machine to manufacture tank panels for transformer housings. Twelve hydraulic servo axes and 25 electric motor-driven servo drives are controlled from the PC-based automation platform. The production of the specification, the engineering and the commissioning of the complex production plant was undertaken by Brüttsch Elektronik in cooperation with Tuboly.

The Swiss firm Tuboly, which today belongs to Astronic Industries AG with headquarters in Dottikon, has supplied the electrical industry with machinery for advanced production technology for over 20 years. Astronic's core cutting lines represent a complementary product portfolio and the amalgamation of the two companies has resulted in an extended product range with a considerable center of expertise for the electronics industry.

### Fully automated production from coil stock to the finished transformer housing

The Tuboly-Astronic business model comprises the design and production of winding machines, folding machines, condenser bushing winding machines as well as special machines and system accessories. The modular corrugated-panel folding and welding machine is a fully-automated, computer-controlled production unit for folding, forming and welding panels for the transformer housings. These are produced fully automatically from the coil to the finished housing. "In

the planning department, the operator creates order-controlled batch sizes depending on the sheet type and sheet width to be used. The resulting production programs are loaded into the system controller and executed," explains Michael Tretter, Electrical & Software Manager of Tuboly-Astronic AG. The automatic set-up function guarantees simple, rapid switching from one dimension to another so that even smaller batch sizes can be manufactured economically. The other production steps are equally remarkable: the sheet metal is folded with two x 250 t hydraulic thrust. Beading is applied while the sheet is precisely positioned and reinforcements are spot welded to both sides. The folded cooling fins are then welded using a mobile feed table and two lateral welding systems.

### Exceptional cooperation from engineering to commissioning

Tuboly-Astronic's production volume is dauntingly high. "More than 50 machines – primarily customer-specific designs – are manufactured each year in Dottikon," reports Michael Tretter. Tuboly-Astronic works very closely with system partners

in order to manage the associated planning and development work. One of these is Brüttsch Elektronik AG, based in Uhwiesen, Switzerland. The two companies have tested their synergy in several projects already. Beckhoff has also been a supplier of controllers to Tuboly-Astronic for many years. Since Brüttsch Elektronik is one of the solution partners of Beckhoff Switzerland, the partners already collaborate closely.

The order for the folding machine was placed with Tuboly-Astronic at the end of 2007. This was followed by planning talks with Brüttsch Elektronik. Herbert Friedrich, Automation Team Leader at Brüttsch Elektronik, says: "The requirements included, among other things, the design of the data flow models for the pro-

nal system. The inclusion of a PROFIBUS master gateway is required to link to the independent welding controller. Various analog Bus Terminals are used along with the binary I/O Bus Terminals. These are used to connect the servo valves and various measurement circuits, e.g. for pressure measurement, regulator control and position recording. The servo axis positions are recorded by absolute and incremental encoders.

**Precise folds using TwinCAT PLC Hydraulic Positioning**

The system features 12 hydraulic servo axes and 25 Servo Drives from Beckhoff's AX2003 series. The control of the folding machine's servo axes, and in fact all the



A total of 12 hydraulic servo axes produce two x 250 t hydraulic thrust in order to fold the cooling fins.



The Beckhoff C3640 Panel PC is used with the Windows XP Professional operating system and the run-time TwinCAT PLC.



25 electric motor-driven servo axes and 12 hydraulic servo axes are controlled by Beckhoff AX2003 Servo Drive systems.

duction data and real-time communication, the design of a standard axis interface for all servo axes, and the overall process functions of the production plant. The highly sophisticated axis functions with electronic gearings and gantry axes, plus the coupling of the virtual control and gantry axes and the linear operating cylinders required the close cooperation of the hydraulic experts from Beckhoff. Brüttsch Elektronik developed the process control program for the folding machine. "This was thoroughly tested on system simulators and optimized in preliminary tests," says Herbert Friedrich.

**Control components keep lines of communication open**

The modular production plant uses four C3640 Panel PCs from Beckhoff. The system is controlled by TwinCAT PLC automation software, including the TwinCAT Hydraulic library paired with the Microsoft operating system Windows XP Professional.

The peripheral devices are connected with EtherCAT via the Beckhoff Bus Termi-

electrically and hydraulically driven axes, have been programmed using the TwinCAT PLC Hydraulic Positioning library from Beckhoff. This PLC library provides code for PTP movements with which the hydraulic axes can be positioned and controlled. The standard control algorithms are used here, for example, operators can work with time- or path-dependent ramps. The axis parameters can be saved as files and loaded via TwinCAT.

The folding machine processes are graphically displayed on the C3640 with its 15-inch TFT display. The graphical display system has been developed by Tuboly itself based on Delphi (Borland) and TargetVisu. Task communication is carried out by TwinCAT ADS.

Tuboly-Astronic AG [www.tuboly-astronic.ch](http://www.tuboly-astronic.ch)  
 Brüttsch Elektronik AG [www.brel.ch](http://www.brel.ch)  
 Beckhoff Switzerland [www.beckhoff.ch](http://www.beckhoff.ch)