

Modular machine design with PC- and EtherCAT-based control system can adapt easily to any customer requirement.

High-speed, high precision textile folding



Belt drive and folding arm for folding textiles

Fully automatic textile folding, according to packaging designs specified by customers, needs to be very fast and highly accurate. In view of the large number of packaging designs and textile types, this is a complex task. The up and coming Swiss company *espriTex GmbH* builds and manufactures modern, versatile textile folding machines which can easily adapt to suit the very different requirements of their international customers. It is PC-based control technology from Beckhoff that guarantees the precision and speed of the folding machines.

The Swiss company *espriTex GmbH*, which is based in Wiler near Seedorf, sells a wide range of machines for folding textiles. "Our clients are mainly manufacturers of household textiles," founder and CEO of *espriTex*, Samuel Gerber, explains. "These include bed linen, bath linen and table linen, as well as blankets, curtains and other products." Given the large variety of sizes, textile qualities, packaging designs and folding measurements, this is a process which is anything but easy to automate. Samuel Gerber explains: "The folding machines 'reduce' the parts to the format and folding design specified by the customer. The resulting folding corresponds exactly to the presentation design of the packaging in which a product is displayed on the shelf. Depending on the type of machine, up

to 1,500 flat textiles can be folded per hour, with one or two cardboard inserts according to customer's request."

The large number of folding programs and processes means that any packaging design required by a customer can be fulfilled.

"The modular design of the machines and the many available folding programs enable us to create almost any presentation design required," emphasizes Gerber. "We build our machines exactly according to the requirements of our customers and their applications, and ideally customized solutions are the result."

The technical folding process in a machine begins when the material is fed in. This is done either manually or directly by a fully automatic sewing system. The subsequent complex folding process is fully automatic. Gerber illustrates this as follows: "We have to deal with very different materials. Silk and satin for example are very smooth, slippery materials which behave differently compared to a heavy cotton or a blended fabric when folded. The second requirement arises out of the formats to be processed. For example, the widths and lengths for bed linen differ all over the world. The sizes on the highly standardized US market alone range from twin, full, queen, king to California king size. This requires changing the types of folding again and again in order to achieve packaging of the same size." Depending on the field of application, it is possible to select from various folding processes, e.g. reverse, cascade, blow tube, slider, sword, rocker arm, box or template folding. The processes most used are based on mechanical folding sliders (the textiles are stretched to the specified width over templates), sword or blow tube folding (the product is pressed between two rollers by means of a folding sword or blast of air), rocker arm combined with a template (the textiles are laid over a template by a rocker bar) and reverse folding (a combination of reversing conveyor belts and blow-tube and sword folding). "We convey, move and work a great deal with compressed air, pneumatics as well as electronics and electric drives, in other words, with mechatronics," is how Gerber describes the processes.

PC-based control technology from Beckhoff enables exceptionally precise, fast folding.

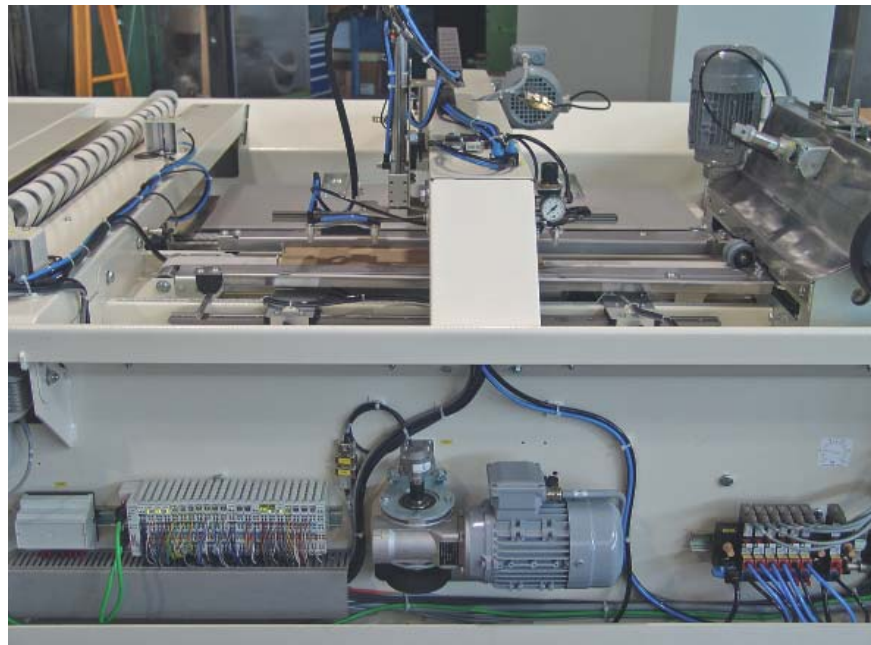
The espiTex machines are extremely accurate. Theoretically, the maximum deviation in the folding is ± 0.5 mm at conveyor speeds of 60 m/min, which, at first glance, seems unnecessarily accurate for folding textiles. However, further deviations are caused by factors which cannot be directly influenced: e.g. environmental effects such as air humidity and temperature fluctuations, varying electrostatic load, a build-up of dust during production, vibrations, as well as current and voltage fluctuations determined by the mains supply or differences in materials from the same production lot. For this reason, the repeatability of the machine is very important.

The control system used is crucial to the precision and speed of the folding processes. espiTex uses a Beckhoff C6350 Industrial PC (IPC) with TwinCAT NC PTP automation software as the central control system. This is installed in the control cabinet and operated via a remote touchscreen. The individual machine modules have decentralized I/Os, connected via the EtherCAT bus system. "There are different reasons why Beckhoff PC control technology is the ideal automation platform for our machines," explains Marcel Stebler who is responsible for software engineering: "The modular control system makes it very easy for us to connect our wide range of system and drive elements, the Beckhoff AX2006 Servo Drive, 17 frequency converters and diverse sensors. In addition, in EtherCAT we have chosen a fast and reliable system bus.

Thanks to the switch to faster PC and EtherCAT technology, we have been able to make our machines 2-3 times more accurate than before."



Samuel Gerber, founder and CEO of espiTex GmbH:
"The machines fold the parts with or without cardboard inserts according to a packaging design specified by the customer, which must correspond exactly to the presentation design of the product as displayed on the shelf."



The individual machine modules communicate with the central control system via the Bus Terminal stations and EtherCAT.



Marcel Stebler (left), who is responsible for software engineering at espriTex and Peter Reinstadler, Area Sales Manager of Beckhoff Switzerland at the operating panel

Integrated safety technology ensures the control system has a compact design

Furthermore, safety I/O terminals are also integrated at the fieldbus nodes. "The Beckhoff TwinSAFE safety system provides another advantage with regards to our concept of a compact control architecture," according to Stebler. "The fact that most impressed us was that although the EtherCAT safety terminals can be easily integrated into the existing terminal strand, they represent an independent safety system in programming terms. Moreover, if necessary, detailed diagnostics can be carried out and made available to the operator at no great cost. This would be almost impossible with a conventional safety system."



Modular espriTex folding machine with a Beckhoff touch screen Control Panel as the operating unit in a customer-specific configuration

3D simulation of the folding process makes programming easier.

espriTex uses a CAD system to build and develop its machines as far as both the mechanics and electronics are concerned. "The 3D design allows us to implement our concepts very quickly," explains Gerber. Regarding the electronic design, the installation and wiring diagrams and the manuals can be made available as PDF files. "We store these documents on the Industrial PC," adds Gerber. "This is convenient for customers, since they no longer have to store thick manuals in order to stay up to date." Likewise, all of the drive data are stored securely on the PC. These data and documents can be used for servicing via the PC which has internet connectivity.

The HMI operating concept of the folding machines developed by espriTex is based on VB6 and is currently being revised with .Net. As Stebler illustrates, the operator masks and all the input masks for parameterizing the folding schemes were programmed by espriTex. "The basic programs for the formulae are stored in a database. Using visualization, these can be adjusted before they are loaded since the characteristics of the textiles must always be taken into account. We use the IEC languages, Structured Text and Function Block Diagram for the PLC programs."

Service and maintenance available all over the world via Remote Desktop

The espriTex folding machines are both stand-alone machines and parts of larger system solutions, and can be coupled to a fully automatic sewing system by real-time Ethernet, for example. With the sewing system the feed is fully automatic. Stand-alone machines are often used as downstream folding machines for hand-sewing stations or to fold and assemble different textiles with various packaging sizes for designs of bed linen sets or similar items if necessary.

espriTex delivers its folding machines all over the world, mainly to the emergent countries where textiles are produced and processed today. "We install the systems directly at the textile manufacturer's premises," says Gerber. "Remote servicing and maintenance, and resident troubleshooting are therefore vitally important to espriTex. PC-based automation has definite advantages for us: if customers have a problem, we do not usually have to visit them since we can simply dial into the IPC. The entire machine control system is then available to us and the excellent diagnostic facilities of Beckhoff control technology nearly always enable us to locate the fault."

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