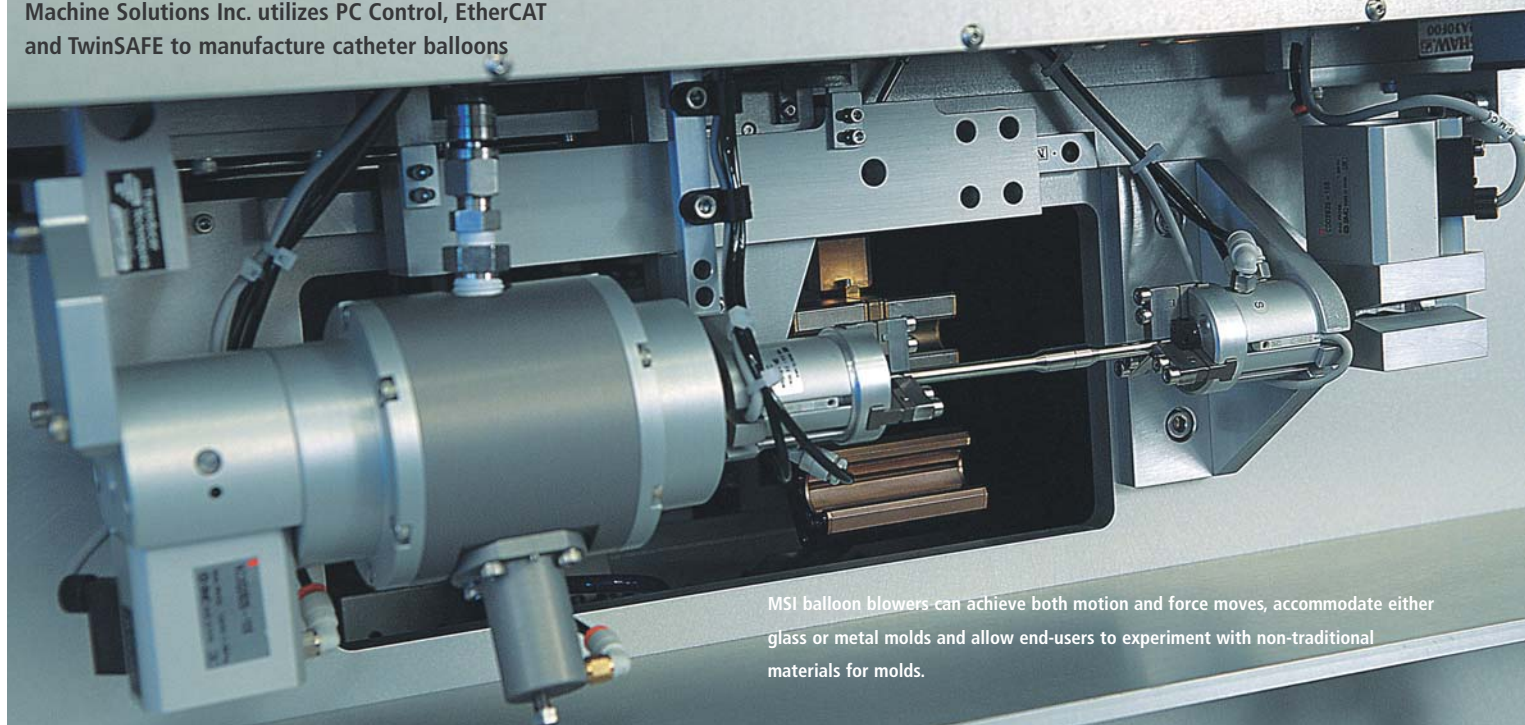


Machine Solutions Inc. utilizes PC Control, EtherCAT and TwinSAFE to manufacture catheter balloons



MSI balloon blowers can achieve both motion and force moves, accommodate either glass or metal molds and allow end-users to experiment with non-traditional materials for molds.

Machine Solutions Inc. (MSI) based in Flagstaff, Arizona, assists medical device firms, large and small, with their machine engineering needs. MSI serves this industry in five primary market segments: stent crimping, balloon pleating and folding, catheter marker band swaging, tube processing and catheter & stent testing equipment. About 50 % of MSI's machines are shipped in the U.S. and the rest to international customers. In 2006, the company sought to create a new machine category in the catheter balloon blowing segment using leading edge automation and controls design.

Safety, flexibility and space usage optimized using innovative automation technology

Catheter balloons can be life-savers for people with vasoconstriction. During medical procedures, a physician guides the catheter balloon through the blood vessel to the vasoconstriction where the balloon attached to catheter is expanded with 8–20 bar. This extends the vessel so that the blood can flow freely again. Different balloon sizes and shapes are used, depending on the type and location of the constriction.

Expandable balloons are produced using a hot air technique: Balloon preforms are formed into balloons in glass or metal molds under defined pressure and heat. After cooling they are checked, attached to the catheter, and folded. Traditional balloon blowing/forming machines produce balloons of a particular size using a blow mold adapted to the size of the balloon. The limitation of a particular mold type can make the manufacturing process very inefficient for manufacturers of various balloon types with small batch sizes.

Advanced systems for more flexible production

"A major goal for the project was to ensure that this production equipment was the most advanced and flexible in the market segment," Brent Bohmont, Software and Electrical Engineer at MSI, said. "Being a new product offering for us, the machine had to meet the industry standard and offer significant features and benefits improvement over existing technologies to clearly differentiate."

"Flexibility is key," said Paul Reiss, Mechanical Engineer at MSI, "especially because regulatory body approvals for invasive medical devices are so stringent. When our customers incur such large costs to build and get approval for their balloon molds, machine flexibility to a variety of molds is critical."

"When we change the blow mold we should be able to adapt the control system via software without having to add separate motion controller hardware," software expert Bohmont said. "This could mean adding motion axes or changing heating circuits simply through software modification." A prerequisite is high-performance and flexible automation and control technology.

PC-based controls and modular I/Os for flexibility and safety

MSI chose to use PC-based controls for the new MSI balloon blowing/forming equipment with powerful processors to handle all control aspects with a single device, ridding themselves of separate motion controller hardware. MSI chose advanced control technology from Beckhoff: specifically, the C6920 Control Cabinet IPC with the TwinCAT PTP software, EtherCAT as the fieldbus system, EtherCAT Terminals and Bus Terminals for data interfacing, and TwinSAFE for the safety functions. The safety terminals are integrated into the EtherCAT system via the BK1120 EtherCAT Bus Coupler.

MSI uses high-speed EtherCAT I/O terminals to handle the force-feedback on the



Catheter balloons from all manufacturers are almost identical in terms of quality. This requires the machine to stand out in other ways.

tube stretching functions of their machine. "EtherCAT proved to be an ideal fit for our needs," Bohmont said. "Typically, analog I/O used in an application like this has a long conversion time. Fast analog I/O via EtherCAT eliminated this – we're simply limited by the signal conditioner. Thanks to the openness of EtherCAT it is possible to integrate not only Beckhoff motors but also motors and system parts from other manufacturers. All connections to our devices and back to plant networks are via simple, standard Ethernet cables rather than bundles of messy wires."

TwinSAFE: Simple safety integration

For the safety functions MSI chose TwinSAFE technology from Beckhoff. "TwinSAFE is a highly streamlined approach to machine safety when compared with traditional safety PLCs and their safety-specific networks, since the TwinSAFE safety protocol utilizes the existing EtherCAT network as a transport medium. This also reduces the cabling effort," Bohmont said.

MSI uses TwinSAFE to create emergency stop circuits and light curtain systems. TwinSAFE is also used to monitor parameters such as mold pressure, heater temperature and pinch points where an operator could be hurt. "Additional functions can be easily added," Bohmont said. "Another helpful feature in TwinSAFE is that we can more easily get status reporting on all the inputs and outputs to see exactly how and when an E-stop is pressed or a light curtain is activated."

Clean bill of health for powerful, safe system

With PC-based controls, one new MSI balloon blowing/forming machine is able to accommodate either glass or metal molds of different sizes. "Many machines



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MSI selected high-speed, deterministic EtherCAT I/O paired with Bus Terminal I/O and TwinSAFE I/O to network their machines via advanced Industrial Ethernet and flexibly create safe functions such as emergency stop (E-stop) circuits and light curtains in a highly streamlined system.



The Beckhoff C6920 Industrial PCs leaves ample cabinet room for other devices.

on the market can only be equipped with one or the other. End-users are also free to experiment with non-traditional materials for molds," Bohmont said.

"Our balloon blowing/forming machine can achieve both motion and force moves. Depending on the balloon size or shape and the material used for the blow mold it may be appropriate to control the process based on motion or force. With TwinCAT we are able to offer customers both options with the same machine," Reiss added.

"Beckhoff PC-based controls are significantly more powerful than any of the controls tools we used in the past," Bohmont said. "The ability to read our load cells and force feedback in real time – at 500 Hz – and use it as input information for the controller makes a huge difference." The flexibility of mounting the devices also proved to be a time saver when designing the machines. "With the new IPC controller, distributed I/O and easy connections via Ethernet cables, we can install our devices in the most space-saving methods possible," Bohmont said.

"We're confident that a PC-based controls approach with Beckhoff gives us all the flexibility and high-end performance we'll need to exceed our competition. So with that position, we intend that all first generation MSI balloon blowing/forming machines will be equipped with Beckhoff PC-based controls, EtherCAT and TwinSAFE," Bohmont concluded.

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