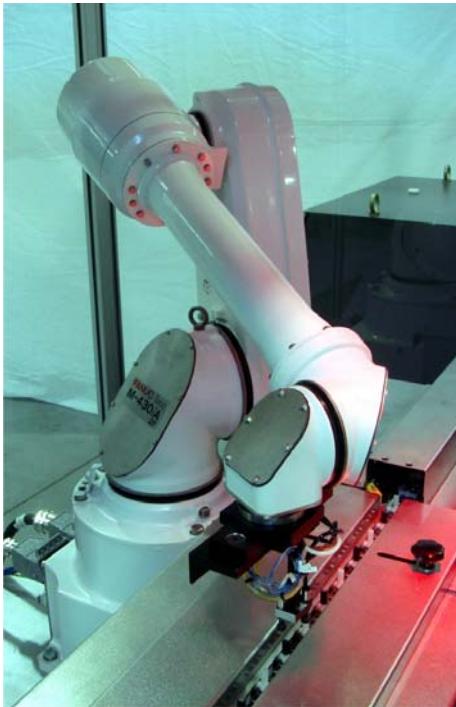


Robotic Machine Infeeds Keep Pace with High Speed Packaging Equipment

By ESS Technologies, Inc. Blacksburg, VA

Introduction: Today's High Speed Packaging Equipment



FANUC M-430iA Robot Loading Diagnostic Test Kits into the Continuous Motion Conveyor Infeed on a Pouchier Machine

Ongoing demands by manufacturers for faster production speeds, greater flexibility, and faster return on investment (ROI) continue to shape the designs of today's high speed packaging machines. Innovations such as servos, advanced controls, and multi-axis robots have allowed machinery designers to create systems that can handle the higher speeds required. However, these machines can operate only as fast as their product infeeds, especially when packaging multiple products per package.

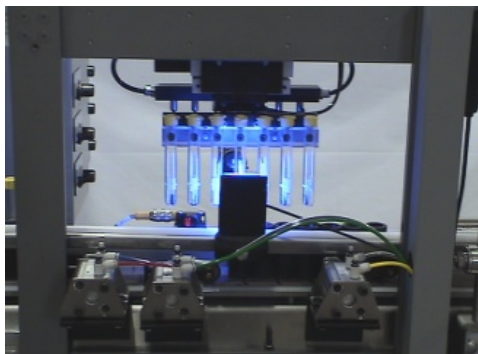
Infeed speeds can affect productivity in both primary and secondary packaging scenarios. Infeeds that fail to keep pace with the equipment's production capabilities create costly unscheduled downtime while the machine waits for product, and speed is not the only concern. Improper infeeding will cause a high speed packaging machine to jam, which stops the system and potentially causes damage to the product or the machine. This is especially true of thermoformers (that form, fill and seal product blisters) and blister packaging machines (that pull pre-formed blisters from a magazine before filling and sealing).

Today, as much as 80% of installed thermoformers and blister packaging machines are manually loaded. To give an example of the expense that manual loading incurs, during a routine process evaluation, ESS Technologies, Inc., a designer, manufacturer and integrator of high speed packaging lines, reviewed a process for a prospective customer that required three personnel, on three shifts to orient and manually load product into a blister packaging machine at a rate of 10-14 cycles per minute. The total cost of personnel salary, machine downtime due to misfed product, and employee absenteeism caused by repetitive-motion injuries placed the estimated annual cost of operation at around \$225, 000 per machine.

Automated infeed systems offer a solution for maintaining fast and accurate product infeeding while reducing overhead expenses, such as those listed above. First-generation automated equipment used fixed or "hard" automation technology, but today, the availability of affordable, flexible robotic automation systems allows packaging line designers to create high speed systems for machine infeeds. The advantages become clear as one compares hard and robotic automation.

Hard Automation vs. Robotics

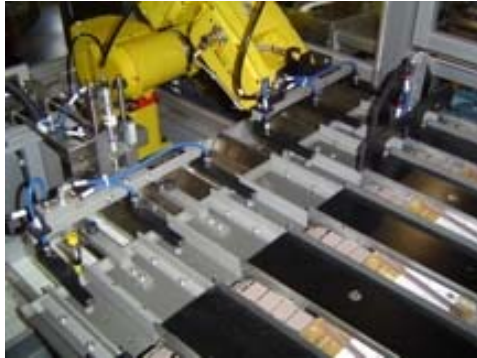
Hard automation refers to a sequence of processes and movements that are determined by the equipment, which has been designed to perform a single function, usually for a single product. This specialized design can come with a high cost, and the system is limited to handling only the product for which it was designed. The higher equipment cost associated with hard automation make this solution viable for products made in large volume or products that have a long shelf life and little chance of being



Hard Automation Used to Handle Test Kits During Inspection

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Hard Automation (left) and Robotic Automation Systems (right) Collating and Loading Cosmetic Blisters Into a Cartoner Infeed



Custom Robot End-of-Arm-Tooling for a Loading D-Cell Batteries Into Blisters on a Blister Packaging Machine

redesigned. Hard automated infeeds can be designed to meet high speed machine input requirements, but changeover to handle different products presents significant downtime for the packaging line. Annual and routine maintenance associated with replacing cylinders, bearing, bushings, and other wear parts can also affect overall cost. In addition, failure to install the correct parts or align them properly results in additional downtime, scrap and re-work.

Flexible automation typically refers to robotic systems. These systems produce batches of products, which can be output in quantities ranging from less than 100 pieces to several thousand units per production run. Each new batch, depending on product design, may require a simple change of robotic end-of-arm tooling and programming — programming is usually performed in seconds via a human-machine interface (HMI). Changeover times are typically under 5 minutes for a robotic system; today's robotic end effectors are designed with quick release, no-tool connections, requiring only a few minutes to change the EOAT.

To meet high speed input requirements and provide greater flexibility for product handling, robotic machine infeeds offer a solution to keep packaging lines running at optimum efficiency while reducing labor costs, scrap and re-work. For example, in the blister loading application described earlier, ESS Technologies, Inc., determined that one robotic loading system, complete with a FANUC robot, custom end-of-arm tooling, a product bowl feeder, a secondary orientation device and programming, would offer an ROI of under one year, allowing valuable human resources to be redeployed in other parts of the manufacturing process. In addition, robotic loading of the blister packaging machine allowed the machine to reach a production speed of 14-18 cycles per minute compared to 10-14 cycles per minute achieved by the manual loading process.

High-speed multi-axis robots can be easily reconfigured for new products simply by replacing the end effector and adding another program. Changeover occurs in a matter of minutes, and sensors alert the operator via the HMI if the correct end effector is in place. Today's robots are easy to program, and often, multiple product runs can be configured with one control program, creating a high speed machine infeed system that handles multiple SKUs with little additional overhead expense or downtime.

Real World Solution: Robotic Infeeds in a drug delivery device assembly packaging line.

The following application illustrates the advantages of robotic infeeds for several types of packaging equipment. A pharmaceutical manufacturer needed an automated high speed system for assembling and packaging a drug delivery device. The customer required a full turnkey solution with the integration of feeders, hoppers, conveyors, material handling systems, and the inspection of the product at every stage of the assembly and

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Robotic Loading of a Drug Delivery Device Into Blisters in a Thermoformer Machine

packaging process. ESS engineers, working with the customer, designed an integrated system that assembles 320 parts per minute and then packages the drug delivery device. The system integrated sixteen pieces of feeding and packaging equipment including seven TaskMate™ robotic systems, an automatic horizontal cartoner, a horizontal case packer, and an ESS robotic mini cell palletizer. ESS Technologies' TaskMate™ robotic systems incorporate FANUC robots with ESS-designed end-of-arm tooling to handle the assembly, collating and loading/unloading of the drug delivery devices.

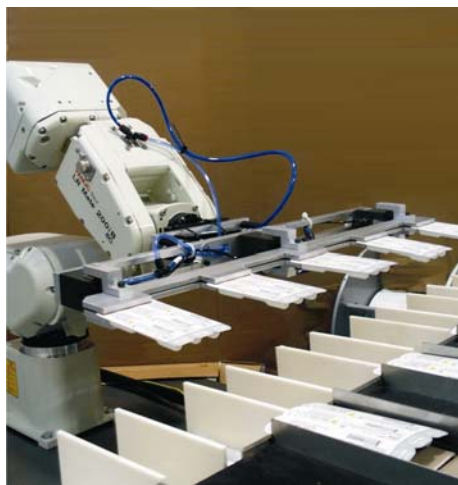
Robotics played a key role in the design of the system, especially in maintaining the required infeed speeds to keep a wrap around labeler, a thermoformer machine and an automatic cartoner performing at optimum speeds. Dosed tablets and handles, components for the drug delivery device, enter the dual-lane assembly process through separate feeders. Two FANUC LR Mate 200iB robots, with ESS-designed end-of-arm-tooling, insert the handles into the tablets. Two more robots collate the devices and transfer them to a thermoformer infeed conveyor. A fifth robot automatically loads 30 completed assemblies per pick to thermoformed blisters.

At the thermoformer discharge, a sixth FANUC LR Mate 200iB removes blister packs, inspects them and rejects incorrectly filled or sealed blisters. Correct blister packs are placed on a five-lane conveyor to a seventh TaskMate™ robotic system that collates and nests the blisters into groups of 10 packs per carton (three devices per blister pack). Collated blister packs are inserted into cartons using an automatic horizontal cartoner. During cartoning, vision systems verify the bar code on the blister, inserts and carton flap. The filled carton crosses a high speed checkweigher to verify content before entering the horizontal case packer. The cartons are loaded into shipper cases, which are conveyed to the ESS Mini Pallet Cell for final palletizing.

By incorporating robotic infeed cells, which also served as discharge systems and inspect/reject systems, throughout the assembly and packaging process, ESS provided a high speed, high performance, highly flexible packaging line that met the production requirements for the assembly and packaging of the drug delivery device. The fully automated system doubled the production rate of the drug delivery devices. In addition, the number of required personnel was reduced from fifteen to five people, allowing the customer to reassign several personnel to other processes.

Conclusion: Tomorrow's high speed packaging equipment.

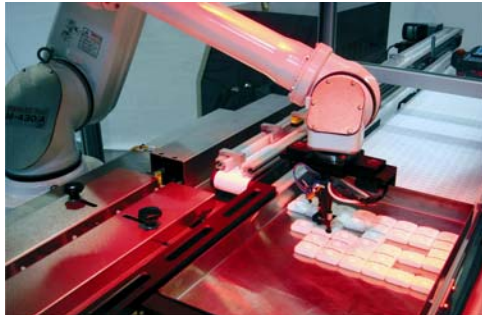
It doesn't take a crystal ball to know that the forces that have shaped today's packaging equipment will continue to do so for the foreseeable future. As the number of SKUs proliferates, packagers will look to machinery manufacturers to develop machinery that is adaptable and offers efficient, tool-free changeovers. Machines will need to handle a



FANUC LR Mate 200i Collating Blister Packs at a Cartoner Infeed

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FANUC Model M-430iA Robot Uses Vision and Line Tracking to Locate Test Kits

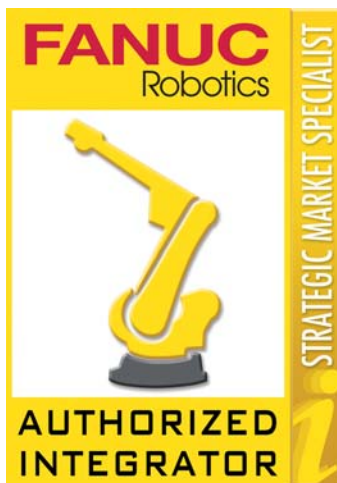
range of applications and product configurations as flexibility becomes as vital as speed. Tomorrow's machines will handle new, lighter, more flexible packaging materials, determined by the consumer-driven push for smaller eco-friendly packaging sizes and lower weights that reduce the waste and cost associated with the manufacture and transport of products.

While the focus will include flexibility, reliability, and high machine speed, pricing pressures will continue to influence packagers and machinery suppliers to find ways to retrofit existing lines to meet current requirements. By replacing manual or hard automation processes with flexible automation, manufacturers in all industries can increase line performance while addressing the emerging requirements for traceability, data management, and anti-counterfeiting strategies. Flexible automation systems and the programming and controls that are used to operate them are uniquely suited to meeting these emerging requirements. Data generated during the production run is automatically stored in the PLC of the robotic cell. Networking options allow that data to be accessed remotely as part of a system to monitor of the complete supply chain.

Vision systems and line tracking for inspection, part selection, parts data, etc., add further flexibility to any robotic system, and vision also plays a role in meeting requirements for supply chain traceability and product quality. The FANUC Robotics System R-30iA controller comes standard with iRVision hardware. By loading the vision software option and connecting a 2-D camera or 3DL sensor to the controller, a vision process is added to the robotic application. Setup is done using any PC running Microsoft® Internet Explorer connected to the robot, and for production, iRVision includes run mode and data displays that can be simultaneously viewed on any network PC and the FANUC iPendant™. Production data can be logged to the internal memory card or system memory.

Robotics offers a complete solution for the automation of primary and secondary packaging lines. As flexibility increases and the cost to install robotic systems decreases, more and more manufacturers can improve production speeds and reduce scrap and rework by incorporating robotic cells to handle machine loading and unloading. The dexterity and speed of today's multi-axis robots has never been greater, making robotic loading a cost-effective means of keeping up with today's high speed packaging equipment.

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