Automation an Efficient Means to 100-Percent Inspection

BY TODD WENZEL

Progressive stampers continue pursuing advanced technologies to increase their competitiveness. Implementing lean-manufacturing practices helps reduce lot sizes and lead times, reduce direct labor and increase part quality. However, added operations such as in-die component insertion and assembly can increase the potential for die crashes. Resulting production interruptions can have major consequences. And, the shorter the lead time the greater the impact of a crash and resulting work stoppage. To combat these conditions, more and more stampers are implementing die-protection programs.

Ultra Tool & Manufacturing, Menomonee Falls, WI, which began its die-protection program nearly 20 years ago to prevent crashes, has integrated advanced die-protection technology with automation for increased production and greater consistency in part quality.

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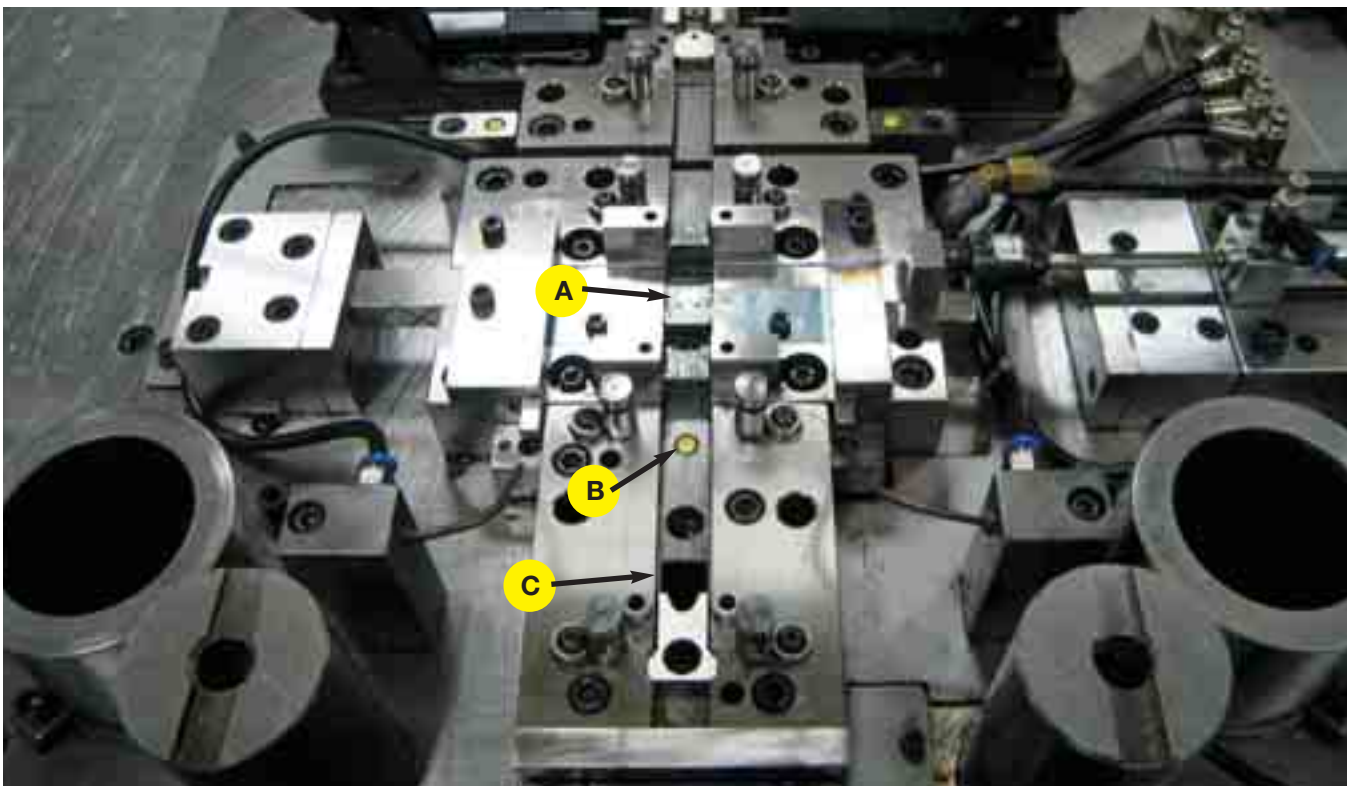
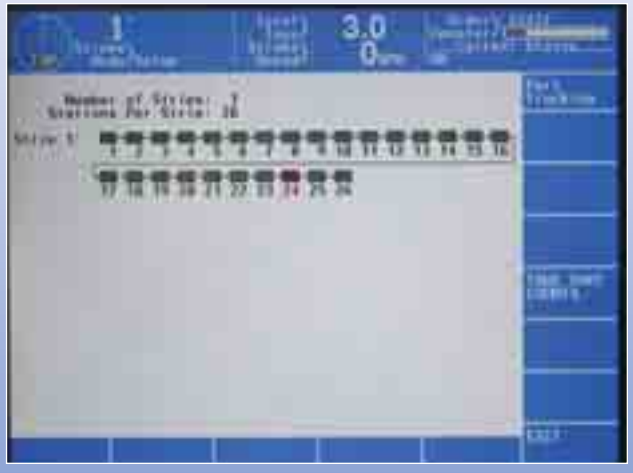


The final stages of Ultra Tool's 27-station progressive die that performs in-die assembly—(A) an inserted part is staked to the stamped strip; (B) a digital proximity sensor verifies presence or absence of the staked component; then (C) the part is ejected down through the die and sorted by a mechanism that kicks bad parts out into a scrap bin.

The control's shift register displays station 23 in red to indicate a bad part due to a missing insert.



The screen indicates the bad part moving through the tool—here it's shown at station 24.

For Ultra Tool, the process control marks bad parts and tracks them as they travel through the progressive die to the ejection station. With a bad part in the ejection station, the control then activates the ejection mechanism and diverts the part to a scrap bin. To accomplish this, the control's internal shift register allows the control's computer to remember where everything is in a sequential operation and performs logic based on that memory.

Now the bad part resides in the ejection station of tool 25. During this stroke, the PLS activates to move the part diverter into place so that the part ejects into a scrap bin.

Ultra Tool established a sensor lab in 2002 for sophisticated sensor applications, with the ability to monitor and control part quality. In addition to supporting the company's zero-defects objective, the enhanced capability paved the way for capturing new business.

Part-Presence Sensing

Able to tackle projects from prototype to die build and production, Ultra Tool also offers value-added operations such as assembly and welding, and can build dies for both its customers and its own requirements. The ISO 9001:2000-certified company also recently received the 2006 Process Control Award through PMA's Awards of Excellence program.

"As new advances in die-protection technology have become available, we look to become skilled in their use and application," says Terry Hansen, Ultra Tool president and owner. "As a result, for one recent job—a unique in-die assembly project for a defense customer—we were able to implement analog sensors to measure critical part features and variations, features rarely built into a progressive die."

The job required in-die assembly of a small munitions mechanical component. While the die runs, Ultra Tool produces the metal stamping, introduces the machined component, assembles the two parts and produces a completed assembly. The component, of cold-rolled steel, runs on a 45-ton mechanical press at 120 strokes/min. The high-volume job produces some 6 million parts annually and must meet Ultra Tool's zero-defects objective.

"When we were awarded the job, we needed to be able to inspect the completed assembly to ensure the presence of the machined component while the assembly remained in the die," says Hansen. "To accomplish this level of inspection, we needed the right control."

Ultra Tool had determined the type of sensors required to inspect the assembly and ensure the presence of the machined component. Engineers also designed a special ejection mechanism. "We were considering writing our own control software, but our system integrator, TCR Integrated Stamping Systems, was able to evaluate our requirements and recommend a ready-made control solution to meet our needs," Hansen says.

Through analysis of the die prints and the process, TCR determined that the control needed to perform three primary functions:

- Monitor the sensors;
- Use the information from the sensors to eject bad parts without stopping the press; and
- Stop the press if too many bad parts were being produced.

In this case, the sensor that monitors insertion of the machined component would have a simple digital output. At the point of the stroke where the strip is held steady by the stripper, the control checks the status of the sensor and looks for either an on or off output. An on signal indicates that the machined component is properly inserted; an off signal indicates a missing component.

Wireless Connectivity Aids In-Die Sensing

Wiring problems can plague reliable operation of in-die sensing installations. Connecting and reconnecting sensors or broken or damaged wiring, due to repeated die positioning and removal of large, heavy dies, can be a significant time waster.

To allow the transfer of signals and power across an air gap in a two-part die, without the need for physical contact between the dies or any hardwiring, Ultra Tool & Manufacturing found a solution: Power Remote systems from Balluff Inc., Florence, KY. Ultra Tool has used the Power Remote system for nearly two years, in a two-part die for stamping motorcycle footboards.

The system comprises three components—the sensors monitoring the stamping process; an output sensor that sends information and receives power; and a transmitter that sends the power and transmits the information to the controller. Information transfers across a ⅛-in. air gap between the die sections, allowing dies to be moved into position and wirelessly connected to the press or to themselves and the press.

Adding Feature Measurement

While not required for this specific project, Ultra Tool decided to integrate a control to monitor analog sensors as well. Analog sensors, which can measure features, give manufacturers more options when building tooling designed to achieve defect-free manufacturing. Capable of monitoring any digital or analog sensor commercially available today, the control recommended by TCR offers the ability to simultaneously monitor more than 80 sensors, providing the flexibility to meet the needs of future projects.

To accomplish on-the-fly ejection of bad parts, the control needed three additional capabilities. First, the die-protection system has to monitor the status of the sensor in the die and, instead of stopping the press when detecting a fault, mark the part as "bad." Second, the programmable limit switch (PLS) that would control the bad-part ejection mechanism needed to be conditioned to activate only when a bad part entered the ejection station. Third, the control would need to have a shift register with sufficient memory to keep track of a one-part-out 27-station progressive die.

Typically, when the die is programmed for the first time, the PLS has a setting that indicates which strip and which station it is to be associated with. The die-protection sensors also are assigned a strip and a station. The control then tracks the sequential operations of the tool and good- and bad-part locations.

Keeping track of this information is a function of the shift register, and the control solution offered a massive shift register capable of tracking as many as 32 stations of a tool, with as many as 12 parts out per stroke. Powerful processors allow the control to perform these functions at speeds to 2000 strokes/min.

Setting Control Limits

The final requirement dictated the need for control limits that Ultra Tool could set, to dictate the number of bad parts it would allow for a given job before stopping the production run. The automated control offers two such limits. One limit monitors the number of bad parts in the last series of press strokes; the other can be set for the maximum number of consecutive bad parts allowed.

"Installing the automated control for the completed assembly job allows us to track the part through the die and receive data we can act on," says Dale Kuphall, sensor applications specialist for Ultra Tool. "If the sensor tells us the part is bad, we can divert it to a scrap bin without stopping the press. And if the press produces consecutive bad parts, we can stop the process, identify and fix the problem, then quickly restart production. As a result, we can guarantee our customers zero defects."

The technology also has allowed Ultra Tool to eliminate secondary operations and reduce part costs for its customer. Traditionally, this type of production job would require a manual insertion process. And, operators would have to perform 100-percent visual inspection of each part to avoid passing bad parts on to the customer.

"With this off-the-shelf solution, we not only gained advantages that have helped us be more competitive, it has saved us the considerable time of creating and building our own solution from scratch," Kuphall adds. **MF**