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International Frequency Sensor Association (IFSA).
Putting Sensors to Work: The Untapped Advantage for Tool and Die Stamping

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Short Message

Adding sensors to their machines can help North American tool and die stampers increase product quality and gain a competitive edge. The most dramatic economic reality impacting the tool and die stamping industry today is the availability of cheap labor in China and India. By using sensors to enhance the dies, North American manufacturers can lower their costs and negate some of the effects of lower labor rates in other world markets where manual sorting for defects is more common. So it’s somewhat surprising that 85% of U.S. die stampers have no formal program for integrating sensors of any type into their dies even though leading manufacturers of press controls, such as Honeywell Wintriss, are continuing to advance the capability of their systems to use sensor inputs. This article looks at how sensors—photoelectric sensors in particular—are helping them compete.

First, let’s look at the evolution of sensor use in tool and die applications. In the beginning, the first sensor used in the stamping industry was human; the operator acted as die protector. However, no matter how well trained, observant, or dependable the operator, errors occurred.

The next progression was using a whisker, a simple wire that sent a ground signal to the press when it made contact with an ejected part. If an ejected part didn’t brush up against the whisker, no grounding signal was sent to the press control and the press would stop. In the 1970s, photoelectric sensors began to incorporate LEDs, resulting in greater reliability and accuracy, smaller size, and increased resistance to shock and vibration. These features made them more applicable for die stamping industry needs since stamping presses are unfriendly places for sensors. Extreme vibration, dirt, flying metal chips, and machine coolant are everywhere, and many stamping presses are in environments that aren’t air conditioned; in the summer, ambient temperatures can top 90°F with equally high levels of humidity. The introduction of fiber-optic cables to transmit light from the sensor to the tip of the cable also...
expanded the reach of photoelectrics. The electronics could be mounted off the die for vibration isolation. The photoelectric amplifier was (and is) generally too large to mount in the die. However, the small diameter of the fiber-optic cable allows you to place it in the die in a way that lets it sense very small targets while also achieving the higher excess gains needed to offset coolant interference.

At the same time as manufacturers of photoelectric sensors are developing smaller, more powerful, and more rugged sensors, die stampers are being pushed to provide lower part cost and higher quality levels to their customers. They need higher speeds, less downtime, and consistent quality, which means they need to know what’s going on inside the die during the stamping process. It’s too costly to manually sort out good parts from imperfect ones after the batch is completed. Using verifying/inspection sensors in the dies means part quality is verified during manufacturing, allowing stampers to attain the high quality level demanded by their end users. To give you an idea of what’s involved in die stamping, consider that a press rated at 200 tons produces up to 200 tons of downward force on the metal strip; any sensor caught in the way will be crushed. Most new presses sold are in the 200–400 ton range. Let’s examine the qualities that make photoelectric sensors particularly well suited to these applications.

- Greater Sensing Ranges

This makes it easier to mount photoelectrics in locations where they’re protected from the moving parts of the die, the metal strip being stamped, and the scrap. For example, Contrinex manufactures a line of 5 mm dia. proximity switches with a 1.5 mm sensing range. Contrinex also manufactures a line of self-contained 5 mm dia. convergent-beam photoelectric sensors with sensing ranges of both 10 and 20 mm. These extended ranges enable greater flexibility in the placement of these sensors.

- Larger Sensing Areas

Banner Engineering produces a pair of non-safety photoelectric curtains that can be placed several inches apart; these have been used for years to verify part ejection. Whereas the whisker needed the part to brush past it, in most cases these curtains can detect parts passing randomly anywhere through their sensing window. Light curtains create a large sensing area, giving them an advantage over whiskers in detecting part ejection.

- The Ability to Detect Small Profiles and Parts

Photoelectrics can sense much smaller targets than other types of sensors. For example, the range of a given proximity switch must be derated (decreased) when the target is smaller than the face diameter of the switch. Several vendors, including Contrinex and Banner, market a photoelectric laser sensor with tiny spot beam diameters that can sense targets smaller than 0.010 in. Fiber optics can be used as well—these help the die maker sense parts of the strip that are otherwise unreachable.

- Analog Outputs

Although not unique to photoelectric sensors, analog outputs let you integrate the sensor into your system. The data the analog outputs supply let you achieve 100% inspection in the die (depending on your setup).

What improvements in photoelectrics would I like to see? More durable construction, smaller size, higher power, and better control over switch points. These characteristics will expand the base of applications for photoelectric sensors and ensure their ability to survive. Dies are simple forms made from tool steel. A strip of metal is pressed against the form in an attempt to make the strip take on the
desired shape. The metal is pressed against the die form on every stroke of the press and can be used to produce anything from battery terminals in a flashlight to automobile fenders.

Until now, tool and die makers have had little interest in electronics or sensors. Their world has been mechanical. Until now. Ideally, a company should have a dedicated sensor specialist, someone who understands both die stamping and sensing technology. This person would weigh the relative strengths of various sensing technologies to find the best fit for the application and have experience in the tool room, understanding press controls and dies. This specialist would select the sensor and integrate it into the die and press control in collaboration with the die designer. It’s a tricky balancing act. Without sacrificing the die’s operation, they want to position the sensor to achieve accurate, repeatable readings while also protecting it during press operation. The completed base die incorporates both photoelectric sensors and proximity switches. Die designers’ training must now include sensor integration: the need to protect more and more sensor cables within the dies. The sensor has to be integrated into the die in such a way that both the sensor and its cable are carefully protected during die change-out, die storage, and die production. This type of protection is custom made by the sensor engineer and tool designer and allows the sensor to perform as required in a challenging and hazardous environment. In some markets, stamping houses have formed associations to share ideas on how to integrate sensors into their dies. This will be an area that’s cautiously explored by the industry, but there’s the potential for significant innovations within these markets.

North American tool and die leaders can hold their own against market factors such as cheap labor by automating their processes. The three main steps include educating the sensor specialist; having the specialist and toolmaker partner to integrate the sensor into the die and press control; and making sure the press operator trusts the sensor, rather than constantly second-guessing it. Those who follow these steps will be able to produce at higher volumes and achieve consistent runs approaching zero ppm as they move into this advanced electromechanical culture.

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Aims and Scope

Sensors & Transducers Journal (ISSN 1726-5479) provides an advanced forum for the science and technology of physical, chemical sensors and biosensors. It publishes state-of-the-art reviews, regular research and application specific papers, short notes, letters to Editor and sensors related books reviews as well as academic, practical and commercial information of interest to its readership. Because it is an open access, peer review international journal, papers rapidly published in Sensors & Transducers Journal will receive a very high publicity. The journal is published monthly as twelve issues per annual by International Frequency Association (IFSA). In additional, some special sponsored and conference issues published annually.

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- Sensor instrumentation;
- Virtual instruments;
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Smart Sensors and MEMS

Edited by
Sergey Y. Yurish and Maria Teresa S.R. Gomes

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