



WHITE PAPER

TOP 3 APPLICATIONS FOR PACKAGING MACHINE SENSORS

Survey results show applications demonstrating how faster, more capable, and highly adaptable packaging machines need sensors to improve performance and reliability—and suppliers are responding

Introduction

Packaging machinery builders are adapting to the times, and to the demands of their customers. As food, beverage, consumer products and pharmaceutical companies develop new, glossy, colorful and oddly-shaped packages — packaging machinery companies are building machines to accommodate their needs. New packaging machines are faster, more accurate, more automated, and more adaptable to new and changing packaging – in part – thanks to advancements in sensor technology.

For every bottle that needs to be filled, for every carton that needs to be folded, and for every bag or box that needs to be sealed, you'll find a sensor at work. So which types of packaging applications rely on sensors the most? Minneapolis-based SICK wanted to find out.

The Survey Says...

Based on a recent online survey conducted by the trade journal Packaging World of more than 40,000 readers we asked: What are the most common applications for sensors in your packaging machinery? The results may surprise you.

The food and beverage industry accounted for 28% of the respondents, followed by healthcare (10.8%) and consumer products (9.3%), with other industries making up the remainder.

In this article, we'll discuss the top three applications, the types of sensors being used, and technology developments and improvements in those sensors.

Application 1: Flap Detection

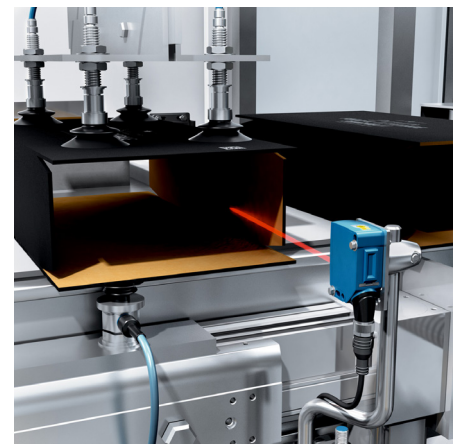
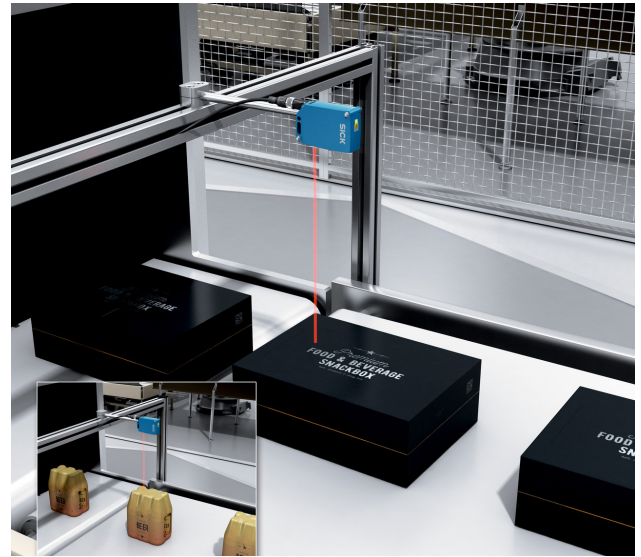
The third most common answer from the survey was flap detection (29%). When cases come down the line to a case sealer machine, the two or four top flaps must be down so that the machine can seal the case without a flap getting in the way. After filling the case, the machine must fold the flaps closed for sealing. This is a repeatable application well suited to automation, so it's not surprising to see that the survey said this was the number three application for sensors.

A common problem during cartoning is that some types of photoelectric sensors do not reliably detect when a flap is partially up or down. When the angle of the flap is not in the correct spot, the sensor's beam does not always detect properly, causing a misread, and ultimately a line jam.

Photoelectric sensors with background suppression can alleviate this issue. However, not all background suppression sensors are created equal. Some background suppression sensors, like those offered by Minneapolis-based SICK, use Time of Flight (ToF) laser technology that takes background suppression to a new level. ToF technology measures the time it takes for the laser to leave the emitter, bounce off the target, and return to the receiver. ToF is much less susceptible to issues like target color and luster, as well as stray reflections and ambient light. ToF is also highly resistant to false trips due to extreme angles of the target making it much more robust than “standard” background suppressive sensors that use triangulation to determine distance from the target. In addition, using a laser as opposed to red or infrared LED provides a much longer detecting range as well as ease of alignment on the target because of its easily seen laser dot.

In a flap detection application, the sensor adjusts for the calculated distance to the target, and can determine if the flap angle will cause a problem with case sealing operations. If so, it triggers an output to stop the line so an operator can correct the situation.

Packaging machine builders and their customers can also use information from these sensors to fine tune case erecting, packing and sealing machines, reducing or eliminating problems in this area.



Application 2: Position Detection

Position sensors on a packaging machine include limit switches, proximity switches, linear encoders, magnetic cylinder sensors and photoelectric sensors—all of which signal the presence or position of various machine components. According to the survey findings, position detection was the second most common application at 39 percent. These sensors detect the position of diverting arms, pushers, and pneumatic cylinders in a cartoning machine, splicing knives, grippers, cutting wheels, flags on chain guards and many other components. In almost all cases, the sensors are detecting a machine's metal components.

According to the survey, the top three position sensor applications are:

- Detecting the end stop position of a mechanical part, such as a deflector
- Monitoring the position of a moving machine part, such as a cassette or cylinder
- Detecting the position of a label applicator

One of the major trends in position sensors is a quest for reduced maintenance, longer life and easy replacement. This has led to a move away from mechanical devices that can wear or are adversely affected by vibration or stress, such as limit switches and Reed switches. As with photoelectric sensors, advancements in sensing technology are allowing modern sensors to meet these goals.

Two types of sensors are ideal for solving this application – magnetic cylinder sensors and inductive sensors – and both have seen improvements in technology that enhance packaging machine performance.

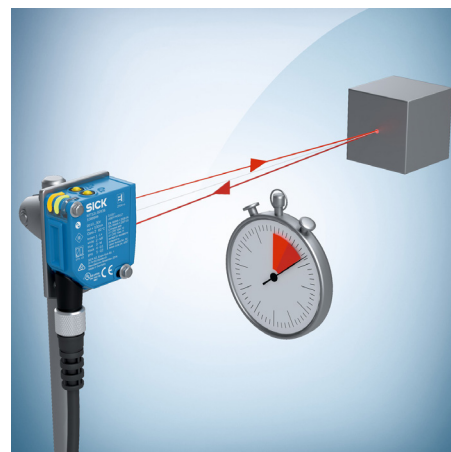
Magnetic cylinder sensors detect the position of pistons in pneumatic cylinders. They are used in applications such as detecting the end position of a pneumatic cylinder in a cartoning machine, and controlling the splicing knife and heat sealer on a form fill and seal machine. The line of magnetic cylinder sensors from SICK, for example, uses proprietary technology with digital functionality that eliminates the need for moving parts in the sensor. This non-contact solution, unlike traditional Reed switches, has a longer service life since there is no wear and tear, and offers higher reliability since it is more resistant to shock and vibration.

Replacing a sensor in a complex packaging machine can create problems, especially if major components have to be disassembled just to reach the sensor. Replacing a cylinder sensor, for example, may require complete disassembly of a label applicator's stamping plate. Some sensors, therefore, are being made slimmer, more compact and designed to mount at the top of a cylinder so they can simply slide into a C-slot or T-slot.

Inductive sensors are used in almost every area of factory automation, including packaging. They are an ideal non-contact solution for detecting metal objects, such as detecting if the correct number of cans are in a sealed box.

Standard inductive sensors have no moving parts, but must be mounted precisely. Most inductive sensors on the market have a $\pm 10\%$ detection tolerance, which means mounting is critical: too far away by a few mm, and it can fail to detect its target; too close and it can be hit and damaged. Advancements in inductive sensors have cleared the way for more flexibility in mounting. SICK inductive sensors have a built-in advanced technologies to lower the tolerance to only $\pm 1\%$, meaning that packaging machine builders have much more leeway when mounting the sensor. Many of these inductive sensors also have the ability to provide visual feedback for mounting purposes through an indicator LED that informs the installer when the sensor is right on the edge of its sensing range. This helps with ensuring the sensor can robustly detect the target from the outset, alleviating downtime in the future.

Sensors with improved tolerances and mounting methods are helping packaging machine builders and their customers improve position detection, creating more reliable machines that are easier to maintain.



Application 3: Detecting the Leading Edge

The number one application mentioned in the survey was leading edge detection at 40 percent. According to the survey results, packaging machines most commonly detect the leading edge of products for three basic applications: first was applying labels; second was for cartoning (for example, packing cookies in a carton); and third was case packing.

Previously, many packaging machines used thru-beam or retro-reflective photoelectric sensors to detect the leading edge. In a thru-beam sensor, a light emitter is installed on one side of a conveyor and a receiver on the other side. With a retroreflective sensor, a reflector on the other side is used to “reflect” the light beam back to the emitter/receiver. In either case, when a package arrives it breaks the light beam, generating a signal to the automation system.



Using sensors with reflectors can cause a number of issues on a line: vibration or impact from a product can cause misalignment with the reflector, causing a false trip. In addition, retro-reflective sensors can have issues detecting very shiny surfaces. Thru-beam sensors also have problems detecting transparent packaging, such as clear plastic used on a meat tray.

Today, an increasingly diverse range of package types, sizes, label designs, colors, and textures are being used to give products visibility that will capture the consumer's eye and lead to a sale. But packagers often find a machine's sensor stations—usually based on conventional photoelectric technology—don't respond adequately to changes in package material and appearance during line operation. This issue is becoming encountered more frequently given the growing popularity of bright, highly reflective packaging colors and surfaces. In addition, package designs may include heat-sealing the package (such as found in form, fill and seal machines) which turns the leading or trailing edge into a flap that's only a few millimeters thick.

Simply stated, conventional photoelectric sensors sometimes don't “see” the product because of the packaging, which can make the products fall outside of the sensor's optical bandwidth. Even one problem may cause jams, which can in turn spark a “domino effect” of line interruptions, not to mention mishandled and damaged products. These issues can cause any number of costly headaches including downtime, waste and greatly reduced productivity.

Labeling operations require that the product be positioned precisely so that the label, bar code or package graphics can be applied in the correct location. If the sensor doesn't detect the leading edge correctly, the label will be misapplied. Other problems include double counts, double triggers, or false triggering after the product leaves the sensing area.

Some operators attempt to compromise for a sensor's limitations by slowing down the line, thereby compromising its efficiency and productivity, or adjusting the device to allow more products to pass. Such subjective, well-intentioned temporary fixes may provide a few hours of reliable performance, but the problems quickly return—and worsen—if the sensor isn't readjusted properly for the next product changeover.

And where once weeks, if not months, of planning preceded even minimal package modifications, the pressure of market forces now requires companies to implement major packaging changes and redesigns virtually overnight. This leaves no time for fine tuning of sensors, increasing the need for more flexible and reliable solutions.

If the target can be detected from above the conveyor, a photoelectric sensor with advanced background suppression functionality can be used to detect the leading edge. Unlike conventional sensor technologies that focus solely on a target area at a fixed distance, background suppression sensors use light triangulation to detect and discern everything in a defined sensing area—both target and background.

The use of triangulation or ToF enables the sensor's receivers to "see" the background behind the object being sensed, but to ignore it, even as products move rapidly through the target area. This greatly increases reliability and reduces misreads to near zero in most applications.

Essentially, a background suppression sensor detects the amount of light returning from the package, adjusts itself depending on the color and intensity, and increases the amount of light being transmitted if the package is dark or decreases the amount of light for shiny objects automatically.

Background suppression sensors are available in a variety of models. The simplest detect objects at a fixed distance, while adjustable units allow users to change the sensing range as needed to accommodate a wider variety of applications and products.

These types of sensors go a long way towards addressing leading edge detection issues, and a related sensing technology can be applied to the next most important problem area.

Conclusion

Advanced sensors are addressing the needs of machine builders and their customers in the three leading applications for packaging machine sensors and in other areas. Advanced technologies in photoelectric, inductive and magnetic cylinder sensing are improving accuracy and repeatability. New designs are eliminating moving parts to increase reliability, simplify maintenance, and increase immunity to shock and vibration. All of these improvements are allowing packaging machine sensors to adapt to changes in packaging materials, sizes, and shapes.



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For more information about this sensor technology for packaging machines, contact SICK at info@sick.com or visit our website at www.sick.com.