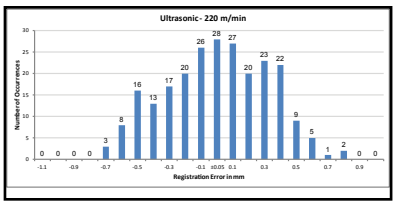
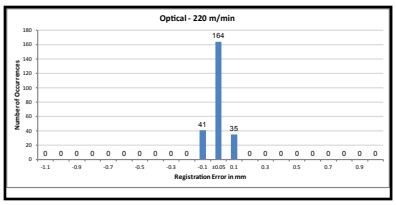
LION PRECISION

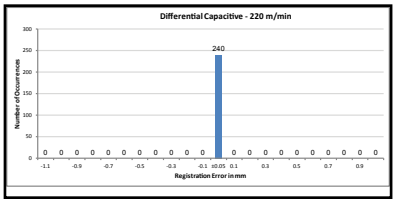
TechNote

LT04-0050 • June, 2015

Comparing Label Sensor Technology Performance







Applications:

All automated pressure sensitive label applications

Summary:

The TechNote describes the results of experiments measuring placement accuracy using different label sensor technologies: optical, capacitive (two types), and ultrasonic.

Capacitive is by far the most accurate (nearly perfect) with optical being a close second. Ultrasonic accuracies are speed related - accuracy decreases as speed increases.

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Label Sensor Technologies

There are three basic types of label sensor technologies: Optical, Capacitive, and Ultrasonic. There are two types of capacitive sensor: Differential, and Single. Each has distinct advantages and disadvantages. While each new sensor technology enables a sensor to do a broader range of label types and designs, no single label sensor technology can be guaranteed to work with every possible label. Newer technologies accommodate a much broader range of label materials and designs than earlier technologies.

Performance Characteristics

Label sensor performance is based on three things:

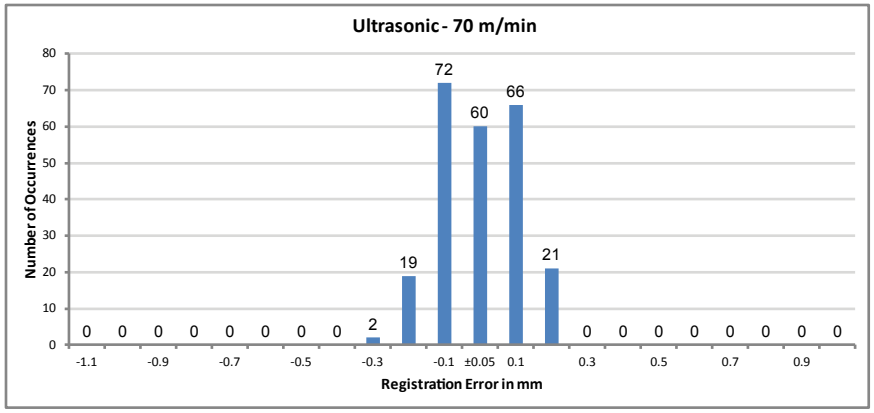
- Registration Accuracy
- Speed (and its effect on accuracy)
- Range of Acceptable Materials

We can rate each technology on each of these parameters on a scale of 1-5.

Reading The Registration Accuracy Charts

Registration accuracy is measured by recording outputs of the sensor and comparing the timing of the outputs with known label edge locations. This test is performed on a specially designed machine with an encoder that precisely tracks label positions.

The charts show the label location (registration) of 240 consecutive labels as detected by different technology sensors. A single bar down the center indicates all 240 labels were accurately placed within ±.0.05 mm (0.002"). Other bars indicate *how many* label placements varied (how tall the bar is) and *how far* they varied (how far the bars are from the center of the chart).



Performance of Each Technology

Optical

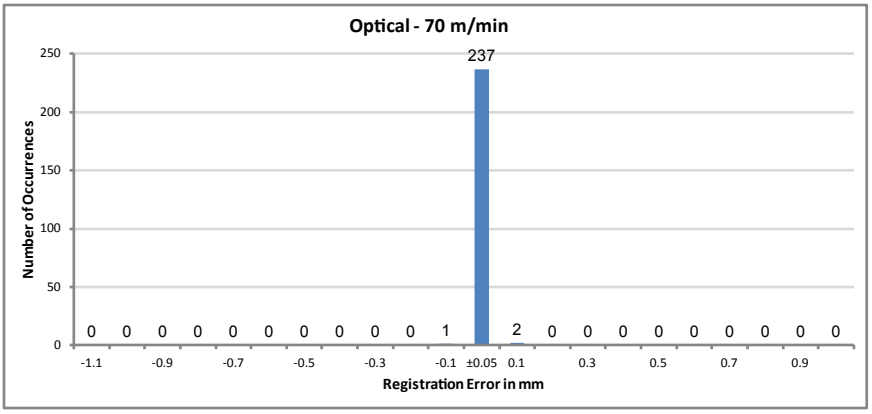
- Registration Accuracy: 5
- Speed: 4
- Range of Acceptable Materials: 2

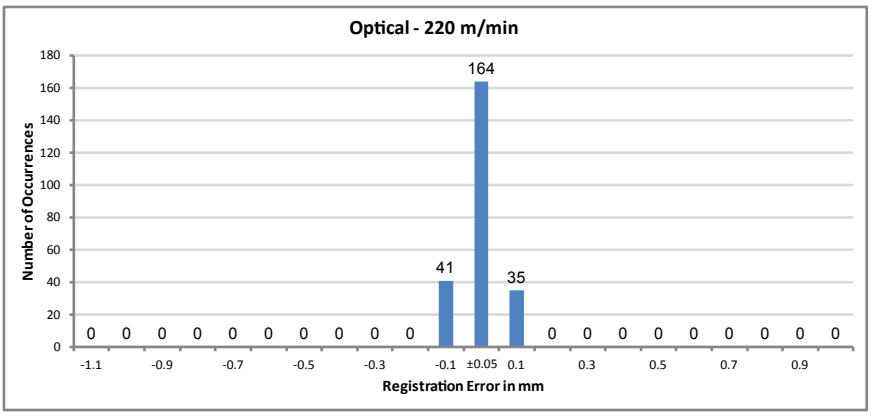
Optical sensors work by placing a light source (usually infrared) under the web and a detector above the web that measures the brightness of light coming through. Changes in the opacity of the label compared to the liner between labels is used to detect the label edge.

The obvious problem with optical sensors is they cannot detect clear labels, regardless of what the liner material is. Clear labels do not block any light, so the edge is not detectable by optical sensors.

Sometimes "eyemarks" are added to the liner - black bars between the labels. The cost of eyemarks is much greater than the cost of a sensor capable of sensing clear labels.

Optical sensors are perfectly accurate at low speeds. At higher speeds, their accuracy degrades a small amount.





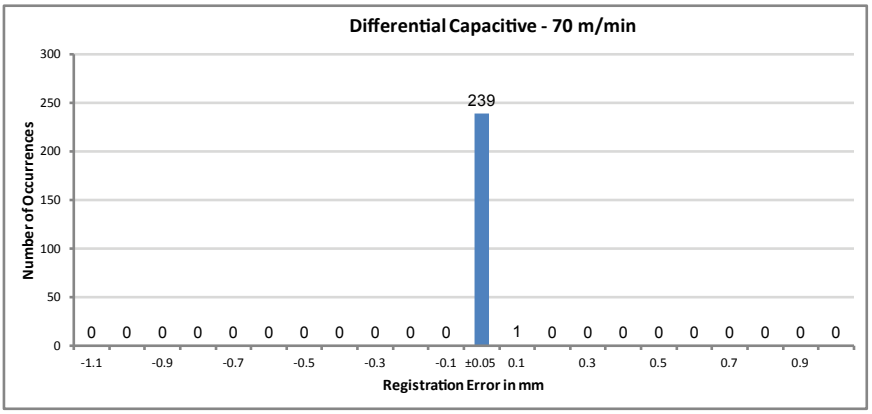
Capacitive Sensors

Capacitive sensors use electric fields to measure web thickness. The change in thickness between the labels and the gaps triggers the sensor; clear labels are as easy to detect as paper labels. Capacitive sensors come in two configurations: Differential, and Single-Ended. ***Capacitive sensors are extremely accurate and very fast.*** They are perfectly accurate at all machine speeds. No other sensor technology can say that.

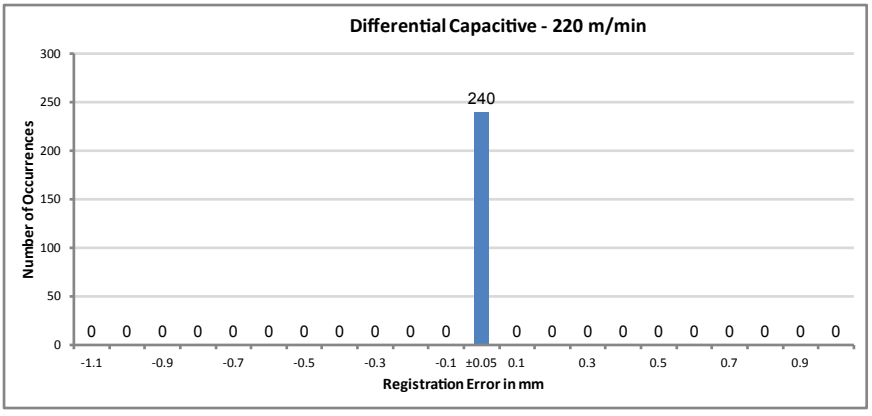
Differential Capacitive

- Registration Accuracy: 5
- Speed: 5
- Range of Acceptable Materials: 3

Differential capacitive sensors use two capacitive sensing elements to sense web thickness. The output of the two sensing elements are subtracted from each other so that the sensor only has an output when one sensor is over a label and the other is over a gap. The advantage of differential sensing is that small changes in distance between the sensing elements and the baseplate due to temperature shifts or vibration do not affect the sensor.



Metallic materials or inks look very "thick" to capacitive sensors. Because differential sensors trigger on differences of thickness between the two sensing elements, metallic artwork or text can cause the sensor to trigger many times as the artwork passes through the sensor. Differential sensors cannot be used when metallic materials or ink are used on the label or liner.

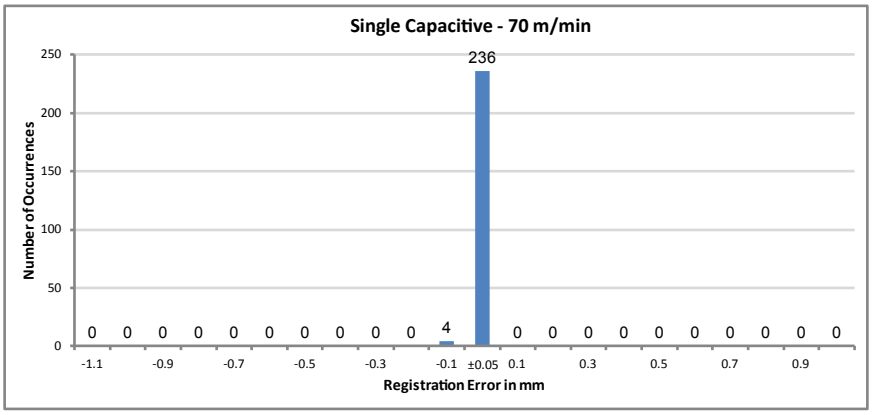


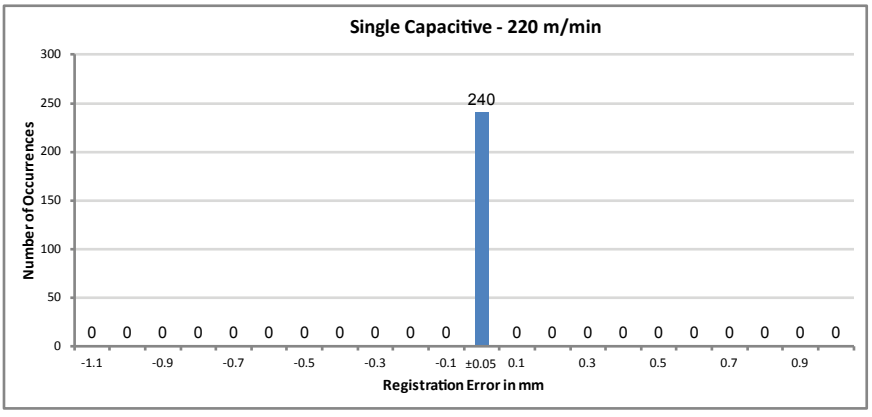
Single-Ended Capacitive

- Registration Accuracy: 5
- Speed: 5
- Range of Acceptable Materials: 4

Single-Ended capacitive sensors use a single sensing element to measure the thickness of the web. They are adjusted so the liner thickness is below the sensor's trigger point. The label+liner thickness exceeds the trigger point and the sensor is triggered. If there are any metallic materials on the label, the sensor sees a further increase in thickness, but because the measurement is already above the trigger point, it has no affect on the sensor output.

Metals appear very thick to capacitive sensors. If a label is entirely metallic, such as a foil or metallized mylar material and has substantial thickness, the apparent thickness of the labels may overwhelm the sensor, even at the gap, so that it is unable to detect the gap. Typical solid foil labels will work with single-ended capacitive sensors, but good web control to keep the web against the backplate is especially important.





Ultrasonic

- Registration Accuracy: 3
- Speed: 2
- Range of Acceptable Materials: 5

Ultrasonic sensors measure web thickness with high-frequency sound waves that are transmitted by a transducer under the web to a receiver above the web. More sound energy passes through the web at the gap than during the label. These sensors have no sensitivity to metallic materials and are able to sense labels of almost any material. They will struggle with any label will multiple layers, especially if air bubbles are present.

Ultrasonic sensors have the advantage of detecting the broadest range of materials. But they are considerably less accurate than capacitive sensors, even at low speeds. Because of the nature of the technology, their accuracy is directly related to web speed – accuracy continually decreases as speed increases.