In the printing industry, registration is the method of correlating overlapping colors on one single image. Each color, in a multi-color image, is applied in a separate step and ultimately lined up so the various components of the image are in their proper place. But, synchronization issues between the web speed and the print heads on the printing press can create very slight misalignments known as registration errors between printing each color. This causes unintended color fringing, blurring, or light/dark streaking along the edges of colored regions. Moreover, this can vary considerably from process to process. It generally requires that the substrate, typically paper, is in correct alignment with the print heads.
A U.S. based printing equipment manufacturer was having a registration problem on one of its digital printing machines at its R&D center. During product testing, the product engineers recognized that the registration of the cyan, yellow, magenta, and black colors in the printer’s multi-color process were off by several microns. This condition was a recurring problem. The engineers believed that the problem could be due to one or more of the following reasons:

- Paper stretch due to tension or the applied ink
- Paper slippage on the drive roller
- Differences in mechanical wheel encoder speed versus actual web speed

After investigating several alternative measurement technologies, the printing equipment manufacturer selected Beta LaserMike’s differential speed measurement system. This solution includes the LaserSpeed Length Differential Indicator (LDI) and two LaserSpeed 9000-303 non-contact encoders. The LS9000-303 encoder uses laser-based technology that projects a unique pattern on the surface of the substrate. As the product moves, light is scattered back to the LS9000-303 encoder. This information is translated into product speed. The LS9000-303 can read forward and backward product speed up to ±4,000 m/min (±13,100 ft/min). Speed measurements are captured with better than ±0.05% accuracy.

Used as a diagnostic tool, the product engineers can use this differential speed measurement system to monitor the line speed of the printing system at any two locations on the web. Since the LS9000-303 encoder measures the product itself and not a roller, slippage is not a problem. Adding the fact that the LS9000-303 encoder has a measurement accuracy of ±0.05%, the stretch measurement will be reliable and correct.

Critical Process Factors. The engineering team wanted to ensure there was no paper stretch and that all drive rollers were pulling the product through the press at the same speed. This meant the non-contact encoder system needed to measure the differential speed with the highest degree of accuracy and repeatability. The encoder also had to be compact and rugged, so it can installed at any location on the press. Another critical factor was the ability of the encoder to reliably read any material surface, as the paper substrate and coatings may change from application to application. One final factor required the non-contact laser encoder to provide the same outputs as a contact encoder. This allowed for simple plug-and-play installation with minimal modifications required to the printing press and current web control process.

Installation. Gauge mounts are installed at several points along the line, enabling the LS9000-303 encoders to be positioned at two different desired locations to determine the differential speed between the drive rollers and the web. The encoders are positioned perpendicular and 12 inches from the web. This setup allows the product engineers to monitor and measure web tension at critical points for paper stretch, as well as monitor paper slippage on the drive roller. The LDI system is also used to compare speed measurements from the contact wheel encoder and LS9000-303 gauge via direct input of encoder pulses. The LDI system includes an RS-232 output which can be interfaced with a PLC to control the differential speed.
Beta LaserMike’s differential measurement system with LaserSpeed encoders offers the printing equipment manufacturer a number of key benefits:

- High accuracy and repeatability
- Low cost of ownership due to no moving parts
- No slippage problems from non-contact method
- Permanent calibration for increased uptime
- Compact design for installation flexibility

As the R&D team at the printing equipment manufacturer continue to use the LaserSpeed system, Beta LaserMike will learn more about the long-term value of the solution.