

# CO<sub>2</sub> Lasers for Flexible Food Packaging

## Converting Applications Need Reliable Lasers for Highest Throughput

●▶ Compact size and high reliability are key factors enabling digital converting systems that incorporate multiple lasers for high-throughput cutting, perforating and scoring of flexible films.

Converting paper, plastic film and other flexible materials into pre-formed packaging is a fast growing application for sealed CO<sub>2</sub> lasers. Specifically, converting involves cutting, scoring and micro-perforating of these materials. For example, scoring (cutting to a finite depth) is used for "easy open" packaging or to create features such as "easy pour" spouts. This article examines how current digital converting systems are enabled by the high reliability, low cost, and small size of a new generation of CO<sub>2</sub> lasers.

### Lasers for Cutting, Perforating and Scoring

One of the major markets driving laser converting is food packaging. This includes cartons and pouches made of several different plastics, foils or paper, or a laminated combination of these materials. Sealed CO<sub>2</sub> lasers are effectively penetrating this market because they can process all these different materials. Lasers are now often preferred over traditional tooling for several reasons. Laser converting is fast, making it compatible with the speed of existing production lines. It is a flexible digital process based on software tools rather than hard tooling. Plus, the laser does not degrade with use. A key feature of laser converting is precision control over scoring depth and micro-perforation hole size, both of which are extremely hard to achieve with hard tooling. And, thanks to the low cost of this mature laser technology, converting with sealed CO<sub>2</sub> lasers is very cost competitive with traditional methods.

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FIGURE 1: Perforating thin films is one of the key processes in food packaging that utilize compact CO<sub>2</sub> lasers.

## Digital Converting with Multiple Laser Beams

When developing laser solutions for existing converting applications, it is very important to provide maximum compatibility and hence minimum process disruption. For example, the LaserSharp Processing Module supplied by LasX Industries can be configured as a retrofit option for mounting on existing slitter/rewinder equipment widely used in converting. Minimizing disruption also means matching the specifications and speed of existing processes. In the case of wide web converting of flexible packaging films, which is typically performed as roll to roll processing with a web (roll) width between and 1 and 2 meters, this translates into a laser retrofit that has multiple laser beams. There are two reasons for this. First, even though the laser beam is scanned over the film using high-speed galvanometer mirrors at speeds of 10 meter/sec, many converting designs involve sufficient detail so that a single scanned beam cannot keep pace with web speeds as high as 300 meter/min. An even more fundamental limitation is the field of view of the scanning optics. An optimum achievable spot ( $1/e^2$ ) diameter for most applications is 200-400 microns. Achieving this requires high numerical aperture optics, which limits the practical field of view to about 350 x 350 mm – nowhere near enough to span the web. Applications requiring smaller spot sizes will have a yet smaller field of view.

### THE COMPANY

#### Coherent Inc.

Coherent designs and manufactures a broad selection of lasers and supplies electro-optic instruments for laser test and measurement. The company's products include laser diodes and laser diode systems, carbon dioxide (CO<sub>2</sub>) lasers, excimer lasers, CW and Q-switched DPSS lasers and systems, tunable-dye, ultrafast lasers and amplifiers, ion lasers. The company provides worldwide service and applications support.

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**FIGURE 2:** The advent of compact carbon dioxide lasers allows converters to use multiple lasers across a wide web. In this photo, each black tube contains the laser beam and focusing optics from a separate laser. (Photo courtesy of Alcan Packaging, Chicago, IL.)

Unless thicker flexible packaging films are specified, converting applications usually require no more than 100 W laser power. With current sealed CO<sub>2</sub> laser technology offering powers from a few watts up to 500 W, this allows two options, a single high-power laser split into multiple beams or several individual lasers. At LasX the latter route was chosen (see Figure 2), because the use of multiple low power lasers provides much tighter process control and optimization capabilities. Specifically, the power of each of the laser beams can be independently and actively controlled as needed, whereas beamsplitters cannot be controlled and may vary according to their sensitive alignment and changes in ambient temperature and humidity. Why is control so important? Consider the case of scoring a multilayer film structure for an "easy open" food package. Precise depth control eliminates the possibility of cutting into the barrier layer which would shorten the shelf-life of the food product.

#### Laser Cost, Reliability and Compact Packaging

LaserSharp solutions most commonly use a line of four Coherent lasers arranged across the web. For faster processing a second row of four such modules located "downstream" of the first row will double the production speed. Here each row of lasers cuts alternate rows of package patterns. This setup is critically dependent on several key aspects and advances in sealed CO<sub>2</sub> lasers. Coherent Diamond lasers were selected for these digital converting systems because they meet the specific needs in terms of unit cost, reliability and size.

Reliability is the most important criteria for the customers. Specifically, in a system



**FIGURE 3:** The advent of small, long lived carbon dioxide lasers is spurring growth in flexible packaging applications. This compact, sealed laser delivers 30 W of power but weighs only 6 kg (13.5 lb).

with eight small lasers versus a single higher power laser, each small laser has to offer higher reliability than would be required from a single laser. Coherent's new Diamond C lasers now deliver superior reliability and lifetime compared to earlier, sealed CW CO<sub>2</sub> lasers through several key design innovations. These improvements include the use of new components and resonator materials to optimize both laser efficiency and gas lifetime. In addition, laser cooling and temperature control have been improved to further benefit both laser stability and lifetime. Plus the RF power supply is integrated in the laser head, eliminating the RF umbilical as a possible failure point. As a result every Diamond C laser is guaranteed to meet or exceed performance specifications for a minimum of 24 months, with no need for gas refilling or other scheduled maintenance in that period.

These lasers also offer a high power/size ratio (see Figure 3) through the use of a folded waveguide resonator. And lastly, they are designed to be manufactured using a high level of automated assembly. This ensures a high level of unit-to-unit performance consistency. Just as important for digital converting, it means these lasers can be produced in volume at a cost level appropriate for this application.