

Consistent Hole Geometry at Speed —

Laser Micro Perforating comes of Age with Beam Compression

Micro perforations in flexible packaging have proven to be an excellent, viable solution for prolonging product shelf life of fresh-cut produce, as well as to significantly increase product fill rates and package stability for bulk items such as flour, cement, fertilizer and pet food. To micro perforate films with consistency and precision, the laser is without question the ideal technology. The challenge, however, has been how to create consistent hole sizes at higher speeds. An exciting, new development in laser technology, laser beam compression, has allowed lasers to “come of age” and be the technology of choice.

Lasers by their nature produce a light beam with an intensity that is readily absorbed by the polymeric film. The focused laser beam heats, melts, and instantaneously vaporizes film, leaving a very small, well-defined, reinforced hole. The systems are computer controlled, allowing for a wide range of hole sizes and patterns.

Limitations in web speed have kept some converters from adopting this advantageous laser technology. For lasers to offer a competitive advantage, converters need the ability to create small holes at high speeds while controlling the number of perforations and minimizing waste. The latest advance in laser technology, laser beam compression, addresses this need, raising the bar for achieving quality results.

Beam compression refers to a patented technology in which the laser pulse is manipulated and guided to direct all its energy to a single point on the film, *independent* of the web speed. It allows web speeds to be increased by three or four times, up to 1200 feet per minute over systems without beam compression. This new patented technology allows for the efficient use of lower powered lasers to produce the same or better results than higher powered lasers. Adding speed and energy savings, laser beam compression enhances the processing benefits a standard industrial laser offers. Because the energy received per spot is independent of the web speed, the resulting reinforced micro holes are consistently round. The comparison is clear in Figures 1 and 2.

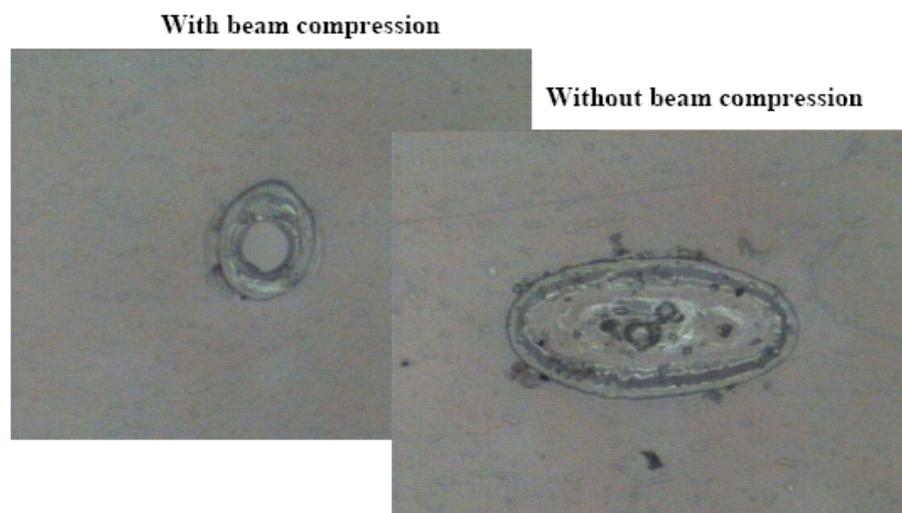


Figure 1: Comparison of micro perforating holes with and without beam compression. Round hole diameter \approx 3mil. Perforations performed at 1000 feet per minute

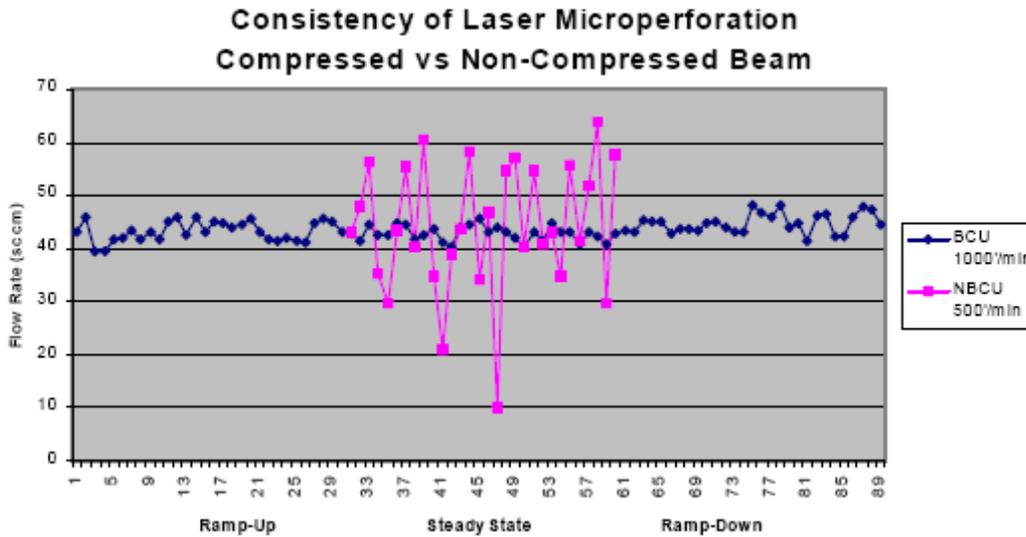


Figure 2: Consistency of laser micro perforation during the ramp-up, steady-state and ramp-down operation during the converting process. Steady-state web speed was a 1000' per minute.

Advantages when Packaging Fresh Cut Produce

Precisely micro perforating a package is critical for fresh-cut produce because controlling the storage temperature and modifying the atmospheric conditions within the package are the most important factors for maintaining freshness and prolonging shelf life. The process is complicated because not all fresh-cut produce has the same oxygen transmission rate (OTR). Correctly manipulating the amount of oxygen, carbon dioxide, and moisture within modified atmospheric packaging at the appropriate storage temperature delays respiration, ripening, and ethylene production.. For example, Table 1 contains a comparison of melons and citrus fruits, in which there is a limited packaging surface area for gas transmission: plastic containers with flexible film lids. Note that melons require a higher oxygen transmission rate OTR (1000) than citrus fruit (OTR= 320).

Table 1: Micro Perforation on Fresh Fruit Container Lid

Fresh Fruit Lid Perforation		
Product	6 oz. Melon	6 oz. Citrus
Container ID (in)	4	4
Lid Area (in ²)	12.6	12.6
OTR Required	1000	320
OTR for 2mil Permeable PE	254	254
OTR on Lid without Perf	29	29
# Perfs on Lid (4mil Hole)	4	2
OTR on Lid with Perf	958	314

OTR is measured in cc/100 sq. in. / 24 hours at 75°F, 0% R.H.

On the limited lid surface area, the highly permeable polyethylene film would only give an OTR value of 254, which is too small for the required OTR value. However, with the perforation of either four or two holes, respectively for the two containers, the OTR value is closely achievable. Because of the limited number of perforations that are required, the accuracy of those holes is of utmost importance for retaining the freshness of the fruit while avoiding lack of free oxygen conditions.

Advantages when Packaging Bulk Products

Converters also use laser micro perforated packages for air evacuation in products such as flour, cement, fertilizer, and pet food. This improves pallet load stabilization and if transported by plane, reduces potential bursting of bags. Laser perforation patterns can be easily adjusted for the variety of venting applications.

Micro perforation with a laser beam allows the converter to consistently produce the desired hole size. Lasers can create hole sized from 75 microns (.003") to 250 microns (.010"), or a range of 175 microns (.007"). Laser micro perforated holes provide breathability without unwanted moisture transmission and can aid in the reduction of insect infestation.

More Applications, More Options

Packaging materials will most certainly continue to evolve and become more sophisticated. With the increasing requirement for packages with improved breathability, converters need the capacity to produce consistent round holes with precise placement at higher web speeds than were possible before. Laser micro perforating with laser beam compression opens up additional opportunities and offers the converter the capability and versatility to stay competitive. The benefits that laser technology brings to the process of micro perforating makes industrial lasers the technology of choice.

About the Authors

Larry Beres (Senior Vice President, Laser Packaging Systems) and Kurt Hatella (Sales Manager, Laser Packaging Systems) are part of the Preco, Incorporated team. Preco, Inc. is a leader in the laser and die cutting systems industries and is the only U.S. company with patented beam compression technology available.