



Fiber Laser Marking of Plastic

Introduction:

Laser marking is fundamentally different from ink printing, the traditional method of writing on plastics. Whereas direct ink printing puts an image on the surface of the plastic which can be removed by abrasion or solvents, laser marking can provide an indelible high-contrast mark in the material itself in a non contact process. With laser marking, there is no direct contact with the plastic other than through the laser beam.

Laser marking is the most flexible way of marking plastics and yields legible, sharp and indelible images. Lasers can mark products with various geometries in a fully computer-controlled process with high reproducibility and reliability. What's more, laser marking can be integrated at any point of the assembly line as well as offline (or standalone), resulting in flexibility in marking and logistics. Combined with very low reject rates, this leads to cost reduction in most cases.

Marking of plastics with lasers is accomplished through colour changes and/or surface restructuring. Four different types of mark can be distinguished namely foaming, engraving, engraving with colour change, and colour change only.

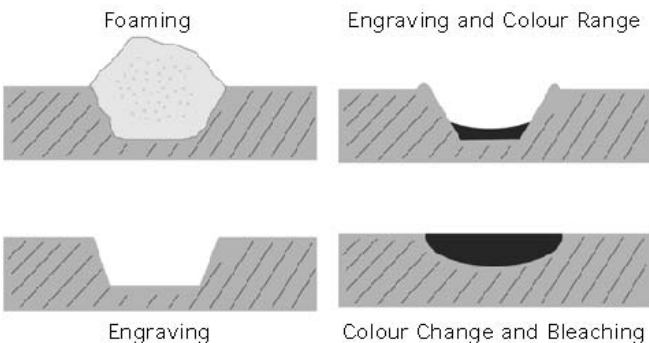


Figure 1: Four types of Mark

Foaming:

At low laser intensities on certain polymers laser marking creates a thin walled foam structure, this appears a lighter colour from the bulk of the polymer.

Engraving/Vaporisation:

Localized increase in temperatures above the melting point of the material causes melting. Once the material is re-solidified, a modified surface structure occurs in the form of an etch.

Engraving with colour change:

At relatively high laser intensities, a local evaporation of surface material causes a trench with ridges. As a result of *carbonization*, a colour change also occurs.

Colour change:

With laser radiation, of sufficient short wavelength, a dissociation of molecules results in a colour change; this is the most desired effect. Mark contrast can be enhanced using a limited amount of additives.

Laser Marking v/s Ink Marking:

Laser marking can be very quick with some scanner based systems being capable of making marks at speeds in excess of 8m/sec giving the capability to mark over 1,000 alphanumeric characters per second. Due to the high beam quality of the laser beam marks as narrow as 25µm can be made to an accuracy of just a few microns. Software packages make the programming of these marks relatively simple and offer a range of built in features, such as laser on/off dwell, to help maximise mark quality and productivity.

Marking using ink requires a lot of space in the working area due to the need for a high quantity of ink cartridges. Moreover, the ink used consists of hazardous toxic materials thus making the working environment unsafe.

Laser Marking:

Marking behavior of plastic is highly variable based on different components, and additives.

The most widely used resin types are:

Acrylonitrile Butadiene Styrene (ABS): produces contrast by foaming and carbonisation.

Nylon: produces contrast by foaming

Polyethylene and Polypropylene (PE & PP):

Lighter colours often require additives to achieve good contrasts.

Polycarbonate (PC): PC absorbs through the



thickness and can produce a subtle carbonisation mark. Good contrast carbonisation marks require higher pulsed energies and power densities than foaming plastics, this particularly applies for ABS.

Why use an SPI Laser?

The SPI laser is a flexible processing laser that allows highly sensitive process control. It maintains usable pulse repetitions up to 500 kHz far higher than other laser sources. SPI's pulsed laser has shown a high standard of excellence in the Marking sector due to its stability and ease of control. It can be used to mark a wide variety of plastics, some of which mark far better at these high repetition rates. This is particularly true for foaming type marks. If you would like to have a sample marked with an SPI Laser, please contact one of our sales persons (see contact list).

1. Spot separation reduces mark visibility at >1:1 mark space ratio – high repetition rate produces clearer marks at higher speeds with sufficient pulse energy/power density.
2. Low repetition rate lasers are sometimes handicapped at >2m/s.
3. Different types of mark require different pulse energies, usually lower than for metal marks.
4. Marking polymers requires low pulse energy and lower power density than for marking metals. This low pulse energy is available at far higher repetition rates from the SPI Laser.



Plastic marking of cow ear tags
Polyurethane, with an absorber, marked in 6.7s at an average power of 20W and waveform 0 (25kHz).

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20W Pulsed SPI Fiber Laser

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