MAKE YOUR TECHNICAL INNOVATION A COMMERCIAL REALITY

LASER PROCESSES: MARKING, ENGRAVING AND ETCHING

Identifying the key differences and clarifying your options

NEXUS
INTELLIGENT ENGINEERING

Talk to us today
nexus-ie.co.uk
info@nexus-ie.co.uk

Connect With Us
@Nexus_IE
linkedin.com/company/nexus-ie/

INTRODUCTION

The process of using lasers for marking is widely used in manufacturing. The highly efficient, flexible and cost-effective nature of the process allows it to be utilised by various different industry sectors for many different purposes, for example marking serial numbers on components for traceability and for personalised engraving.

The process is especially common in automotive, aerospace and the medical device industries, but this is by no means an exclusive list. Schools, hobbyists and small businesses recognise the technique as a viable option to mark and customise their products and parts.

For a broad range of materials including metal leather, glass wood etc. The purpose of this eBook is to help you understand the available options, for laser marking providing you with more clarity going forward with your own marking project.

LASER MARKING

WHAT IS LASER MARKING?

There are 4 different types of laser marking each of which essentially use heat to create markings with a smooth finish. Manufacturers in a wide range of industries using various materials opt for laser marking but their individual needs dictate the type of laser marking they use.

WHAT MATERIALS CAN BE LASER MARKED?

What makes laser marking so flexible is that by using lasers with different wavelengths and processes you can mark a whole range of materials. Wood and glass are the hardest but there are long wavelength lasers that are even able to mark those too. You might be surprised to hear that even cheese and bread can be laser marked, whether this is relevant to your business or not, it simply serves as testament to the flexibility this technique offers. There are some materials such as steel, titanium, tungsten carbide and inconel that are so hard that annealing laser marking is the only viable option.

Below you will find more detail on the four unique types, what the processes involve, the materials they work best on and the types of products that use them.

1) ANNEALING LASER MARKING

Using a low energy beam, annealing laser marking causes oxidation beneath the surface of the material. This process causes discoloration and a smooth finish. Often this result is a black or dark mark but shades of yellow, green and red can be achieved.

Annealing only uses low temperatures but the heat generated is focused, creating highly contrasting clear marks with zero disruption to the rest of the material.

It is worth noting that the process is slightly slower than other techniques, this is because it does not use aggressive heat to bring the carbon to the surface and the material also needs time to cool down. However in comparison with traditional marking processes the efficiency, relative speed and finish of Annealing Laser Marking makes it a common choice when manufacturing hard metals such as steel, titanium, tungsten carbide and inconel especially in the medical industry for QR codes, logos, barcodes and UID codes.

2) CARBON MIGRATION LASER MARKING

This process is applied to metals only. Through the process of heating, the material chemically bonds with its own carbon molecules. Carbon is brought to the surface and dark, smooth markings are produced as a result. This technique does require a more aggressive heat which makes the process faster.

For obvious reasons, you can only use carbon migration laser marking with metals that contain carbon such as steel, stainless steel, carbide and titanium. This process is common in aerospace, jewellery engraving and metal work but not exclusively.

3) FOAMING LASER MARKING

This is the process of laser marking for plastics. The laser actually melts the material releasing foam, gas and bubbles. It's the bubbles that change the property of the plastic, altering the light refraction. The result is a light, virtually smooth marking. Because the markings are light, Foaming Laser Marking works better on darker plastics. This is why it is a popular technique for products such as ink cartridges, keyboards and plastic packaging.

4) COLORATION LASER MARKING

This is the only laser marking process that can be done on both plastics and metals. The colour of the marking varies and is in contrast to the colour of the material in the first place. Specific areas are targeted and heated. The pulse frequencies can be modified for varying shade.

When working on plastic, the results are created again through foaming. This time the polymers are manipulated which causes coloration. When working with metal oxidation occurs. It can be used on both treated and untreated surfaces and the main benefit is its flexibility. It's commonly used in bottle cap production and decorative jewellery.

LASER ENGRAVING

WHAT IS LASER ENGRAVING?

The laser engraving process involves the surface of the material being physically removed by the laser. High laser temperatures vaporises the material, exposing a cavity which becomes the mark. Laser engraving is fast, every pulse vaporises a targeted section of the material. The mark created can be clearly seen and is also recognisable by touch.

WHAT MATERIALS CAN BE LASER ENGRAVED?

Nearly any material can be laser engraved including almost all metals, glass, wood, plastic and leather.

WHAT ARE THE DIFFERENT TYPES OF LASER ENGRAVING?

1) DEEP ENGRAVING

Most engravings only need to go 0.020 to create a deep enough cavity for a visible mark but for some purposes, the skilled engineer may need to go deeper. Depending on the required results, the process can simply be repeated. With each pass of the focused light, the surface of the material is vaporised further. This allows for marks as deep as 0.125".

The process of deep engraving requires particularly skillful engineering to ensure that the most efficient laser is selected for the material and task in hand. Although it can be done on all metals in theory, deep engraving creates far more heat which can cause damage, in some cases destroying them completely. This is why a full professional assessment must be done before the deep engraving is decided upon.

Deep engraving can be done on curved surfaces as well as flat and due to the nature of working with light beams it can work on parts or areas that are out of reach to bigger mechanical engraving tools. This also gives the process fantastic flexibility and can create an unlimited variety of marks both simple and complex. From barcodes to complicated logos and 2D data Matrix Codes.

It is commonly used as an economical, accurate and efficient marking solution especially for injection mold cavities, core pins and inserts. It is a popular choice for companies with products or parts that are likely to become worn quickly because the deeper the engraving the longer the mark will last in harsh environments.

2) LASER ABLATION

Another type of engraving is ablation. The definition of ablation is to remove specific layers from the material without damaging the rest of the layers. As a process, this has a variety of uses and is used in many industries from manufacturing to medicine (ablation can be performed on biological material).

Short but high intensity bursts of light are applied to increase the pressure and break the material's bonds. With the right amount of pressure (calculated by a professional), a shock wave releases specific material fragments as glasses quickly and efficiently.

When making marks in manufacturing, ablation removes the top layer of the material which is targeted by the laser. A cavity is left that can be seen and touched. It is a favourite among manufacturers because it is so quick, and it produces very little heat so has minimal impact on the rest of the material. It works well on many materials used in manufacturing including plastics, paper, ceramics, glass and even crystals.

3) LASER ETCHING

Laser etching is often referred to as a process in its own right, but it is in fact a type of laser engraving. The etching process creates a similar mark that other types of laser engraving cause, but these are caused by the heat actually melting the surface of the material. The cavity is caused when the melted material expands, a raised mark that can be clearly seen and touched appears.

In stark contrast to deep engraving, laser etching creates marks with little depth, usually 0.001". Although the mark is shallow, the process alters the finish of the material because it changes the reflectivity, intensifying the contrast.

Laser etching can be done on many metal surfaces including those that are bare anodized and plated. It also works with ceramics and plastics.

CONCLUSION

HOW TO KNOW IF YOUR PRODUCT SHOULD BE MARKED USING LASER MARKING OR ENGRAVING?

All laser marking processes result in a smoother finish. Engraving techniques including etching create a mark that is detectable to the eye and via touch. However, beyond this the differences are dependent on the type of process, wavelength of the laser, the material you are using, the purpose and environment that the product will be used in.

There are a lot of different variables to consider and every job is unique. This is why here at Nexus IE we always perform a Material Feasibility Evaluation by a professional engineer before we make any recommendations.

This is a free service and no work will be completed until you agree to the costs and time scales recommended. As a local company based in Cambridge, UK, we offer a personalised and safe service, keeping you in control of decision making throughout. We are upfront and you will find no hidden costs in the process.

If you are ready to find out more about how Nexus IE can help with your mark making connect with us today and speak to one of our consultants directly.