



LASER MARKING ON METAL

ANNEALING | DEEP LASER MARKING
SURFACE MARKING | ABLATION

How does laser marking work on metal?

You can use different technologies to mark metals, including punching, molding, labeling, and micro-percussion. However, **laser marking has revolutionized this process like nothing else before, becoming the most convenient and widely used professional method.**

LASER is the acronym for **Light Amplification by Stimulated Emission of Radiation**. In brief, light particles (photons) excited with current emit energy in the form of light. This light is converged into a beam, forming the laser beam.

How laser works

Basic principles

All lasers are made up of **3 components**:

- External pump source
- Active laser medium
- Resonator

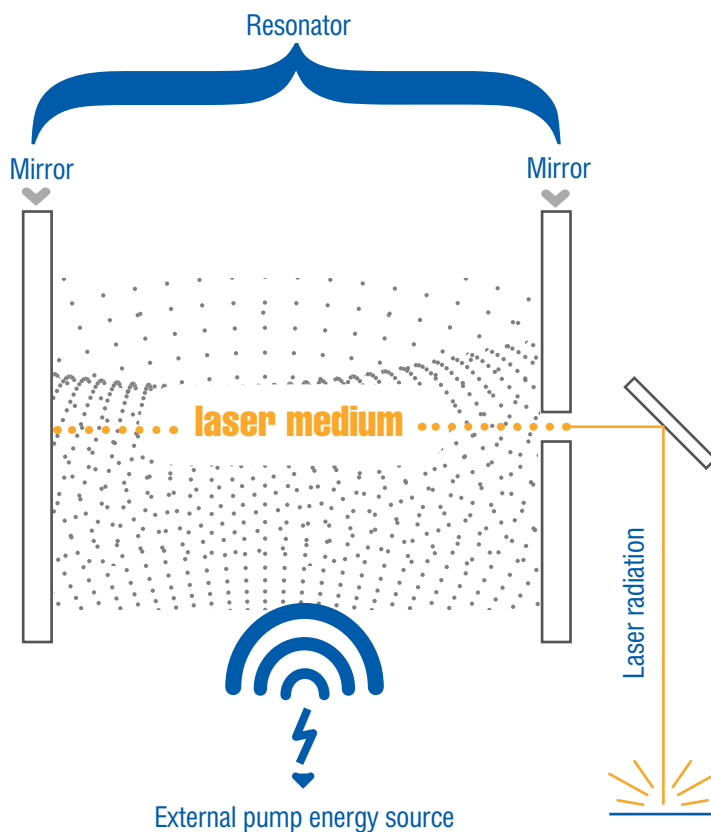
The source brings external energy to the laser.

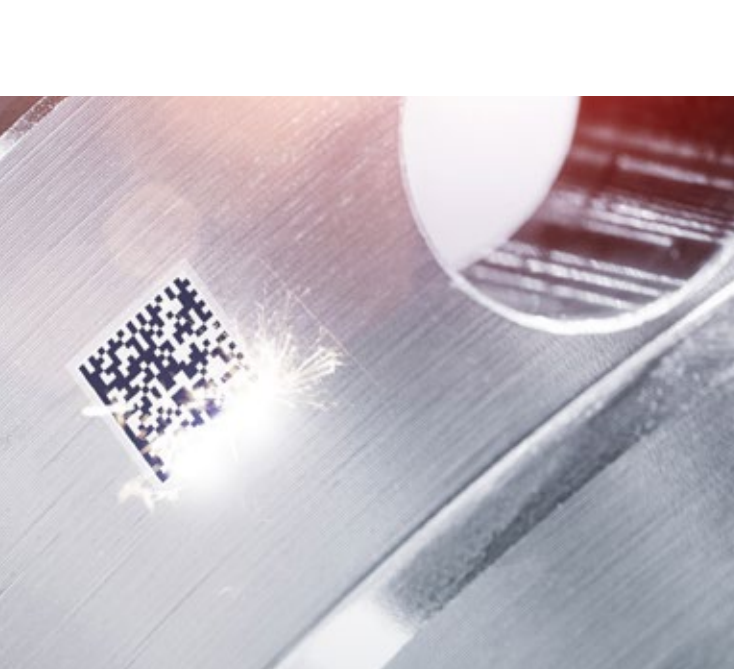
The active laser medium is placed inside the laser. Depending on the design, the laser medium can be made of a gas mixture (**CO2 laser**), a crystal body (**YAG laser**) or glass fibers (**fiber laser**).

When energy is transferred to the laser medium through the pump, it emits radiation.

The active laser medium is placed between two mirrors. One of them is a one-way mirror. The resonator amplifies the radiation of the active laser medium. At the same time, only a certain amount of radiation can leave the resonator through the one-way mirror.

This bundled radiation is the laser radiation.





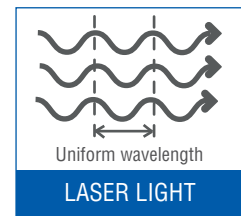
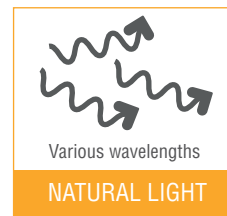
Characteristics of a laser beam

Laser radiation has
4 essential characteristics:

*It's monochromatic, highly directional,
highly coherent, and has high energy density*

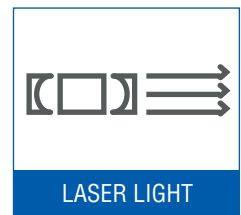
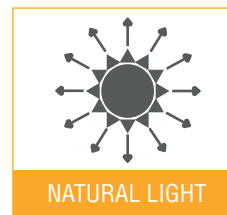
MONOCHROMATICITY

Natural light includes a series of wavelengths, from ultraviolet to infrared. **A laser**, is a light beam with **a single wavelength**. This characteristic is called **monochromaticity**. Monochromaticity allows for greater flexibility in the optical pattern. This translates into precise projects that transmit the laser beam over large distances and focus the laser on one spot that can reach 20 micron.



HIGH DIRECTIONALITY

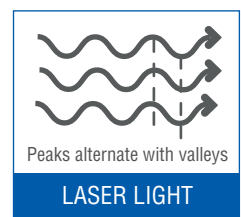
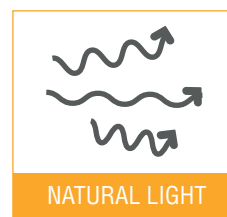
This property **allows light to maintain a direction while it travels across the space**. High directionality indicates that the direction is maintained with high precision and low expansion. Natural light propagates in all directions, whereas laser emits radiations **in one direction only**. This characteristic allows for designing optical systems that can treat surfaces in an extremely accurate way.



HIGH COHERENCE

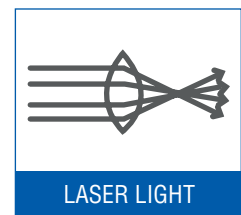
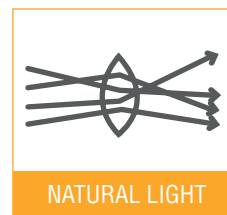
This characteristic describes the extent to which **light interferes with itself**. If we consider light as a wave, we can state that the more stable the light phase and the higher its coherence.

Given that phase, wavelength and direction do not vary, a strong wave can be maintained to transmit laser beams over a long distance without diffusion.



HIGH ENERGY DENSITY

Given the laser's high temporal and spatial coherence, we can **convey the energy even towards a tiny spot**. This means increasing **intensity** (energy density) to obtain enough energy to mark (or engrave) and cut metal.



That's why today, many sectors use laser light to process materials. Coherence helps maintain the intensity, which can be directed by means of lenses. When the laser beam hits the material's surface, the resulting energy is absorbed and converted into heat. This way, the material can be modified, melted or removed completely. **That's how we can engrave, mark or cut a wide range of materials.**

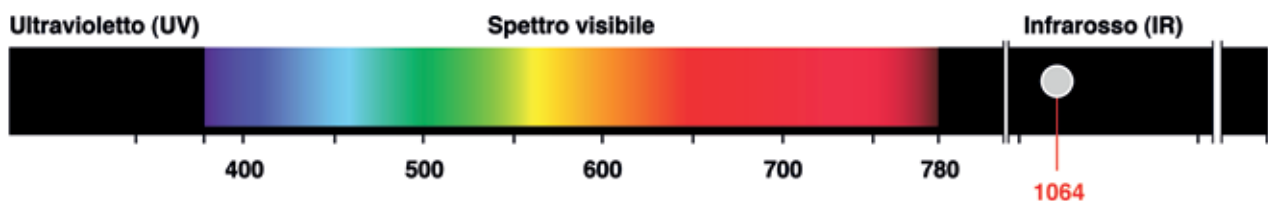
What's the best laser source for marking metal?



Fiber laser sources are the best and most innovative metal marking laser technology. They're ideal for precision marking, micro-processing and cutting any metal, alloy, painted metals, and metals with a treated surface (e.g. anodized aluminum).

Fiber laser technology has marked a milestone in laser beam generation. Many optical and mechanical components, which caused failures and instability, have been replaced by **one active fiber optic coil**. The fiber laser is expected to ensure over **100,000 marking hours** thanks to single-emitter diodes and the fully integrated construction of the optical part.

Infrared (IR) beams are the most versatile for laser processes. IR beams are outside the visible spectrum for the human eye.



THE ADVANTAGES OF FIBER LASER MARKING

- No contact
- High speed
- High quality
- Indelible marking
- Easy-to-use data matrix codes
- Wide range of markable materials





Can laser engrave any metal?

Laser can engrave any metal or alloy, including steel, aluminum, copper, gold, brass and nickel. However, not all materials react in the same way. Moreover, some materials require specific processes.

Examples of laser marking on different materials



BRASS



STEEL



ALUMINUM



COPPER

COMPARING DIFFERENT TYPES OF LASER MARKING ON STEEL

Laser marking steel falls within two categories:
surface marking and etched marking

SURFACE MARKING

Metals are marked so that the propagated light generates **white markings** or a thin oxide layer, resulting in **black markings**.

- White marking is obtained quickly without altering the material's surface.
- High-contrast black marking without altering the material's surface and/or its roughness.



WHITE



BLACK

ETCHED MARKING

The material is removed revealing the **etching**.

- Less regular surface with protruding and recessed parts (based on the material used).
- Greater resistance even to mechanical abrasions.



Is laser marking indelible?



Laser marking is indelible. Laser allows you to **identify and trace** products with a high resolution finish, ensuring long-lasting markings that are also resistant to acids, chemicals and corrosion. In brief, to delete laser marking you need to remove the marked surface mechanically.

Can I use color laser marking?

Yes, you can. However, you must always evaluate the type of metal first. Steel and titanium are most suitable for obtaining vibrant colors. These materials can undergo “**annealing**”.

The laser heats the material's surface, chemically changing it and generating oxide.

By controlling the energy from the laser, you can add different temperatures, thus forming different oxide layers. **Each layer is a color.**

you can obtain **white markings, black markings, or colored markings** by controlling this process and using always the same laser without engraving the material.



How long does it take for laser to mark?

Laser is an extremely **fast and flexible** tool. Laser marking can be made in **less than one second**.

The factors that can determine the length of the process are:

**DIMENSIONS OF
THE OBJECT TO BE
MARKED**

LOGO
LOGO

**ENGRAVING
DEPTH**



**LASER
POWER**

**20 W
50 W
100 W**



Can a laser-marked object deform?

Generally, a laser-marked object is not subject to deformations, even if every application is unique. For example, the aerospace industry, which does not allow material alteration, uses surface marking to prevent any deformation or chemical and physical alteration of the engraved material.

Can the material oxidize during laser marking?

It depends on the processing. In some cases, oxide is obtained on purpose for aesthetic effects. In other cases, it should be prevented.

Experience and preliminary tests help you choose and set the correct parameters, which ensure always perfect and oxide-free markings.

Does laser marking allow me to make cuts also on thin plates?

Yes, you can make beautifully finished micro cuts, even though you need to consider the following aspects:

THICKNESS

The plate must not be more than 1 mm thick. Otherwise, the cutting time could be too long.

CUTTING AREAS

The optimal cutting area is about 80X80 mm because it's in this area where the laser beam is more perpendicular to the surface. This ensures a larger amount of energy and faster and more precise cuts.

Example of a component cut using a 30 W laser marker



Does marking quality and capacity depend on laser power?

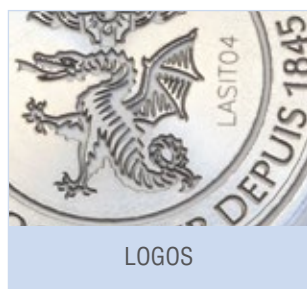
The quality and capacity of the marking does not depend on power. **Speed** is the only parameter that depends on power.

Whether you use a 20 W or 100 W laser, the aesthetic result and the depth of the marking will not change. The only parameter that changes is the time required to obtain the desired marking (more power = less time).



Does laser marking allow me to write anything?

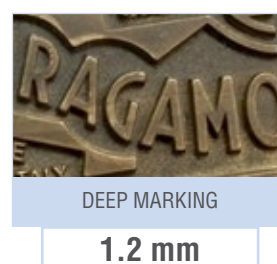
Laser is intrinsically versatile, AS you can mark anything you want, including alphanumerical codes, extremely complex drawings, logos, and ID codes (e.g., **Datamatrix**, **QR Code**, **Barcode** etc.)



What is the maximum and minimum marking depth?

We can obtain markings with different depths by modulating the laser's basic parameters, such as **power**, **pulse frequency**, **speed**, and **number of repetitions**.

Markings can reach a depth of 10 micron, becoming impalpable, or several millimeters, depending on the needs and desired outcomes.





What are the advantages of laser marking?

Laser is the ideal solution for any marking requirement. It's used to customize and decorate any object or trace components within a production process. That's why it's used in so many sectors and industries.

Moreover, it can be used for writing, creating logos and more on any material in a quick and flexible way and with exceptional results. Laser replaces less effective and long-lasting systems (such as screen printing and pad printing) or systems that can damage the material's surface (such as punching or micro-percussion marking).

EFFICIENCY

Laser marking is a contactless process. This means that tools are **not subject to wear**. Moreover, it doesn't involve purchasing or disposal **costs for consumables**, such as chemicals or inks. It doesn't require pre- or post-treatments.

INALTERABILITY

Unlike other technologies, laser marking is **permanent and resists wear**, heat and the contact with acids. THIS characteristic is essential to ensure traceability and quality.

HIGH-DEFINITION

The tiny laser spot allows for marking complex patterns with the **utmost precision**. Even the smallest character can be easily identified, ensuring a reliable quality check. Moreover, by combining the marking process with cleaning, you can increase the contrast and make Datamatrix and QR codes more readable even in harsh environmental conditions.

NO CONTACT

The absence of contact between the marking system and the component to be marked leaves the material free from pressure, tension and fastenings. This way, **its surface remains intact**. Moreover, it allows for marking areas that are not easy to access, without using particular tools.

SPEED

Laser marking is one of the **fastest processes on the market**. It allows for increased productivity and brings economic advantages.

VERSATILITY

Laser allows you to write anything with any font or alphanumerical character and create **logos, barcodes, sequential numbering, drawings, Datamatrix codes**, etc.

Comparison between laser and other technologies



	STAMP	LABEL	INKJET	PUNCHING MACHINE	LASER MARKER
RESISTANCE OVER TIME	2	3	3	2	5
LESS PRODUCTION WASTE	1	3	3	3	5
MARKING IRREGULAR SURFACES	2	2	3	1	3
DATA CHANGE FLEXIBILITY	1	3	5	2	5
MATERIAL CHANGE FLEXIBILITY	3	3	3	1	4
INITIAL SAVINGS	5	3	2	3	2
SAVINGS IN THE LONG RUN	2	1	2	3	5



Our mission

We started manufacturing laser marking heads over thirty years ago. Today, we manufacture complete laser marking systems. In the past few years, we have been focusing more on automation, providing integrated traceability solutions to meet the requirements of an ever-growing market oriented towards process automation and customer requirements.



lasitlaser.com

We operate on a global scale, serving over **50 countries**. We've been designing and manufacturing **standard and customised laser marking machines** for thirty years, always ensuring continuous support to our clients.



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LASER MARKING INNOVATION



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