LASER MARKING ALUMINUM

Common applications and marking specifications

LASER MARKING ALUMINUM

Marking aluminum is one of the most common applications for a fiber laser marking system. This is because laser marking aluminum with a fiber laser provides many opportunities to make unique and interesting permanent marks.

Both uncoated and coated aluminum substrates can be made to yield attractive marks with a fiber laser. Aluminum coatings are usually in the form of anodize or chemical film conversion coatings (like Iridite or Alodine). In all cases, laser marking removes the coating on the aluminum by vaporizing it away.

To achieve the types of long lasting, clear, and durable marks on aluminum substrates with a fiber laser requires an understanding of the marking system and the material.

This whitepaper will address some of the most necessary marking aluminum topics including:

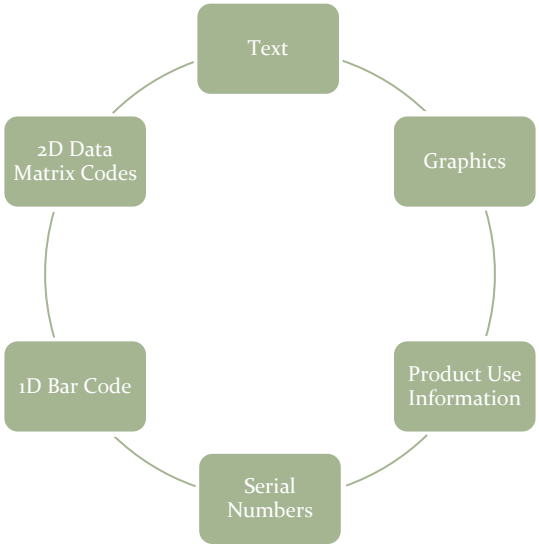
- Common Applications
- Types of Mark
- Laser Marking Equipment

COMMON APPLICATIONS

Aluminum is a commonly used material that can be found in nearly every industry. From gun components to automotive parts, aluminum can be found in a wide range of industries, including:

- Ad Specialty Products
- Aerospace
- Automotive
- Consumer Goods
- Electronics
- Job Shop
- Firearms
- Medical
- Metal Fabrication

Because aluminum is so widely used, it marked by an equally wide range of marks. Some of the most common mark types include:



Essentially, any image that can be reduced to a set of vector lines or text can be marked.

TYPES OF MARK

Generally speaking, there are two techniques that can be used to create various marks on aluminum:

Ablation
- Most common
- Removes a coating

Engraving
- Vaporizes material
- Creates a depth of several thousandths of a an inch

Each marking technique produces different looks on the aluminum, dependent on the type of aluminum being marked. Each technique is also accomplished in a unique way.

Ablation

Laser ablation is the removal or vaporization of material from the surface of some material or substrate. Ideally, the laser light is absorbed on the surface of the part and there is minimal penetration into the part.

When the coating on aluminum is vaporized away, the base material is exposed and the laser textures the surface such that scattering of reflected light gives the appearance of a stark, white mark. The same is true when marking bare aluminum.

If a dark dye has been used in the anodizing process, the marking contrast is excellent, creating a stark white mark on a dark background. In the case of clear anodize, light colored anodize or chemical film coating, the white mark on a light colored background provides a much more subtle appearance. After marking, an oxide layer will form naturally on the exposed surface and this provides some level of protection to the marked area.

White laser marks on clear or light colored anodized surfaces can be made darker by the application of an oxidizing solution, such as Aluma Black, manufactured by Birchwood Casey. The solution must be applied to the engraved surface, allowed to work for a minute or so and then cleaned off. If the solution is allowed to stay on the part for long periods then it can darken the areas adjacent to the laser marking and cause a “fuzzy” appearance to the marked area. The downside to application of

an oxidizing solution is that any scratches or blemishes in the anodized surface that come in contact with the solution will also turn dark.

Ablation marking on aluminum can be performed relatively quickly. Typically, two laser passes are used. The first laser pass is a "damage" pass using 12-15 watts of laser output power and 25-40 inches/second marking speed to ablate away the chemical film or anodize. The second laser pass is a "cleanup pass" using reduced laser power, say, 10 watts or so, and 30-50 inches/second marking speed to brighten up the marked area.

Engraving

Engraving creates a mark that goes deeper into the material. Increased laser power and lower marking speeds are the trademarks of deep laser engraving. Our

experience at Jimani is that deeper laser engraving is best accomplished with marking speeds of about 5- 10 inches/second using multiple passes in order to remove thin slices of material until the desired depth is achieved. Using very slow marking speeds in order to remove a lot of material in a single pass will result in a slaggy bottom in the trough of the engraving and an accumulation of slag at the edges of the engraving. Multiple laser passes with different fill angles at higher speeds allow for more material removal and cleaner troughs and edges. More laser passes results in deeper marking until the laser beam begins to go out of focus or the vaporized material can't escape from a very narrow trough.

Hard Anodized Aluminum

Laser marking hard anodized aluminum presents particular challenges not found when marking other types of aluminum. This is because a coating of hard anodize will be many times thicker than type II anodize. The anodize will penetrate the substrate as much as it builds up the surface. The result is a durable, ceramic like surface.

Laser marking hard anodized parts can be challenging and difficult. We like to use our 50 watt lasers for hard anodize marking although with more laser passes and slower marking speeds although, it can also be accomplished with a 20 watt laser.

We will typically increase our fill spacing in the marking objects to .001 inches and then make multiple passes at a relatively high speed, say 25 inches per second or so, using relatively high laser power, say 40 watts or so. With hard anodize we still use the damage and cleanup pass technique but the cleanup pass rarely gives the same bright white final appearance that is achieved when marking Type II anodized surfaces.

LASER MARKING EQUIPMENT

Laser marking is an excellent technique for identifying and decorating aluminum substrates. Since their introduction, fiber lasers they have become the laser of choice and now, the industry standard for metal marking applications. Fiber lasers provide the benefits of lower capital costs, lower operating costs and superior marking performance.

The Langolier is a cost effective, highly reliable, zero maintenance, energy efficient, turnkey laser marking system built with industry leading components and safety features and is appropriate for a broad range of materials and applications.

JIMANI

Jimani's mission is to provide quality laser marking systems for applications that are well suited to the equipment and laser marking process. Unlimited growth and sales numbers have never been a driving force at Jimani. Using the same equipment that Jimani sells, Jimani's contract marking services have provided the foundation for understanding and optimizing the wide range of laser marking applications and issues that must be addressed by a quality laser marking system.

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