Materials

The physical properties of a metal sheet determine whether the sheet is suitable for laser processing. The absorption coefficient indicates how much laser power can be absorbed. Heat-conductivity reveals how fast heat dissipates, or in other words, how much of the laser energy absorbed is available for the cutting process.

In the area of iron, carbon steel, mild steel and stainless steel, lasers produce excellent results. This is due to the fact that alloy elements such as iron, chrome and nickel conduct heat worse and absorb the laser beam better than precious metals. It is virtually impossible to cut precious metals such as gold and silver using a CO_2 laser. A Nd:YAG laser – due to its different wavelength – can couple the laser beam more easily into certain materials. For this reason, Nd:YAG lasers can also cut nonferrous heavy metals and precious metals -- an option which is used, for example, in the jewelry industry.

Good cutting results can be achieved with nonferrous metals made from aluminum alloys and titanium and titanium alloys. Pure aluminum, on the other hand, can only be cut without burs up to a thickness of 3 to 4 mm.

To finish up, it should be mentioned here that in addition to sheet metal, non-metals such as cardboard, leather, ceramics, glass, and synthetics can also be cut well with a CO_2 laser. However, other dangerous materials are produced than those in metal processing.

The degree to which a workpiece can be processed is determined not only by the composition of the material, but also by the condition of the material surface and the geometrical shape of the workpiece.

Material surface

Different material surfaces lead to different cutting results. Here are a few examples:

- Sheets whose surfaces have been cold rolled and pickled can be easily cut.
- Zinc-plated steel sheets can be cut to a depth of 4 mm practically without burs by using nitrogen (fusion cutting) and oxygen (flame cutting) as cutting gases. Electrogalvanized or hot-galvanized sheets can also be easily cut.
- Precious metals coated with foil up to a thickness of 3 mm can be flame cut without burs. The foil must be vaporized before the sheets have been punctured and cut.
- Material surfaces with a bright finish such as copper reflect the laser beam to a high degree. In extreme cases, this even prevents the CO_2 laser beam from penetrating the material.
- A light oily layer common to many metal sheets does not negatively influence the cutting results. On the contrary, when puncturing, slag adhesion to the sheet surface is reduced considerably.
- A layer of scale on the sheet surface deteriorates the cutting results. Layers of lacquer, paint and synthetic materials (for example, stickers and grease pencils) also have a negative effect on the cutting quality.
- Rust and layers of scale on the workpiece can cause burn-outs and the formation of craters, as the slag flow can be disrupted by changes in viscosity.

Workpiece geometry

Workpieces with large, less intricate contours can be cut quickly and easily. Other geometric shapes such as fine webs, pointed corners or small holes (edge length / diameter < 2x material thickness) require the modification of particular processing parameters. In such cases, reducing laser power and cutting speed prevents an excessive amount of heat from entering the workpiece. Excessive energy can burn pointed corners away or round off perpendicular corners. Cutting pointed corners can, however, be enhanced by programming traverse paths such as loops or by a specially programmed corner cooling.

Processing example: mild steel