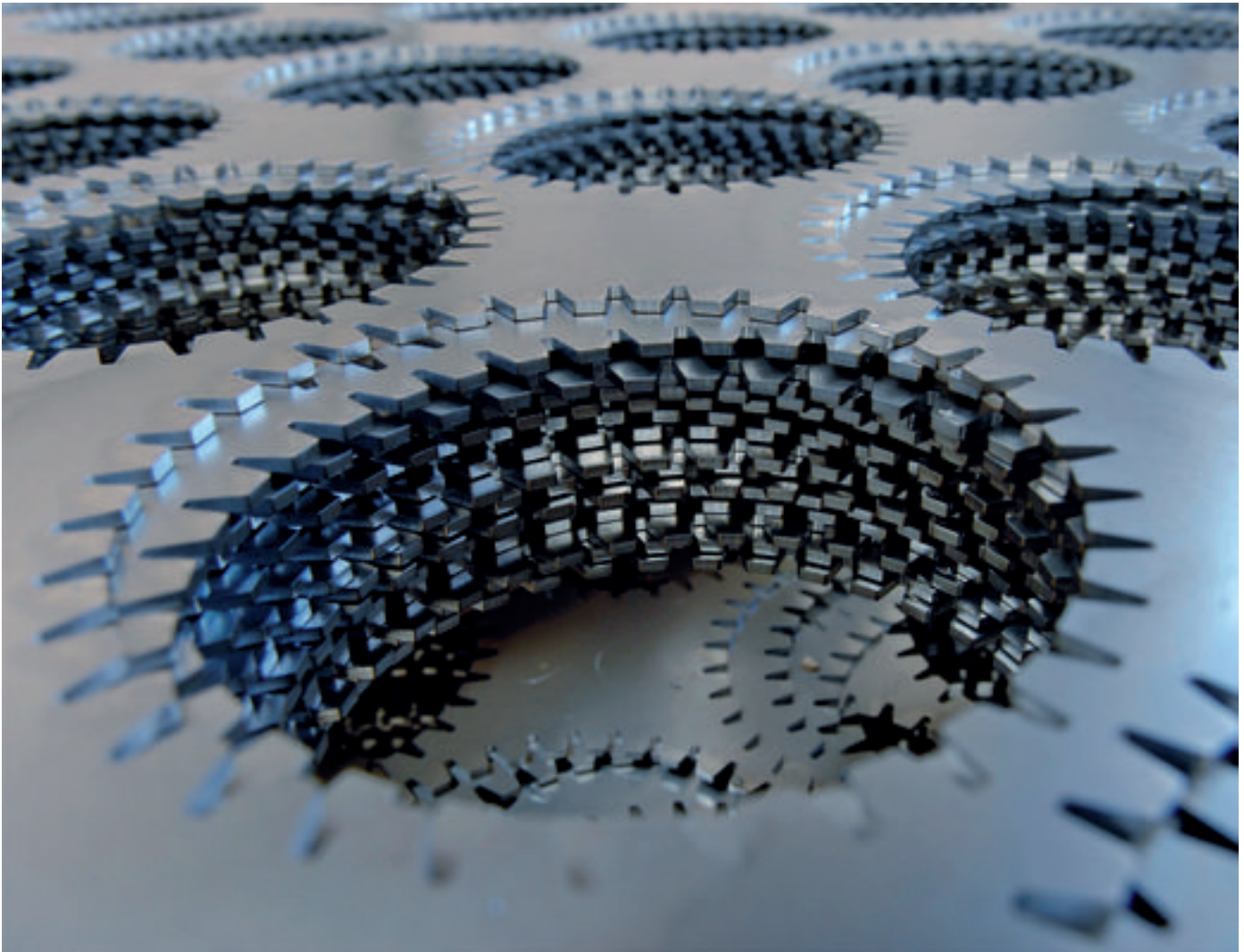


## Lasline, Nitrocut, Oxycut – gases for laser cutting

Expertise that gets right to the point



## Laser technology – high-tech that has made its mark



Increasing demands on productivity, cost-effectiveness and quality require new solutions. One such solution – laser technology – has become indispensable in many areas of production, research and medicine. The number of applications and process technology solutions here is growing continuously. The use of lasers to process materials offers a whole range of advantages over conventional processing techniques: high product flexibility, excellent quality and reliability, and low unit costs.

One of the keys to the optimal application of laser technology is the selection of the operating and process gases. With **Lasline®**, **Nitrocut®** and **Oxycut®**, Messer provides all of the gases and gas mixtures you need in order to successfully process materials using lasers.

### Flexibility for many applications

Laser cutting is characterised by high precision, high cutting speeds, low heat input and less distortions.

Many materials can be cut perfectly with a laser:

- **Steel**
- **Aluminum**
- **Non-ferrous metals**
- **Wood**
- **Glass**
- **Plastics**
- **All kinds of textiles**

Application areas span many industrial sectors, including:

- **Automotive construction**
- **Aircraft construction**
- **Metalworking**
- **Sheet metal working**
- **Shipbuilding**
- **Textile industry**
- **Medical technology**

**Lasline®**, **Nitrocut®** and **Oxycut®** play a major role here in terms of essential factors such as quality and cost-effectiveness.



*View inside a custom cutting operation*



*Stent, approx. 1 mm in diameter*



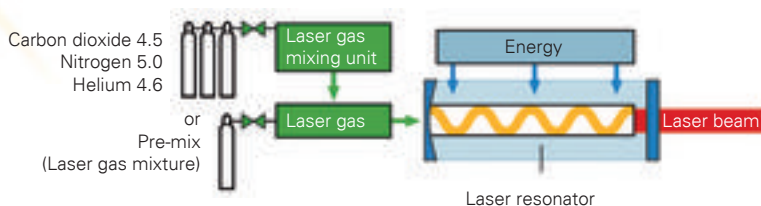
# Types of lasers – no universal solution

The requirements of laser beams vary just as widely as the range of processes and applications that make use of them as a tool. Suppliers of laser equipment respond to those requirements with different configurations and power classes. Most systems can be classified into one of three main groups: **CO<sub>2</sub> lasers**, **diode lasers** and **solid-state lasers** – depending on the medium in which the laser light is generated.

## CO<sub>2</sub> lasers – the dominant solution

The most commonly used type of laser by far is the CO<sub>2</sub> laser. The laser beam is generally produced using a three-component gas consisting of helium, nitrogen and the component that gives the system its name, CO<sub>2</sub>. The wavelength of the CO<sub>2</sub> laser light is 10.6 µm and invisible to the human eye. Mirrors and lenses are used to direct and shape it. One of the special configurations used is the particularly efficient, diffusion-cooled CO<sub>2</sub> laser.

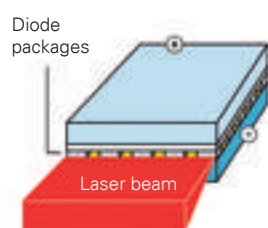
Depending on the equipment configuration, either the laser gas is produced from the three components in an internal mixer or else a pre-mixed product is used. The better reproducibility of the latter approach has made it the preferred option. The **Lasline®** product range offers a suitable selection here.



CO<sub>2</sub> laser

## Diode lasers – the economical alternative

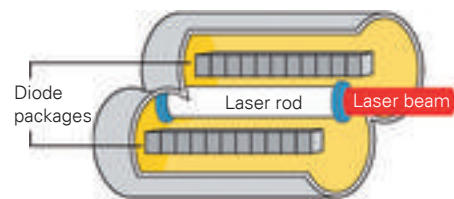
This type of laser is based on high-power diodes. The diode laser achieves its high power output through the arrangement of many electronic components in a block. Due to their comparatively poor beam quality, high-performance diode lasers are less suitable for cutting – but they are perfectly acceptable for welding, brazing or hardening applications.



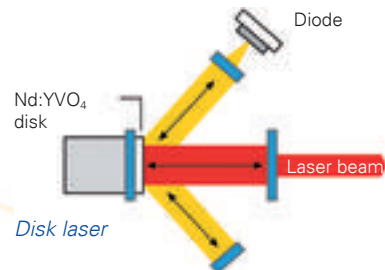
Diode laser

## Solid-state lasers – rod, disk or fibre?

For their laser-active medium, solid-state lasers use synthetic YAG crystals (YAG = yttrium-aluminium-garnet). Besides the rod configuration which has been in use for a long time already, the disk configuration is also now starting to be used.



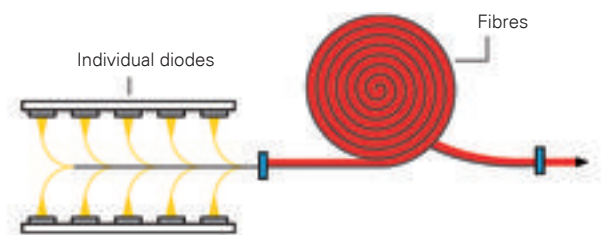
Rod laser



Disk laser

The laser beam is generated without the need for operating gases. Process gases such as shielding gases have a significant effect on the welding process. Due to the short wavelength of just 1.06 µm, the laser light can be transmitted through fibre optic cables. This makes it easier to implement automation solutions using articulated robots, for example. Fibre lasers that have recently been expanded into the kilowatt range have a significantly smaller beam diameter than CO<sub>2</sub> or Nd:YAG lasers. This permits them to achieve greater precision when cutting materials.

Fibre lasers are also the perfect solution for micro-welding operations. When processing a material with a fibre laser, the heat input is very low. That's why it is preferred for welding with a higher power beam.



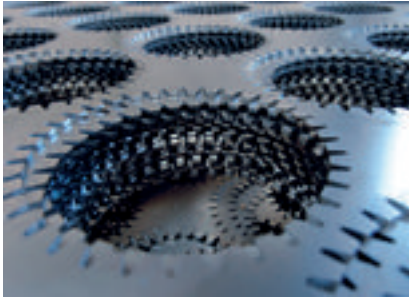
Fibre laser

# Cutting processes – three approaches

All laser cutting processes essentially fall into one of three categories: **Laser oxygen cutting**, **fusion cutting** and **sublimation cutting**.

The right process to use for any given application depends on the material, the quality requirements and business considerations along with the cutting gas used.

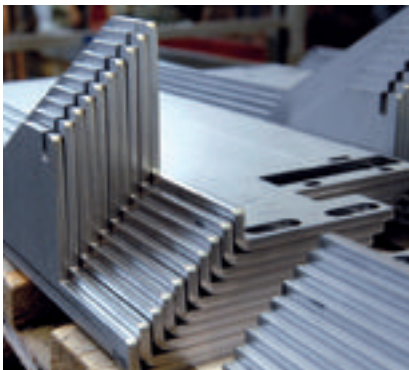
## Laser oxygen cutting



Laser oxygen cutting with pure oxygen is similar to oxy-fuel cutting: the material is heated up to the ignition temperature and then burned in a pure stream of oxygen. This requires that the material is suitable for flame cutting – its ignition temperature must be below the melting point. This is the case with un- and low-alloyed steels. It is not the case, however, with high-alloyed steels and non-ferrous metals. Here flame cutting with oxygen is possible, but for qualitative and economic reasons it is not recommended.

Materials that can be cut	Cutting gas
Un- and low-alloyed steels	Oxycut® (oxygen 3.5)

## Fusion cutting



Materials which are unsuitable for flame cutting are cut with the fusion cutting process. To do so, the material is heated up to the melting point and forced out of the kerf by a high-pressure stream of cutting gas (up to 25 bar). The cutting gas used is usually nitrogen; argon is also used in special cases. This is the case, for example, for titanium, tantalum, zircon and magnesium, as these materials form chemical bonds with nitrogen. For quality reasons, the fusion cutting process can also be used to cut un- and low-alloyed steels. This creates oxide-free cutting surfaces, but cutting speeds are considerably slower.

Materials that can be cut	Cutting gas
CrNi steel, non-ferrous metals, glass, plastics	Nitrocut® (nitrogen 5.0), argon

## Sublimation cutting



Materials without a melting point, such as wood, plastics, composites, Plexiglas (PMMA), ceramics or paper are cut by sublimation cutting. In this case, the material changes directly from the solid to the gaseous state. The cutting gas keeps the particles and vapours away from the optical elements.

Materials that can be cut	Cutting gas
Plastic, paper, wood, ceramics	Nitrocut® (nitrogen 5.0), argon

## Gases and gas supply – reliable and application-based



Gases are needed at several points in the process. Depending on the system, they perform the following functions:

- **Gases used as operating gases to generate the laser beam (CO<sub>2</sub> laser)**
- **Cutting gas**
- **Purge gas**

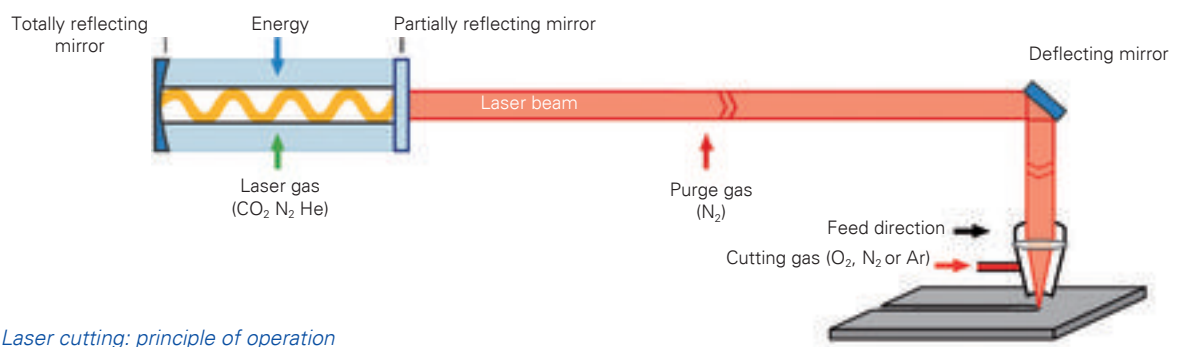
### Laser (operating and) process gases

Laser or operating gases are required in order to operate the resonator. Process gases are fed into the laser beam in the workspace, e.g. as welding shielding gas or cutting gas. The purity, quality and mixing consistency of the operating gases for CO<sub>2</sub> lasers are subject to the highest standards – and for good reason:

- Even traces of moisture or hydrocarbons can impair operation.

- Hydrocarbons can damage sensitive and expensive optical components.
- Moisture disturbs the excitation discharge and disables the laser from achieving its full efficiency.
- The formation of acid molecules can lead to corrosion damage.
- Dust particles can scatter the laser light, thereby disrupting the process.

For perfect laser operation, therefore, it is absolutely essential that the gases used are extremely pure and free of disruptive contaminants. These gases are either supplied in pre-mixed form or their separate components are mixed in the laser unit. And the gas supply system must also satisfy the purity requirements as well.



*Laser cutting: principle of operation*



## Gases and gas supply – reliable and application-based



### Operating gases

The term “operating gases” refers to gases required to generate the laser light. These gases, too, must be extremely pure and free of disruptive contaminants in order to guarantee perfect operation of the laser. They are either supplied in pre-mixed form or their separate components are mixed in the laser unit.

Gas	Purity
CO <sub>2</sub>	4.5
N <sub>2</sub>	5.0
He	4.6

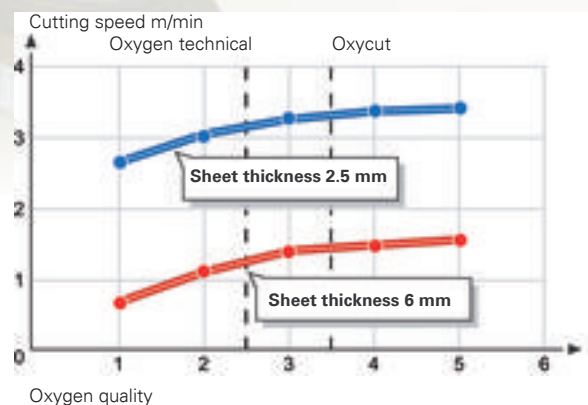
The gas supply system must also satisfy the purity requirements. The composition of the gas mixture depends on the type of laser. The exact composition is specified by the manufacturer. A change in the composition can impair performance or damage the resonator.

### Process gases / cutting gases

Cutting gases are selected according to the material to be cut. Materials which are suitable for flame cutting are cut with pure oxygen. Here the purity of the gas can have a strong influence on the cutting speed. With the high purity of **Oxycut®**, for example, the cutting speed can be increased by up to 20% – depending on the thickness of the sheet or plate.

Most materials which are not suitable for flame cutting are cut with nitrogen. Its inertisation effect results in oxide-free cutting surfaces. Here slight contamination by oxygen or moisture cause discolorations on the cut surfaces. **Nitrocut®** ensures high quality cut surfaces.

Titanium, tantalum and magnesium are examples of materials that form nitrides, as they react strongly with nitrogen. In order to be able to weld these materials without having to perform post-processing operations such as milling, grinding or pickling, it is recommended to use argon when cutting them.



### Gas supply

Depending on the quantity needed and on the intended use, Messer offers various supply concepts which have proven themselves in practice. Smaller quantities such as in the supply of laser gases (operating gases) are handled with gas cylinders.



Individual 10-litre or 50-litre cylinders are most commonly used. For cutting, oxygen or nitrogen is provided in tanks.

Process	Pressure (bar)	Quantity (m³/h)
Oxygen cutting	1-5	2-5
Fusion cutting	15-25	30-50

### Installation

For optimal gas supply, gases have to be transported to their destination without becoming contaminated. This requires proper installation of the hardware, appropriate selection of gas fittings and a need-based supply of gases in the purity needed. The installation of a particle filter provides additional security. The supply of gas to the resonator also demands extremely high purity, both in the resonator gases themselves and also for the pipes and hoses used as supply lines.

The degree of purity of the gases is indicated in percent – a figure given to several decimal places. In order to simplify labelling, an international index system has been established. The indices consist of a digit, a point and a second digit. The first digit indicates the number of nines, and the digit to the right of the point represents the last digit of the complete value.

Example:

2.5 = 99,5 %
3.5 = 99,95 %
4.6 = 99,996 %
5.0 = 99,9990 %

For the supply lines in the fixed part of the equipment, pipes made of copper or CrNi steel are ideal. Hoses always carry the risk that nitrogen, oxygen and especially moisture will diffuse into them. The use of special materials can minimise this problem.

### Safety – without compromise

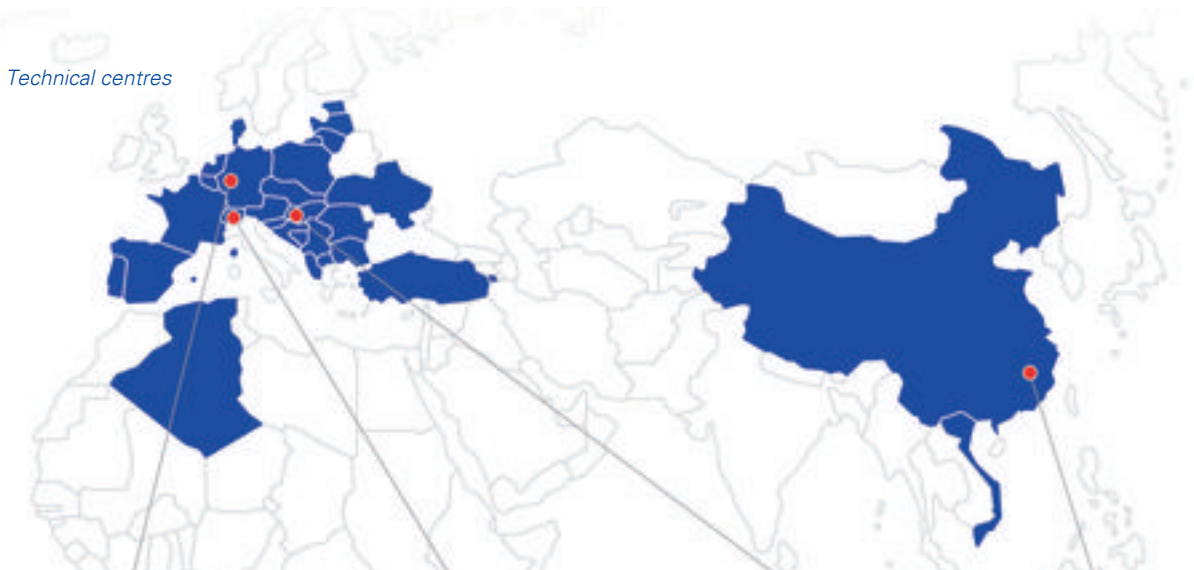
Equipment used in the laser processing of materials requires consideration of several special work safety aspects which are typical of laser-based processes. First and foremost, there is the laser beam itself: its potential risks differ depending on the type of laser, and so the protective measures also differ accordingly. Moreover, emissions generated during welding or cutting must be appropriately extracted and filtered. For the safe use of laser systems and their peripheral equipment, the applicable guidelines and regulations have to be followed.



*For medium and small requirements Messer offers cutting gases also in cylinder bundles, such as the new MegaPack.*

# Advice, Delivery, Service

Technical centres



Krefeld



Dällikon



Budapest



Shanghai

## Technical centres – sources for innovation

For the development of new technologies in the field of welding and cutting, Messer operates technical centres in Germany, Switzerland, Hungary and China. These facilities provide ideal conditions for innovative projects as well as customer presentations and training courses.

## Portfolio of gases – comprehensive and clear

Messer offers a spectrum of gases that extends well beyond the standard fare: it ranges from just the right gas for each application, and clear, application-oriented product designations to the continuous introduction of new gas mixtures designed to address current trends.

## Specialised on-site consulting – right where you need it

Specifically in the context of your particular application, we can show you how to optimise the efficiency and quality of your processes. Along with process development, we support you with troubleshooting and process development.

## Cost analyses – fast and efficient

We will be glad to analyze your existing processes, develop optimisation proposals,

support process modifications and compare the results with the original conditions – because your success is also our success.

## Training courses – always up to date

For the optimal handling of our gases, we can train you on processes and how to use them. Our training courses illustrate the use of various shielding gases for welding and explain how to handle them safely. This also includes the storage of the gases and the safe transport of small quantities. Information and training materials for your plant are also part of the service, of course.

**You can also download this brochure and many others from the Internet as a PDF file:**  
[www.messergroup.com](http://www.messergroup.com)

## Good for you and the environment

This brochure not only contains interesting information – it is also kind to the environment as it is printed on 100% recycled paper. We would kindly ask you to dispose of any brochures that you have “finished reading” or no longer require as waste paper for recycling.



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