The JETLASER

Laser cleaning –
Wide range of applications

Directory

Just click the numbers to navigate

Cleaning by Light?

Perfect surfaces are key for the quality and appearance in industrial production. What started as a vision long ago has become reality:

Surface cleaning without blasting media, water, chemicals or dry ice.

More and more customers around the globe are choosing our flexible JETLASER systems for industrial surface cleaning to benefit from these advantages:

- Dry process – without abrasives, ice pellets or chemicals
- Gentle cleaning – without tool or surface damage
- Mobile systems – cleaning where its needed
- Robust, maintenance-free laser technology – from the pioneer and leading manufacturer in industrial laser cleaning
- Compact systems – small footprint, no need for storage and preparation of cleaning media and its recycling

Read this white paper to find out why leading international companies in your industry rely on the JETLASER.

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Laser cleaning

Basics

Laser light has become an indispensable part of our everyday lives. Since the first appearance of a laser beam in the James Bond movie “Goldfinger” in 1964, light as a tool has become established in countless applications: Lasers are used to measure distances, project light shows, separate and join materials, label components or perform surgery.

Since 1993, lasers have also been used in industry to clean and decoat surfaces. What started as a crazy idea of physicists around pioneer Dr. Heinz Jetter and his company JET Laser has established itself 25 years later as a tool for precise, environmentally friendly and material-friendly processing of high-quality surfaces in numerous industries.

1995:

The world's first hand-guided laser cleaning system was presented at the Hannover Messe

But how does "cleaning with light" work?

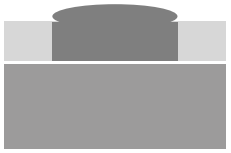
Our cleaning lasers work with a wavelength of about 1µm. Light of this wavelength is well absorbed by many typical layers of contamination, which means the energy of the laser beam can be absorbed in the layer.

Unlike laser cutting, for example, our lasers do not emit their energy continuously, but in the form of tens of thousands of short light pulses per second, each with a duration of only a few nanoseconds (1 nanosecond = 1 billionth of a second). Each pulse typically illuminates an area of a few millimeters on the surface.

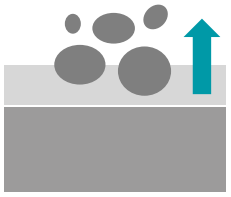
In the illuminated area, the energy introduced causes the layer to abruptly heat up locally and evaporate (so-called sublimation) or flake off - the coating is transformed into vapor and dust and can be extracted.

1 Laser beam contacts the coated surface

2 The laser activates with the material / coating, but not the part itself



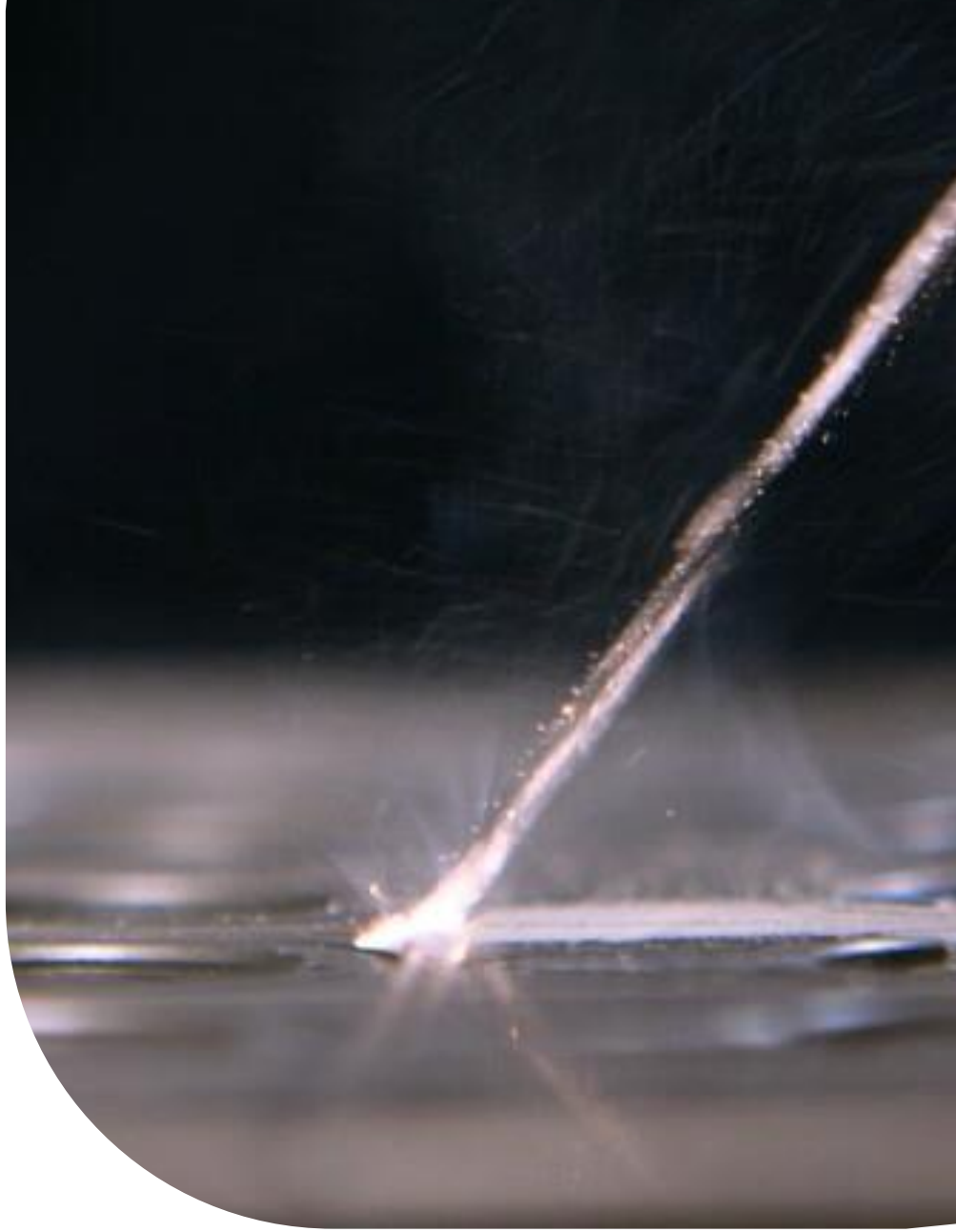
3 The surface is cleaned due to vaporization or sublimation



Yes, we scan!

The individual light pulses are positioned overlapping by a so-called “scanner” on the part to be cleaned. Depending on the system, we use a 1D scanner (which creates an oscillating cleaning line) or a 2D scanner (which deflects the beam in two directions on the surface).

The scanner strings together the individual light pulses, resulting in a two-dimensional ablation that looks to the human eye like a continuous laser line several centimeters long. This line is guided by the operator over the surface to be cleaned and allows the cleaning of large areas at speeds of up to several m² per hour.



Laser parameters at a glance

The higher the energy per light pulse and the more pulses per time a device emits, the higher the average power. We offer laser systems between 100 watts and 2,000 watts average power. As a rule of thumb, the higher the average power used, the faster a system can clean.

However, the actual speed is determined not only by the power used, but also by the accessability of the parts surface, the absorption behavior of the layer to be removed and its thickness. For typical processing tasks, the area rates are about

Application	Area rate per hr with 500 W
Mold cleaning Release agent residues	3 - 6 m²
Oil removal	15 - 20 m²
Removal of light oxide layers (rust)	5 - 10 m²
Paint removal	3 - 10 m²

The parameters in detail

Pulse Energy – The energy that a single pulse of light brings to the surface layer (typically a few millijoules)

Pulse Overlap – Determines how close together the laser pulses of the scan line are placed

Pulse repetition rate – The number of pulses per time (typically about 10,000 to 50,000 pulses per second)

Focal length – By exchanging lenses of different focal lengths, the beam spot can be made smaller or larger on the component, thereby changing the energy density (so-called fluence) on the surface

Average power – Calculated from
pulse energy * pulse repetition rate

Example:
100mJ pulse energy * 50 kHz pulse repetition rate = 500 W average power
50mJ pulse energy * 100 kHz pulse repetition rate = 500 W average power

Energy density – also called fluence – generated in the beam spot of the laser light hitting the layer (typically few J/cm²).

When choosing the parameters, one selects the energy density in the beam spot sufficiently high to remove the layer to be removed. If you fall below this threshold, the process does not work; if you exceed the value significantly, the process becomes inefficient or there is a theoretical risk of damaging the underlying material.

Example:
Oily release agents in molds can be removed with an energy density of 1.5 joules per cm². The steel substrate only changes at an energy density of about 10 joules per cm².

→ **The good news** – Our systems can be changed from one mode to another with a few simple steps and we can recommend the right parameters for an application based on our extensive experience.

Key advantages of the process :

Material-friendly

Due to the extremely short pulse duration only a small amount of heat is transferred to the underlying substrate, which is why even sensitive materials can be easily cleaned without melting or cracking.

Mobile

Our systems are compact and can be moved with a trolley. Laser cleaning thus allows in many cases the cleaning of fixtures and tools in installed condition without dismantling.

Low maintenance

Lasers deliver consistent results over thousands of hours of operation and require little maintenance or repair.

Dry

Lasers operate without solvents, abrasives, or water, reducing resource consumption and making them easy to use in a manufacturing operation.

Energy-saving

Laser cleaning systems have a power consumption of a few kW/h and are therefore much more sustabinable and cheaper to operate than wet-chemical or pressure-driven cleaning technologies.

Compact design

Our systems are the size of a refrigerator and are thus significantly smaller than conventional cleaning machines.

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Applications for laser cleaning

An overview

Wide range of applications

The applications for flexible and hand-held laser cleaning are almost unlimited. In addition to use cases in the cleaning of molds and tools or maintenance, there are numerous applications for industrial laser cleaning technology.

Some of the most typical applications at a glance

Paint Stripping

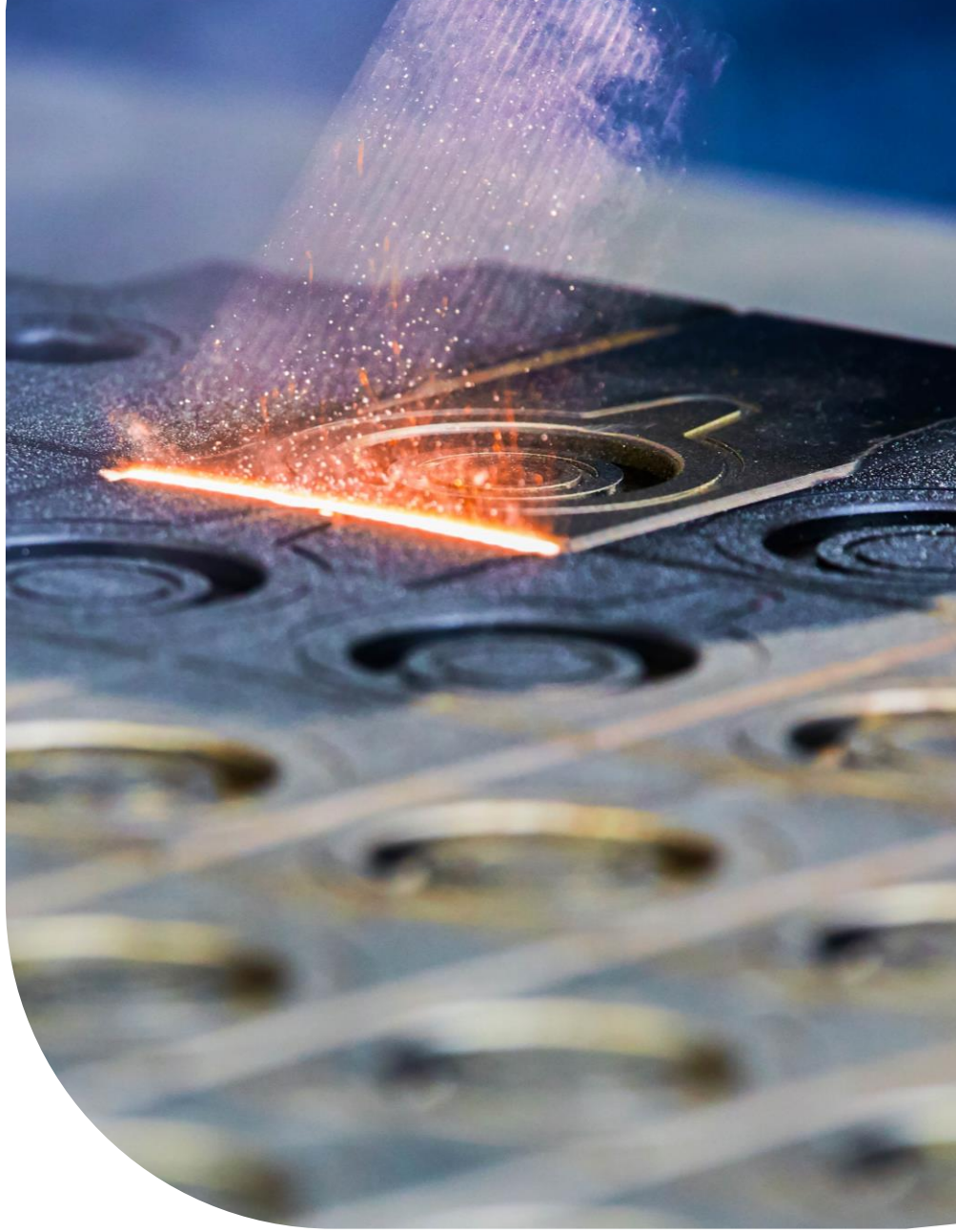
Coatings can be processed efficiently with the laser process in many cases. There are numerous applications for this:

One increasingly popular application is the locally selective stripping of surfaces with cathodic dip coating or powder coating. During further processing of such components, joining surfaces must be free of paint. In the conventional process chain, these areas are therefore masked off with adhesive tape or masking material before painting. After painting, this time-consuming masking must then be removed again. At the same time, improper masking results in expenses for reworking or scrap parts.

Selective paint stripping on a cathodic dip coated cover for battery trays

By using laser equipment, the masking is eliminated entirely – instead the unwanted paint is removed after a full-surface dip coating. In the process, the laser removes the desired geometries. This typically automated processing can also be carried out in a semi-automated operation with the JETLASER for small quantities.

Old top coats on industrial plants, bridge railings or other infrastructure can be selectively removed without affecting underlying layers. Especially when removing lead-based paints, the laser process in combination with local extraction allows a significant reduction of problematic substances requiring disposal.



Historical building monument before (left) and after laser cleaning (right)

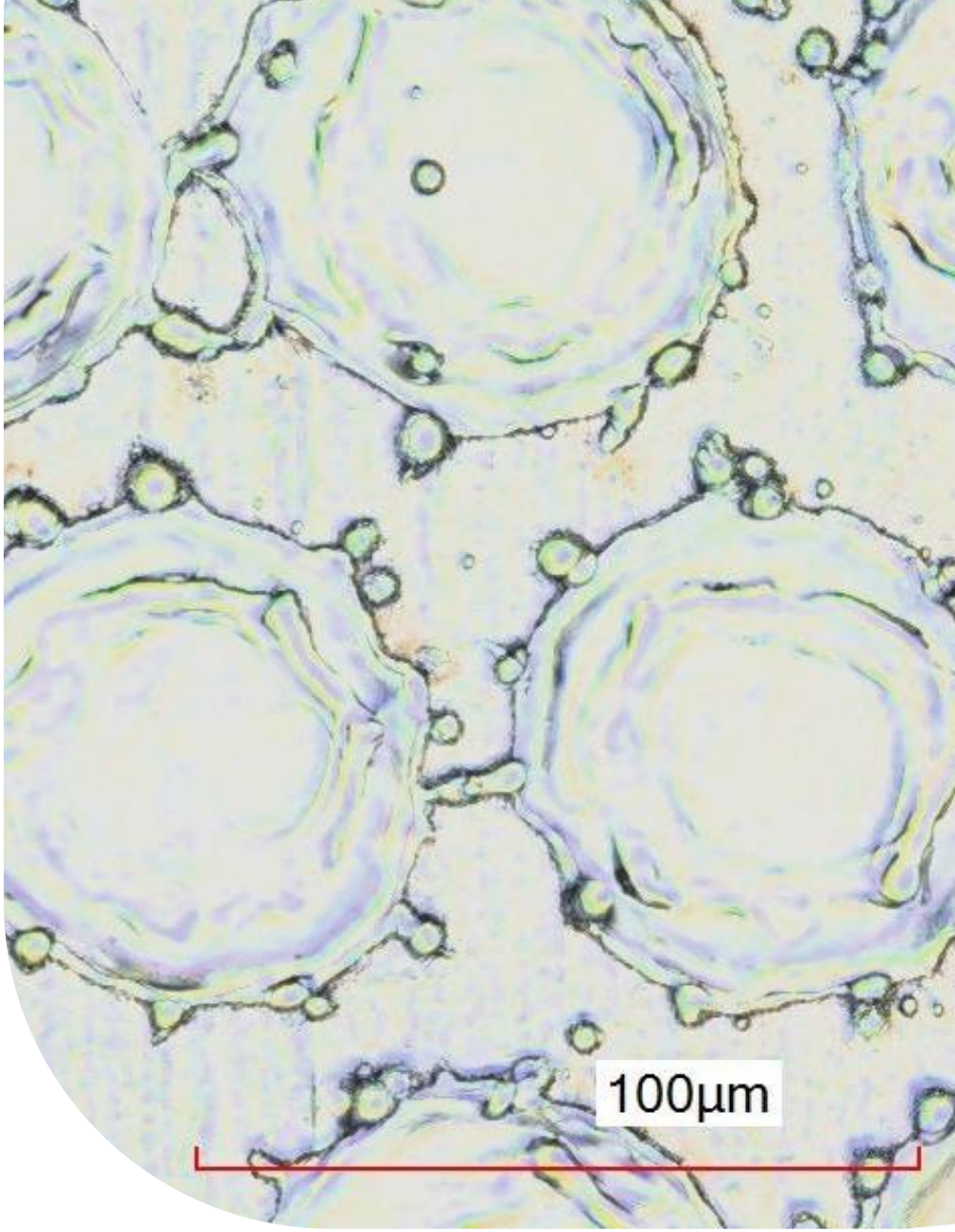
Wooden window frame of a protected building before (left) and during laser cleaning (right)

Building Renovation

When renovating old buildings, the JETLASER may be used for stripping paint from historic wooden window frames - these can be stripped without removal on site and then freshly painted.
Also sandstone facades, marble and clay can also be cleaned to remove traffic film. Restoration of fire damage is also possible.
Sooty buildup can be laser ablated prior to repainting.
The laser removal of graffiti and chewing gum residues, is usually too slow and not economical compared to existing processes.

Surface preparation

Whether before painting, welding, soldering or adhesive bonding - a perfectly cleaned surface is an essential prerequisite for a durable connection. Typical contaminants that could interfere with subsequent contacting and coating processes can be removed quickly and residue-free with the laser. These include oxide layers or oily residues and release agents, for example. Laser processing can also be used to increase the roughness of a surface by introducing small cavities - similar to cleaning with an abrasive blasting process. In the pretreatment of welding processes for aluminum or stainless steel, lasers achieve a speed of many meters of weld per minute.



Microscopic image taken with a confocal laser scanning microscope of a laser structured aluminum surface

Rust Removal

In the maintenance of critical infrastructure or tools, surfaces often have to be freed from rust in order to be able to exclude structural damage. The blasting processes commonly used to date and the required abrasive extraction are often difficult to implement at processing locations that are difficult to access.

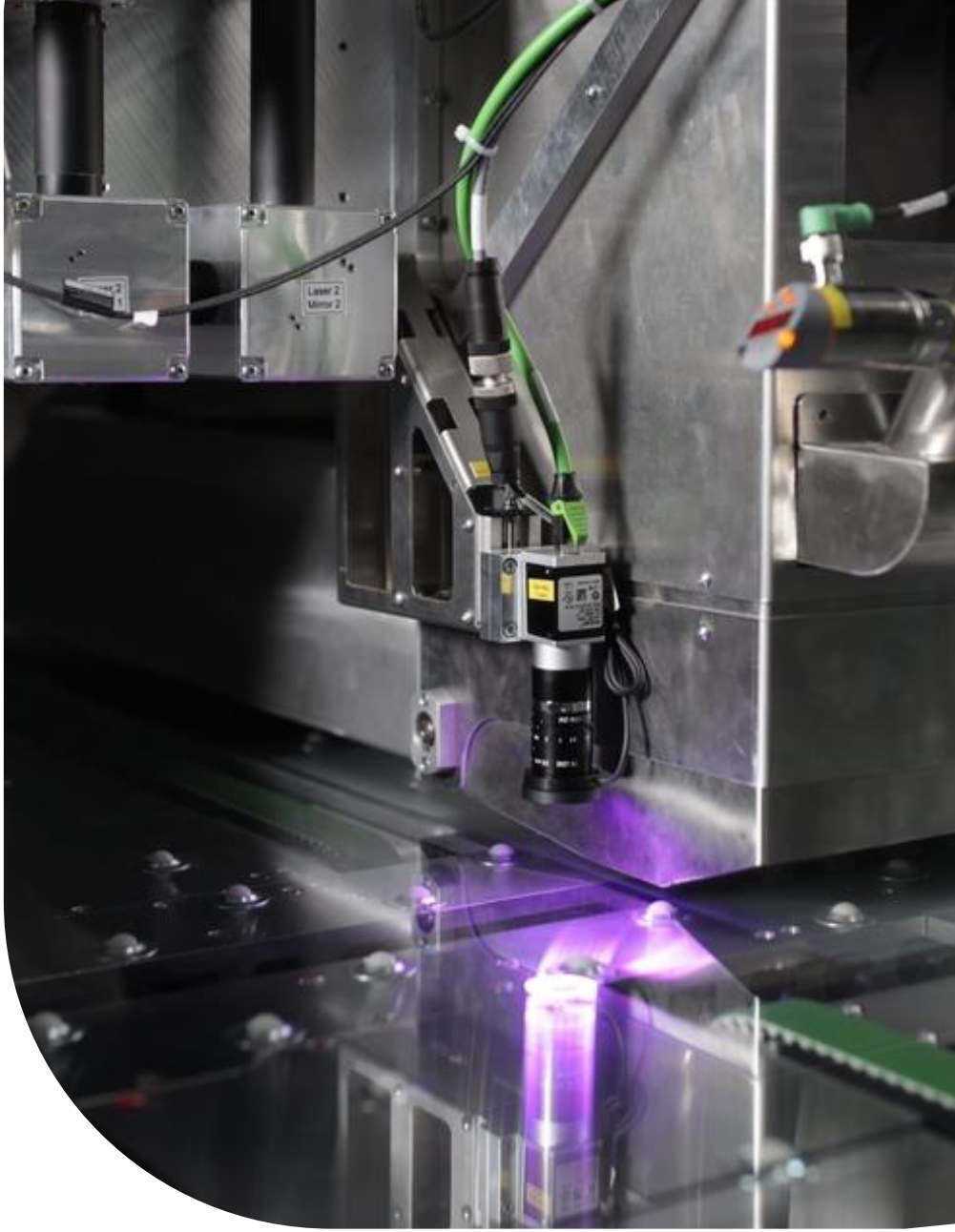
Light and medium rust deposits are removed quickly and thoroughly by the JETLASER. The substrate surface and structural integrity of the workpiece is not affected by the process.

Deep-seated rust typically requires high power systems to realize economical processing times. Also, the laser process operates as a "line of sight" process and requires direct access to the surface with the laser beam. For this reason, the laser is only suitable to a limited extent for use in the refurbishment of historic vehicles.

Coating Removal

During vacuum or plasma coating of components, areas are often exposed that should actually remain free of coatings. In some cases, the coating is also deposited on shielding plates or tool carriers, which have to be cleaned regularly.

In many cases, such thin film coatings can be removed effectively with the laser. Typical applications include the removal of thin conductive oxide or metal layers when coating architectural glass, solar cells or displays.



Laser Thin-Film Removal
(in an automated 4JET system)

04

JETLASER

Systems for laser cleaning

Click to see in action

Our JETLASER series includes several models that differ in cleaning speed due to their laser power, but are built according to the same operating principle:

- A mobile base unit houses the laser source, the cooling unit and the control system.
- The laser light and the control signals are guided through a hose package via a flexible light guide cable.
- The handpiece allows the laser light to be guided over the surface to be cleaned. This handpiece contains a so-called optical collimator, a lens and the scanner with which the laser light is "brushed" over the surface.
- For the respective data on dimensions, weights and other technical data of the different models, please refer to the respective valid data sheet.

Interested? Please contact us!

We help you to choose the right laser system

How much laser power is required?

A simple rule of thumb: the more average laser power, the faster the system works and the higher the initial investment.

The JETLASER series includes systems for every application: from the compact entry-level model with 100 watts of power, to the workhorse with 500 watts, to high-performance systems in the kW power range for continuous cleaning of large areas.

Depending on the model, the investment costs range from EUR 50,000 to EUR 300,000.

Our mobile JETLASER is ideal for applications:

- For which dry ice cleaning, sandblasting or chemical baths are used today
- For surfaces that are "visible" to the laser beam (i.e. do not have complex undercuts or channels)
- For a high variety of different component geometries
- If several different cleaning tasks are involved (for example, in industrial services)
- Where mobile use is required (as in the cleaning of built-in tools or the processing of facades)
- When little space is available

Your way to the right decision

1. Arrange a trial cleaning of your parts with us or one of our partners
2. Discuss the results and recommended specification with our consultants
3. Arrange a test purchase, or rent a system for trial use at your facility

By the way:
We also offer contract machining of components in our Laser Jobshop as a Service.
Inform yourself!

If you need to clean more and faster – Automatic laser cleaning

For high volumes of repetitive cleaning tasks, such as processing large series of components in multi-shift operation, automatic laser systems like 4JET's SCANYWHERE cells are best suited.

- Modular systems with 200 W to 4,000 W laser power
- 1 or 2 robots for optics or part positioning
- Loading by conveyor belt, turntable or lift gate
- Intuitive program generation

05

Safety

We are serious!

As a German company that has been supplying machines to some of the most demanding industries and customers worldwide for two decades, we place the highest value on the safety of our products.

Therefore, the following must be clearly stated in advance:

Hand-held laser systems - regardless of their performance class - pose a safety risk if operated improperly and may cause permanent damage to eyesight. It is also important to ensure effective extraction of the ablation products.

Of course, our systems are CE compliant, but with a comprehensive safety architecture we go far beyond the requirements of the norms and usual industry standards:

We only allow two-handed operation. Regardless of whether left- or right-handed – one hand guides the system, the other includes a "dead man's circuit" to ensure that the device no longer emits laser light in the event of slips.

- The components and safety mechanisms installed by us meet the requirements of so-called Performance Level D according to the specifications of the Machinery Directive. This means, for example, that no leakage radiation can be emitted from the laser even in standby mode (an effect that we have observed in the laboratory with devices from low-cost suppliers – despite CE marking).
- Our lasers monitor their power and detect a possible fiber breakage immediately.
- We supply a comprehensive accessories package for safe and convenient operation of your system.

However, the most important contribution to occupational safety is provided by the customer. In addition to an inherently safe machine, laser safety is based on 3 organizational pillars that we support:

Personal Protective equipment

We supply suitable safety accessories qualified by us. These include laser safety goggles and laser safety curtains to protect operators and work areas from stray radiation. Our range also includes suitable fume extraction systems with the appropriate filter class for the vapors and dusts generated during processing.

Work instructions

Documentation of safe working practices is an essential building block for a consistent safety culture. Our comprehensive documentation provides important building blocks for such training, which must be further detailed for the customer's particular application.

Safety instructions

Operators are to be sensitized regularly (not only during initial commissioning by us) with regard to possible safety risks and organizational measures.

To ensure that these measures are permanently in place on the customer side, we recommend that users train a laser safety officer. Work content and training are similar in the different international markets and there are numerous providers for classroom and online training.

Operating costs, maintenance and spare parts

Our laser machines operate largely maintenance-free and require only a power connection and compressed air. After a short instruction within a few hours, operation is possible without any problems.

The operating costs of a laser system are less than 1 € / hour.

The operator only has to carry out the maintenance work prescribed in the operating instructions, which is limited to regular inspection and cleaning of the equipment.

The laser sources and optical fibers we use are products of well-known German or listed international companies.

Base units and control hardware are also from the "big names" and designed for use in industrial production - this means not only high availability, but also continuity in the procurement of spare parts should there be a defect after a few years.

Our customers can rely on extensive technical support from 4JET and, depending on the area of application and availability requirements, can purchase additional services, including for example:

- Hotline support – we help 24h a day, 350 days a year
- Training – online or on site, we train you
- Teleservice module with mixed reality glasses – your operator becomes the eyes and hands of our service experts – without expensive travel!
- Warranty extensions – up to 3 years

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