TRUMPF Laser

Lasers for Medical Device Manufacturing

Quality in Focus

TRUMPF

TRUMPF – Setting the Pace in Production with Lasers for Medical Device Manufacturing

With its outstanding characteristics, the laser in medical device manufacturing is the production tool of choice. It is used for welding, cutting and marking of all conventional materials.

1973

TRUMPF Laser, previously HAAS-LASER, is a pioneer in industrial laser devices for spot and seam welding. Medical device manufacturers are among the first users. The same applies later on when lasers are used for cutting applications.

1985

TRUMPF brings the first industrial laser light cable onto the market. It guides the laser beam flexibly along a glass fiber, from laser device to processing station. The beam separation resulting from this offers many advantages, e.g. four longitudinal seams can be simultaneously welded onto an endoscope shaft, minimizing distortion.

1990

TRUMPF introduces welding lasers into dental laboratories. Today the technology is standard practice.

1998

TRUMPF opens up entirely new possibilities with its diode-pumped marking lasers, introducing a new quality of laser marking.

2005

TRUMPF introduces new lasers for microprocessing – an area of application that extends far into the future.

Whatever is involved – the manufacture of endoscopes, medical instruments or implants – lasers work with speed, precision and repeatability. The result: highest quality.

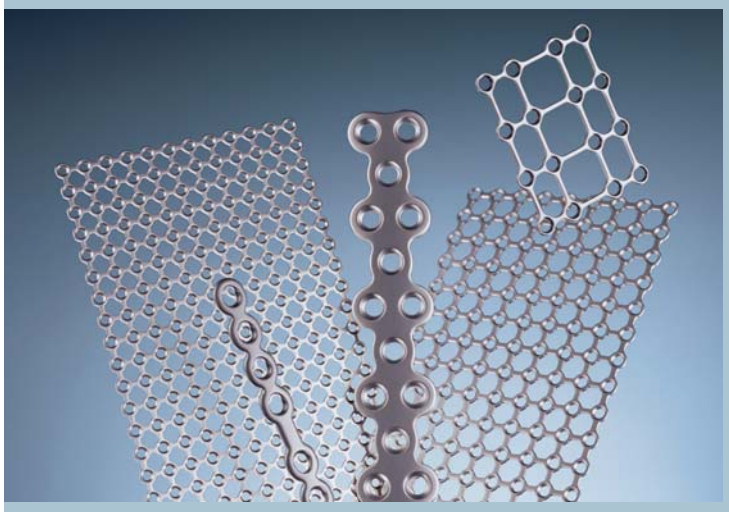
With its innovative, reliable products and many years' experience, TRUMPF is one of the leading producers worldwide of industrial laser devices and installations for cutting, welding and marking. Since 1973, medical device manufacturers have been using TRUMPF lasers on their production lines.

To suit the large variety of applications, TRUMPF offers laser devices and installations for automated as well as manual production.

A sophisticated service concept gives users peace of mind with regard to economically efficient use of the laser. This ranges from application support to individual training and service.

Welding

- Small spot diameters and narrow seams
- Non-contact and no mechanical force
- Minimal heat affected zone
- Hermetic weld without porosity
- Corrosion-resistant
- As bio-compatible as the base material
- Complex contours



Cutting

- High precision
- No mechanical force
- Smallest of radii for cutting tubes and hollow bodies
- Variable cutting angles
- Thicknesses from < 0.1 to several millimeters
- Minimal heat affected zone
- Excellent edge quality with minimal burr

Marking

- Long-term durability
- Resistant to high-temperature sterilization
- As bio-compatible as the base material
- Minimal heat input
- Flexible and fast in text/image application
- Metals and non-metals
- Resolutions to 25 µm

Instruments for Surgery

A large number of instruments are used in surgery – and every single one is subject to the most stringent quality requirements, from materials and processing method upward.

The manufacture of surgical instruments requires large product variety and small lot sizes. Here, the high flexibility of the laser makes it ideal for welding, cutting and marking applications.

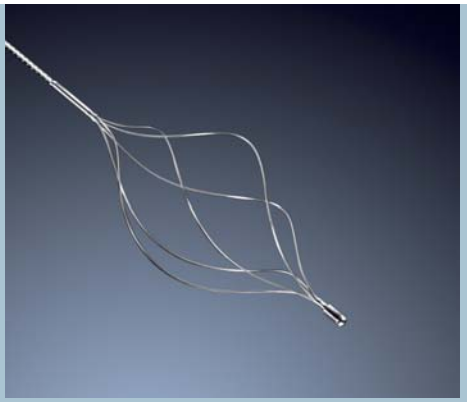
Surgical instruments feature many different cutting applications. Trocars and endoscope shafts require ultra-small radial cuts, and complex openings can be cut in thin-walled tubes.

Contour cuts can be found on various forceps and scalpel points, and notches on bone reamers and drills. The production of linked element structures in moveable guide instruments is done solely via cuts in the tube.

All cuts are of high quality: they are smooth, sharp-edged, and with minimal burr. The cutting angle is selectable. Depth of roughness and heat affected zone are just a few micrometers.

Endoscope
Seam welding
Marking

Endoscopic forceps
Seam welding
Cutting
Marking



Retrieval basket made of Nitinol
Spot welding

Like cutting, welding also benefits from high power density of the laser. The heat affected zone is somewhat larger than with cutting, but just as defined and limited.

Inlets and connections to endoscopic instruments are welded quickly and precisely – often in one single set-up.

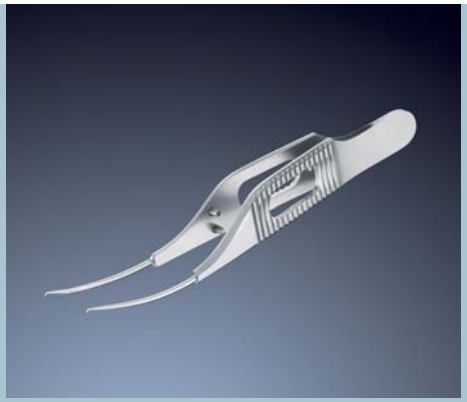
On the endoscope shaft, two tube-to-tube connections are welded using four weld seams, simultaneously and thus distortion-free. The shape and cross-section of the tubes remain the same. The simultaneous processing is made possible by dividing up the laser beam into several laser light cables.

Welding generally takes place without the use of additional material. Filler material, in the form of wire, can however be used to create a flat surface or fill a gap. The pore-free, sterile surfaces of the laser seams have the same biocompatibility as the base material.

Laser marking fulfils the requirements for long-lasting and durable product identification. The color-change thus created does not affect the surface consistency of the material. Marked instruments remain sterilizable at high temperatures. The laser masters many different marking tasks without a problem, due to its unrivaled flexibility and continuous high quality.

With its high resolution, the laser is also ideal suited to marking data-matrix codes, and thus for the highest information density.

Acetabulum reamer
Cutting
Marking



Forceps
Cutting
Welding

Neurosurgical punch
Marking

Passive and Active Implants

Long-life cycle and biocompatibility are of the utmost priority with medical implants. Active implants also have to be as small and light as possible. The laser offers ideal production methods for this.

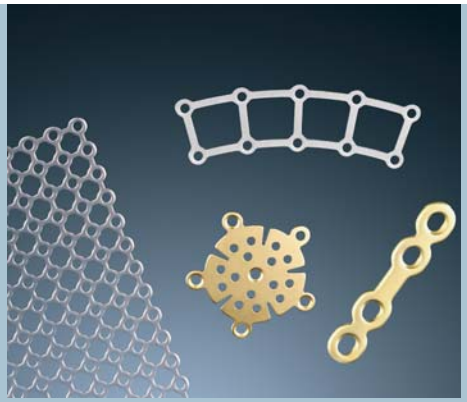
Where the cutting of titanium implants for orthopaedic applications is concerned, the laser is ideal not only for its cut quality but also its high flexibility.

Whether for implant systems for surgery to the mouth, jaw, face or hand, or implants in the spinal region, a variety of implant shapes can be cut quickly and economically without the need for any tool changes, and via CAD/CAM.

The cutting angles can be adjusted, and the cuts have smooth surfaces and sharp edges with minimal burr. Finishing work is generally not required.

With aneurysm clips for neurosurgery, the laser is used for precision welds on the clip. The weld seam is also smoothed via laser. The fine weld connections are distortion-free. This results in optimal guidance and perfectly-shaped aneurysm clips.

The tiny but pin-sharp laser marking on the clip guarantees identification and traceability.



Titanium implant systems
Cutting

Wrist implant
Cutting
Marking

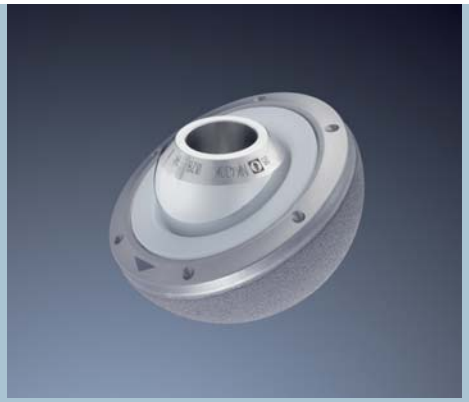
Larynx membrane
Welding

Pulsed solid-state lasers are especially suitable for closing the titanium housings of pacemakers, defibrillators or implanted pumps. Overlap spot welding ensures that the two halves of the housing are hermetically welded. Here the melt-heat spreads from pulse to pulse across the housing, so that the sensitive electronics located inside are never heated to more than 50 °C. The welding depth can be precisely adjusted. This prevents any interior weld splatter.

Moreover, pulsed solid-state lasers are also used for various spot welds on internal electronic components as well as in electrode production.

Laser marking of implants is highly varied and individual. It includes the product identification and corporate logo plus further functional information. Serial numbers and data-matrix codes ensure traceability of all patient-related data.

Like the weld seam, markings are also physiologically safe.



Hip joint prosthesis
Marking

Hip shaft prosthesis
Marking

Upper thigh implants
Marking

Laser Machines for Welding and Cutting

TRUMPF laser machines are flexible in application, and suitable for every lot size. Short set-up times and simple transmission of CAD data to the machine control enhance their economic efficiency still further. Additional axes also ensure optimal adjustment during 3D processing.

Generously-sized working areas and high-precision CNC axes with travel of up to 1000 x 500 x 400 mm are among the distinctive features of laser machines from TRUMPF. All the machines can be combined with TRUMPF solid-state lasers of every power class via the flexible laser light cable. This means that both laser and machine can be individually adapted to suit processing requirements.

Optically supported installation means that set-up times are drastically reduced. Movement along contours can also be optically controlled. This enables production of a single workpiece without any preliminary prototype.

Repeatability of the various processing tasks is guaranteed, because the laser tool always provides constant results.

The stability of the laser and the precision of the machine enable processing accuracy to 20 µm during cutting and welding.

The processing data is stored in the machine and can be recalled at any time.

Additional turning and swiveling axes plus a swivelable focusing optics enable sophisticated 3D processing. This is useful for endoscopic components, for instance, where several inlets are welded in one set-up.

A machine with a rotary indexing table is advantageous in particular when loading and laser processing take almost the same amount of time. One example is the closure of the two halves of a cardiac pacemaker.

Cardiac pacemaker
Spot welding
Seam welding

Endoscopic component
3D welding

Endoscope shaft
3D cutting
Simultaneous welding

Laser Machines from TRUMPF

- Travel up to 1000 x 500 x 400 mm
- Precise cutting and welding to 20 µm
- Short set-up times
- Optically supported set-up
- Appropriate for any lot size
- High repeatability
- Easy operation
- CAD/CAM interface
- Seam viewing and control via camera
- Ideal for 3D processing

Bronchoscope
3D welding
Inner tube welding
Cutting

Infant bronchoscope
3D cutting
Welding

Laser Workstations for Manual Welding

Workstations from TRUMPF enable sophisticated, manually guided welds under a stereo microscope. Machine welds are also possible via supplementary power-driven workpiece movement.

On manual workstations the workpiece is positioned by hand under the stereo microscope and guided from weld point to weld point. The crosshairs on the stereo microscope show the focal position of the welding spot. The diameter of the welding spot can be selected from 0.2 to 2 mm, with a welding depth of up to 2 mm. When the laser pulse is triggered, the small melt occurs in just a few milliseconds, and cools down again just as quickly. Overlapping spot welds create a weld seam.

ProfiWeld and PowerWeld
The ProfiWeld is a compact, mobile workstation with an integrated laser. A 230 V-connection suffices as energy supply. Ergonomics, easy accessibility and simple handling are the distinctive features of this device. This enables sophisticated manual welding of geometries that would normally need at least five axes on a machine.

With the PowerWeld, welding can be done manually as well as machine-aided. The workpiece is moved in two axes on an air-cushioned plate. In addition there is a rotating axis that can be swiveled. Motor-driven workpiece movement enables faster welds. Various laser devices can be connected to the PowerWeld via a laser light cable, depending on requirements.

Either manually or by machine: the laser and machine data are stored and the welding programs can be recalled at any time.

ProfiWeld
Manual welding under the stereo microscope

Trocar
Seam welding

Customized Welding Solutions
The housings of ProfiWeld and PowerWeld enable them to be operated in any work environment. Open workstations can be individually designed – for long workpieces, for instance. However they have to be set up in a separate room to ensure laser safety.

Even if the user or supplier sets up the workstation themselves, TRUMPF focusing and observation optics can be easily integrated. As on the PowerWeld, TRUMPF laser devices are connected with the focusing optics at the workstation via laser light cable.

Workstations from TRUMPF

- Manual welding of complex geometries
- Workpiece hand-guided or via powered axes
- Observation and monitoring via stereo microscope or camera
- Laser welds repeatable anytime
- ProfiWeld and PowerWeld for any working environment
- Customized solutions with open workstations
- Laser and workstation can be set up independently of each other
- Laser selection to suit requirements
- One laser for several workstations

Endoscopic instrument
Seam welding

Surgical forceps
Spot welding

Forceps for aneurysm clips
Spot welding
Seam welding

Marking Lasers for Long-Term Traceability

Marking lasers from TRUMPF provide all materials in medical device manufacturing with clear, detailed and sharp identification. At the same time, biocompatibility is fully maintained. Whether it is text or images – the laser marks both with high precision.

TRUMPF offers an extensive range of diode-pumped lasers for marking applications. Different wavelengths for differing materials ensure optimal processing results.

With the TruMark Station – the enclosed laser workstation from TRUMPF – the workpieces to be marked are loaded by hand and removed again after marking is completed. Different workpiece heights are compensated for by the z-axis. In the case of loaded pallets or larger working areas, an x-y table with travel of up to 600 x 400 mm is available, and for circumferential marking a rotating axis. The workstation and its housing can be set up within any work environment.

The marking laser without workstation is ideal for compact integration into customized manufacturing solutions.

Laser marking is distinctive for precise line control accompanied by high local resolution, and no additional material is required. The laser beam is computer controlled and guided across the workpiece surface at high speed. Metals and non-metals alike are permanently marked.

On metallic components marking is done with tempered colors that the focused laser beam creates via local heating of the surface. Here the surface remains smooth. The color is non-wearing, absolutely sterilization-resistant and just as biocompatible as the base material.

With plastics, the marking is done via color changes or pigments layered inside the material. The surface also remains unchanged.

Whether it is serial numbers, text or data-matrix codes, the individual product marking guarantees complete traceability of instruments and implants.

Even the tiniest of surfaces have enough room for a machine-readable dot-matrix. In addition, corporate logos increase recognition considerably.

Bronchoscope
Scaling

Spinal implant
Functional marking

Surgical scissors
Marking
Data-matrix code

Marking lasers from TRUMPF

- Various workstations according to CE guidelines
- Compact integration component for customized solutions
- Wavelengths: 1064, 532, 355 nm
- Freely programmable fonts
- High resolution and repeatability
- High information density
- For all materials
- For all workpiece geometries

Titanium screw for spinal implant
Marking
Logo

Plastic cannula
Marking

New Perspectives with Laser Microprocessing

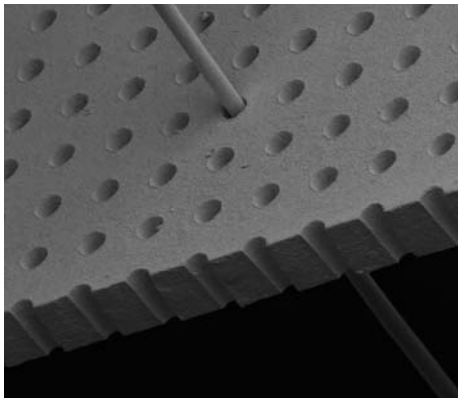
Today, ever more sophisticated processing methods are required, and medical device manufacturing is no exception. TRUMPF has new laser devices for cutting, drilling, ablating and structuring – applications already of great significance in the electronics, semiconductor technology and automotive sectors.

Microprocessing means highly precise material removal with high repeatability in the micron range. The materials machined today include semiconductors, ceramics and all metals.

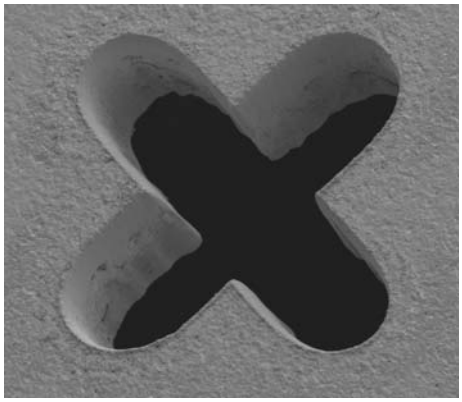
Short pulses, high peak power and extreme focusability are distinctive features of the new laser series from TRUMPF.

Variability from pulse to pulse and the highest stability of all laser parameters such as pulse energy, average power, beam location or beam shape make the laser an ideal tool for industrial microprocessing.

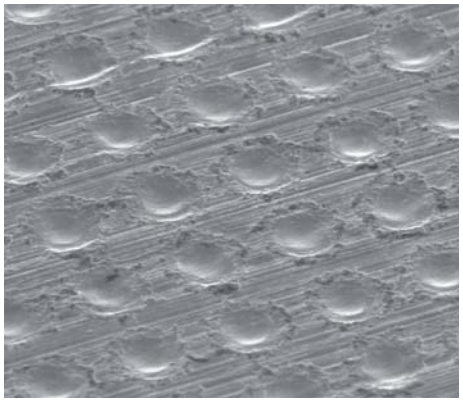
The smallest drill holes with a diameter and roundness accuracy of 1 µm are possible. Drilling diameters of 20 µm as well as aspect ratios of up to 1:20 can be achieved.



Human hair
Threaded through a ceramic drill hole,
Ø 100 µm



Ceramic
Mold cutout
Depth: 200 µm



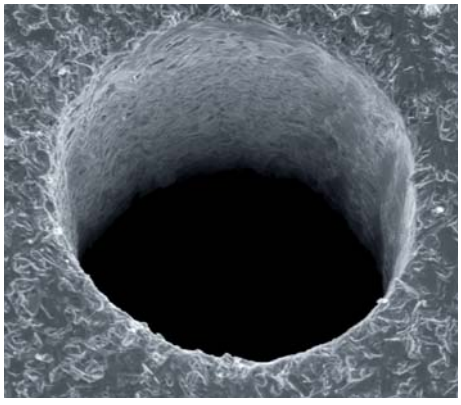
Stainless steel
Structuring
Width: 40 µm, Depth: 5 µm

TruServices – TRUMPF offers you more

From the first contact onward, the user receives full support from TRUMPF, and for as long as he uses the laser.

Apart from drilling, microprocessing lasers are used in the production of ultra-fine structures as well as for layer-by-layer removal of metal from molds and notches in all kinds of different materials.

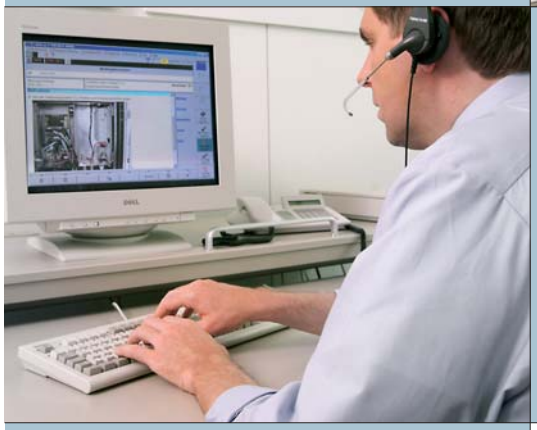
In medical device technology implant surfaces are already being structured for improved osteo-integration. Further applications are being prepared.



Tungsten
Drill hole, Ø 75 µm
Depth: 200 µm

Consulting
Before the decision to buy you will receive comprehensive consulting from our sales representatives and application specialists. We also carry out customer-specific feasibility studies for you in our very well-equipped application laboratories.

Training
In the TRUMPF training centers we provide you with laser application training individually tailored to your requirements. Experienced application technicians also support you with the installation of your process.



Telepresence
With Telepresence, TRUMPF offers a service that is unique worldwide. The operating and control data as well as all measuring parameters can be accessed online at any time. That way our service experts can quickly diagnose errors, evaluate them and often remedy them instantly – regardless of where in the world the laser device is located.

Service
Lasers from TRUMPF have proven themselves over many years in industry. Uptime is at over 99 percent. In a global service network, our laser specialists carry out the set-up and start-up of the devices on the spot, and the maintenance work quickly and efficiently.

TRUMPF is certified to DIN EN ISO 9001 and VDA 6.4.

TRUMPF

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