Laser Material Processing

2.0

Laser cutting

We laser cut in micro dimensions stainless steel from 0.010 mm to 2 mm material thickness. The cutting is without material distortion with a contour accuracy of ± 5 µm up to a material thickness of 50 µm. We cut stainless steel, steel alloys as well as hardened surfaces contact free from prototypes up to a full-scale production. An extensive stock of stainless steel materials of 0.010 mm to 2 mm, in steps of 10 µm is available for a fast delivery.
More information on page 2

Laser welding

Perfect laser welding down to the smallest micro details, without addition of material, welded from edge to edge. Due to minimal heat-affected zones we can produce narrow weld seams of less than 0.250 mm. With a maximum weld depth of 0.8 mm we realize gas-tight and optical clean welding seams.
More information on page 3

Laser deposition- and repair welding

Repair welding is done for mold and tool maintenance. We repair small cracks up to large areas of stamping- or injection molding tools with minimal heat-affected zones, without distortion of the tool. A wire feed system guarantees a uniform and precise laser welding process. During the manual deposition we deposit with additional wire, layer by layer or point by point, to obtain the desired geometry. With mechanical post processes like polishing, rotating, milling or EDM we reconstruct the original shape of the tool.
More information on page 4

Laser drilling

We drill the smallest boreholes, depending on the materials thickness. With sharp edges we drill round boreholes with little melt up to an aspect ratio of 1:25. Regardless of whether you wish cylindric holes or holes with defined conicity, we produce them on your demand. We manufacture the holes with high accuracy and low tolerances and high reproducibility.
More information on page 4

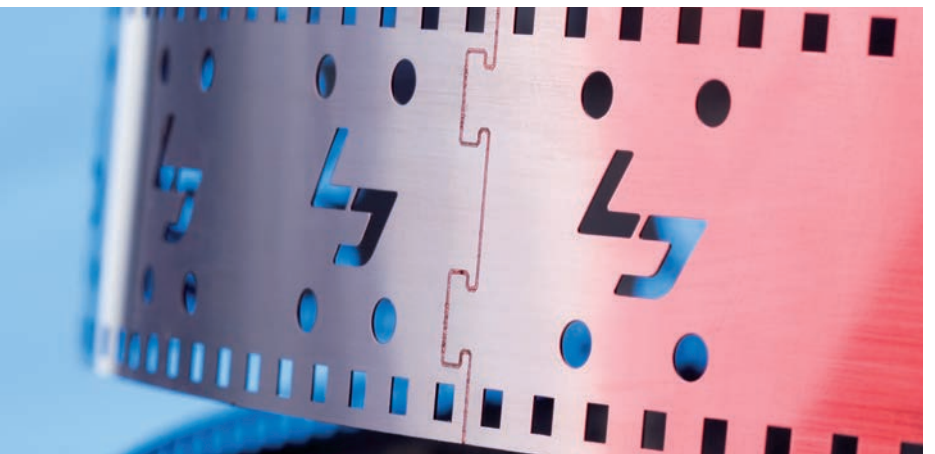
Laser labelling

Laser labelling is applied today in almost all industrial areas. Labels with data-matrix code, CR-code or defined series numbers are used to guarantee a distinct assignment and trace-ability. The long shelf-life and the precision of the labeling guarantee after many years a clear legibility.
More information on page 5

Laser ablation

With our ultra-short pulse laser we structure materials like metal, polymer, ceramics, glass and sapphire. Due to the short pulse duration and high pulse energy we avoid heat transfer into the material. Therefore sensitive and brittle materials can be processed with this type of laser.
More information on page 5

Example for laser cutting parts



LaserJob GmbH
Liebigstraße 14
82256 Fürstenfeldbruck
Germany

phone +49 (0) 8141 52778-0
fax +49 (0) 8141 52778-69

info@laserjob.de
www.laserjob.de

Laser cutting

We cut in micro dimensions

With a working surface of 600 x 800 mm our high-performance Nd-YAG-laser can cut precise parameters. Our micro exact and high focused laser material process allows minimal material distortion, minimum change in material properties and optimum contour definition.

Material selection of our laser systems

All materials, alloys and metal composites (listed in table 1) can be processed in the specified dimensions. For inquiries regarding other metals, please contact our specialists. In order to laser-cut very thin metal foils in metal thicknesses of 0.010 – 0.020 mm we recommend the use of custom fixtures which can be designed and built at our factory.

In order to provide fast delivery, LaserJob has an extensive stock of high-precision metals available. Material test certificates are available upon request. Specialty stainless steel with specific properties (e.g. higher tensile strength or higher fine grain properties) can be custom ordered upon request.

Laser cut with micro-tabs

For very thin materials and delicate parts we recommend the application of micro-tabs. Micro-tabs allow stable post-processing steps such as deburring, polishing or coating. We also recommend micro-tabs to avoid bending and to insure stable handling. For production in multiple panels or with minimum material thickness, LaserJob can deliver the parts separate from the base material in single pieces. In the base material a precision bore hole can be integrated for the production of small parts in series. This leads to a fast and non-destructive release of the parts from the base material through stamping tools or pressing tools. The position of the micro-tabs is discussed in detail in advance with the customer. LaserJob offers two variation of micro-tabs, see picture 1 and 2. Variation A is recommended when it is possible to exceed the outline contour of the laser cutting parts. Variation B is recommended if it is prohibited to exceed the outlines because of construction reasons and therefore internal micro-tabs are necessary. In general the micro-tabs have the size of 0.2 – 0.05mm in width.

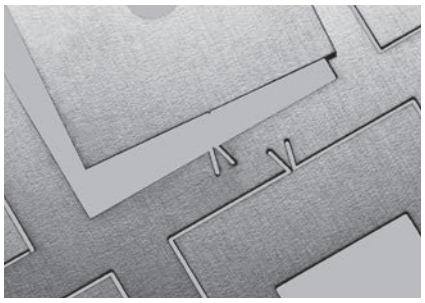
Rework steps

LaserJob has the ability to deliver the manufactured parts burr free or with a minimum burr due to unique properties of the cutting quality. If special requirements are required we offer rework treatments in form of

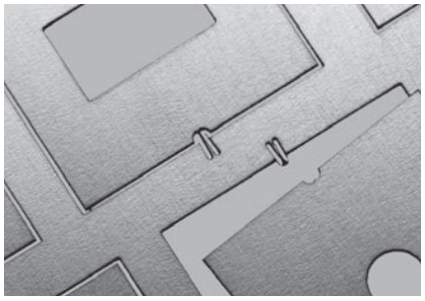
- **Brushing**
  With a CNC controlled brushing system, the cutting burrs on the laser exit side are removed. The brush head moves in all four directions, covering the entire area.
- **Polishing or manual grinding**
  If the parts are delicate and below a material thickness of 0.2 mm, we recommend manual grinding of the parts.
- **Grinding (Trovalizing)**
  With a capacity of 5 or 10ltr/container all parts can be treated with a material thickness of 0.5 mm and a maximum size of 50 x 50 mm.

Material	**Min. Thickness** (mm)	**Max. Thickness** (mm)
Stainless steel ST37 Stahl	0.010	2.00
Tin Plates	0.010	2.0
Aluminium AlMg3	0.010	1.5
Anodised Alu	0.010	1.5
Copper Cu	0.010	0.8
Copper/ Berrylium CuBe	0.010	1.0
Copper/Tin CuSn	0.010	0.8
E-Copper	0.010	0.6
Brass CuZn	0.010	1.0
Nickel	0.1	1.0
Silver	0.1	0.8
Nickel/Silver	0.1	1.0
Titanium	0.1	2.0
Tantal	0.1	1.0
Gold Au	0.2	0.8
Invar	0.050	2.0

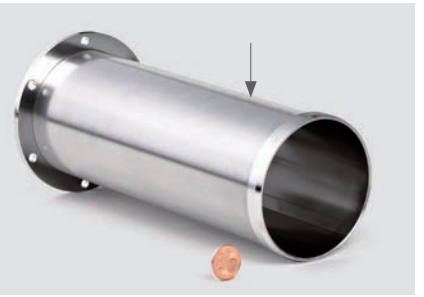
Table 1: Material selection



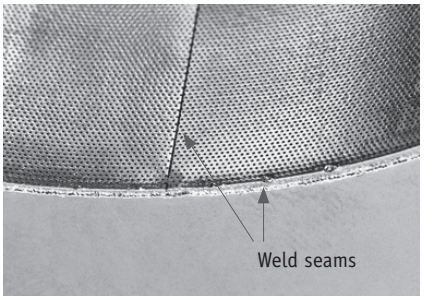
Picture 1: Micro-tab with excess outlines



Picture 2: Internal Micro-tab



Picture 5: Filter with weld seam and welded flange gasket



Detail view

Laser welding

Perfect laser welding down to the smallest micro detail

The pulsed Nd-YAG-Laser allows for solid and safe welding of parts and areas on micro levels. The weld seams are laser-welded without the addition of material and are reliably interconnected without splices. With the focused/pulsed energy input of the laser beam you have the advantage of low thermal stress and very low material distortion. With our laser systems we manufacture a maximum laser welding depth of 0.8 mm. With the 4 axes (3 linear and 1 rotary) NC-control system we achieve optimal all-round welds. We produce from single piece orders up to high volume production. If a clamping device is required we are able to construct and manufacture it. Typical laser welding applications are utilized in the following industries: automotive industry, machine production and equipment industry, medical products and electronics industry.

Material selection, which can be processed with our laser welding systems

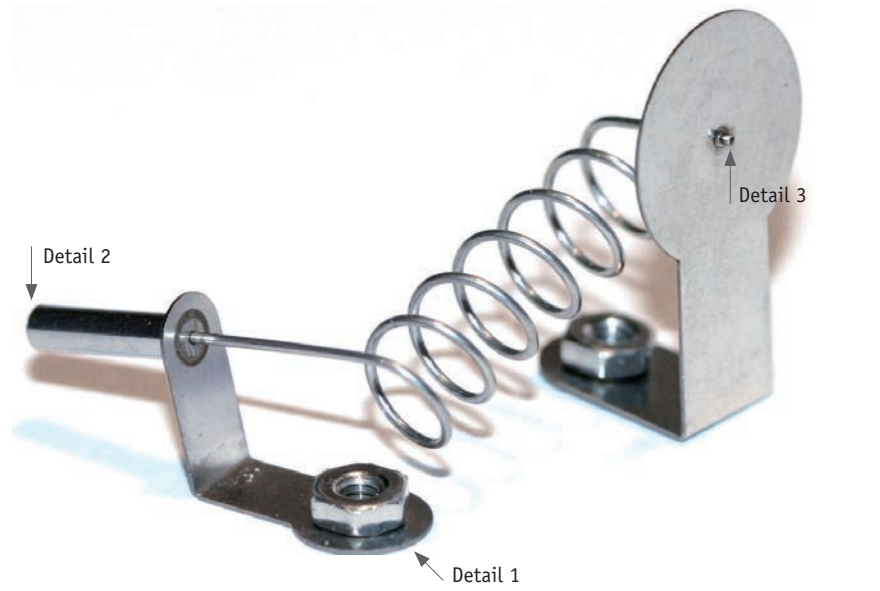
The results of the welding process are heavily dependent on the selection of suitable materials. Materials for optimal welding results include:

- Stainless steel (1.4301 and 1.4310)
- Nickel
- Invar
- Gold
- pure Aluminium 99 %
- pure Copper 99 %

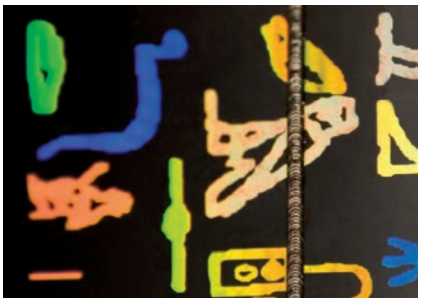
Metal alloys with additives such as sulphur, lead, magnesium, silicon, zinc and carbon are worse for the laser welding process. Welding trials are required on a case-by-case basis when these alloys are specified.

Advantages

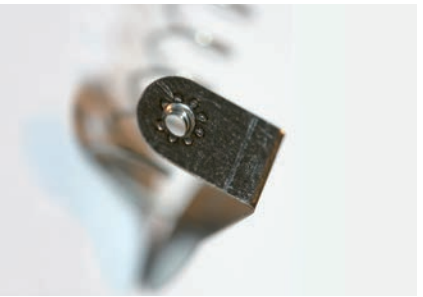
- high stability of welding seam
- welding without additional material
- minimum heat-affected zones and narrow weld seams (> 0,25 mm)
- lowest material distortion
- gas-tight and water resistant welding
- optically smooth laser seam



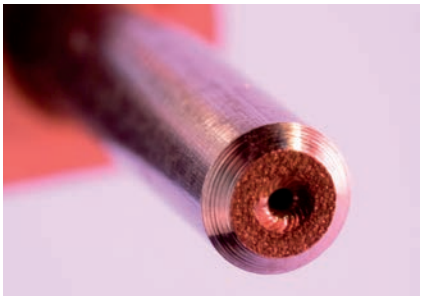
Picture 3: Vaporizer



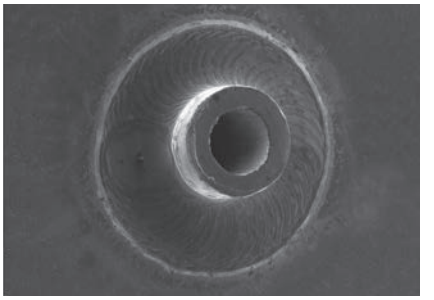
Picture 4: Example for laser welding of nickel foil with hologram



Detail 1



Detail 2



Detail 3

Laser Material Processing

Laser deposition- and repair welding

Form and tool maintenance with repair welding

With our flexible pulsed Nd-Yag laser we are able to weld laserspots with a diameter of 0.2–2.0 mm. Therefore we are in the position to repair small cracks or large areas of stamping tools or injection molding tools. Due to a minimal heat-affected zone during the laser welding process we avoid any deformation of the tool. With the turn and tilt objective together with the rotary axis modul we perform horizontal to vertical rotations for a completely welding process. For control and observation of the welding process, we use TV-systems and lenses with an enlargement of 1:16. This ensures a tight weld seam to withstand a pressure e.g. of 17 bar. A programmable laser wire feed system guarantees a uniform and precise welding process. We repair tools made of materials like mild steel and tool steel, heat treatable steel, stainless steel, cast steel and cast iron, alumina, copper and copper alloys, titan and silver, see picture 6.

Laser deposition welding with wire

During the manual depositing welding process a wire with a diameter of 0.1–0.6 mm is positioned by hand to the welding area. The laser beam melts the wire. The molten material forms a strong connection with the base material, which is also melted, and then solidifies leaving a small raised area. In this way we build up material point by point, line by line or layer by layer, see picture 7 and 8. A stream of aragon or nitrogen protects during the welding process all parts against oxidation. With post processing like polishing, turning, milling or EDM we reconstruct the original shape of the tool.

Laser drilling

Smaller than small

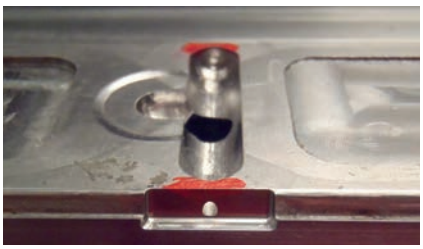
LaserJob is able, depending on the material thickness, to laser drill the smallest boreholes. We laser drill smelt free, round boreholes with sharp edges up to an aspect ratio of 1:25. Regardless of whether you wish cylindrical shaped boreholes or boreholes with defined conicity, we produce them on you demand. We laser drill stainless steel material with a thickness of t = 75 µm (0.0029 inch) boreholes with a diameter of 30 µm–40 µm (0.0011-0.0015 inch) and with an accuracy of ± 2 µm (0.000078 inch). With this guaranteed high precision, our laser technology finds application for defined gas flow rates or liquid flow rates. During the laser drilling process the laser beam generates contact-free bore holes (from very fine up to larger boreholes) by quickly placing energy in the material with a short laser pulse in a high power density. Therefore the material melts and evaporates. The higher the pulsed energy, the more the material melts and evaporates. During the evaporation the volume increases in the borehole and, suddenly, the high pressure forces the melted material out.

Advantages

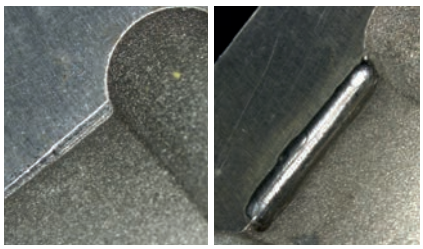
- high accuracy
- low tolerances
- lowest material distortion

Application examples

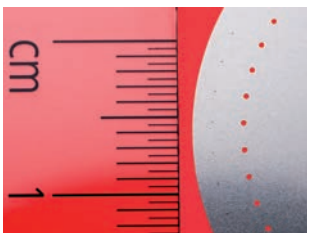
- measuring disc with boreholes for defined gas volumes, see picture 9 and 10
- drain valve
- throttle plate
- pinhole
- singling disc



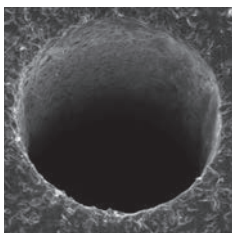
Picture 6: injection molding tool for repair



Picture 7: crack in the edge
Picture 8: repaired edge before afterwork treatment



Picture 9: measuring disc with 40µm borehole



Picture 10: borehole

Picture 11: DataMatrix-Code

Picture 12: example of labelling

Picture 13: Glass structurized

Picture 14–15: Ceramic

Laser labelling

We label with microscopically small featrues
High quality laser labelling is used in many industrial applications. LaserJob offers laser labelling via job-shop service for a variety of industrial labelling tasks as well as for new development and prototyping. On flat or curved surfaces or on parts with complicated geometry, laser labelling is the most flexible and resistant method. The laser labelling process generates very flexible texts, graphics, numerical sequences and codes direct from the software. Excel-, graphics or CAD files (DXF, HPGL, XLS, CDR, PDF) may also be processed. Labelling with data matrix code is also a very important application in the industry and production. The long shelflife and the precision of the laser labelling guarantee, even after many years, assure good readability (see picture 8). The identification of batches for traceability is an essential production method for labelling different parts and materials. We laser label many metals such as: stainless steel; or steels; hardened surfaces; anodized aluminium; polymers (ABS) and self-adhesive foils.

Advantages
- sustainability of the laser labelling
- flexible laser labelling (numerical sequences, flexible texts etc.)
- no additional material necessary
- fast and highly reliable labelling, see picture 9

Laser ablation with Ultra-Short Pulse Laser

Since 2011, LaserJob has utilized a new and innovative laser beam source which offers new fields for laser ablation applications.
With the development of an ultra-short pulsed laser (USP laser), the field of laser ablation applications expand. Pulses with a short duration of less than 15 ps (15 x 10–12 s) and pulse peak power of several MW can show completely different absorption behaviors of the materials in the laser ablation process. Since heat conduction is no longer possible in such a short time, the molecule chains are broken off directly with the grid structure of the material bond. The material sublimates (direct transmission from solid to gaseous state). Even materials which do not react with a wave length of 530 nm (green) (e.g. glasses, sapphires, etc.) are now possible to process with USP lasers. LaserJob's USP laser even allows laser ablation, borehole drilling and structure surfacing of metal alloys. The USP lasers are an additional high precision and universal tool, available for the laser ablation process, see pictures 13–15.

Advantages
- laser ablation of glasses, polymers, sapphires, diamonds
- laser ablation of ceramic substrates without micro cracks
- laser ablation of very fine layers

Quality assurance and quality control

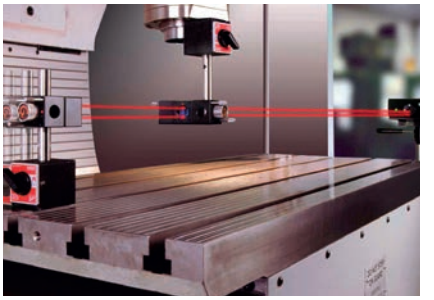
Quality assurance is extremely important at LaserJob. Effective quality control starts with the incoming inspection of stainless steel sheets. A thickness measurement instrument measures every stainless steel sheet with an accuracy of ± 0.5 µm, see picture 16. Directly after the laser cutting process, aperture size and aperture geometry are controlled. The measurement system detects on an area of 600 x 600 mm with a precision of 1,4 µm + 5L/1000 µm the position of the apertures, see picture 17. Available as well is an image dimension measurement system with programmable transmitted- or reflected light, with a position accuracy of xy ± 0.7 µm, see picture 18. For further analysis a 3D digital microscope VHX-1000 can be used as well, see picture 19. Pad size and pad geometry are measured immediately after the laser cutting process and a report is generated in a document form or certificate of analysis. In regularly intervals, control and maintenance of the lasers takes place with the support of a laser interferometer. The laser systems are reviewed in terms of position accuracy and machine capability with an accuracy of ± 0.1 µm, see picture 20.

Picture 16: Thickness measurement

Picture 17: Hexagon Optiv 662

Picture 18: Keyence Microscope IM6700

Picture 19: Keyence 3D-Digital-Microscope VHX-1000



Picture 20: Renisahw Laserinterferometer ML10

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Service

LaserJob supports you with a highly qualified and motivated team. Precise coordination with your requirements and project flexibility are trademarks of our service. We can deliver our products from single pieces up to series production, within 5 days after order entry.

We also offer
- CAD construction
- custom fixture construction
- prototyping to full-scale production
- rework process
- data storage
- customer material storage
- short delivery time
- inspection sheet or initial sample test report
- complete execution
- material test certificate
- bending, including sinking (subsidences) and coatings
- multi-shift operation
- standard materials avaiable from stock
- qualified employees

Shipping conditions

Shipping time
Standard shipment time ex works is 5 – 7 work days

24 hour or 48 hour express shipment, ex works are after notification

Common carrier: TNT, UPS, DHL, GO, FedEX (all delivery forms) as well as direct delivery with courier and delivery with partner companies

Packaging
All LaserJob parts are shipped in reusable packaging. To avoid damage of the parts, proven packaging materials are used and we carefully pack even on customer request.

Order process
For a complete and fast order processing we need the drawing of the parts with tolerances. We can read drawings in DXF-format or Gerber files.
To guarantee fast handling of your order, send the purchase order with the drawing via

- e-mail: **mail@laserjob.de**
- fax: **+49 (0)8141 52778-60**
- post

Please send the datas via e-Mail to **mail@laserjob.de**

We are certified per ISO 9001:2015

LaserJob data sheets
1.0 SMD stencil
1.1 NanoWork®-stencil
1.2 PatchWork®-stencil
1.3 Tensioning system LJ 745
1.4 Frames and tensioning systems
1.5 Repair and Re-balling stencil
1.6 Wafer bumping-stencil
1.7 LTCC Via fill-stencil
2.0 Laser Material Processing

Auch in Deutsch erhältlich.

As of 05/2017