

## Laser-based Manufacturing

Centralized manufacturing with laser welding,  
laser cutting & laser marking

### Challenge

For the manufacture of prototypes and products, high-precision welding and sharp-edged cutting work is often required on the finest structures and with a wide range of contours, whereby the permissible energy input is limited. Markings must sometimes be very fine, and the application of bar codes and data matrix codes is required.

### Solution

The Technical Center's central manufacturing shop provides services for laser-based manufacturing methods.

#### Laser welding (use of pulsed laser systems):

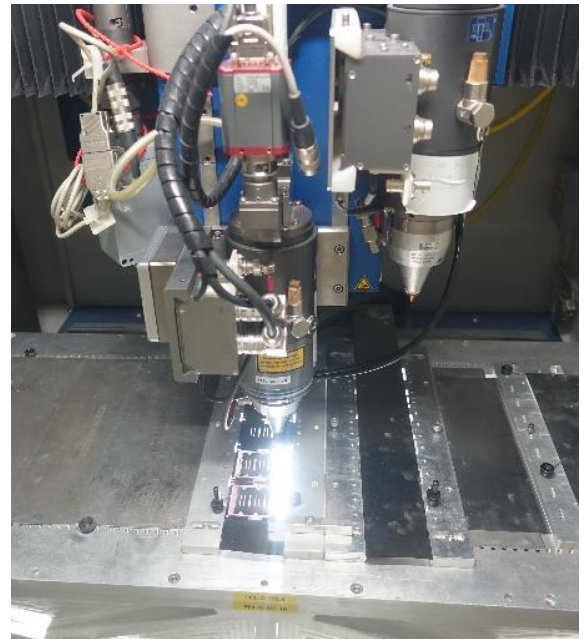
- Low heat input for minimal distortion
- High-precision accuracy for joining even small components
- Contactless and without power transmission
- Slim weld geometry with large depth-to-width ratio
- Welding of non-ferrous metals
- Gas-tight welding of components

#### Laser cutting (use of pulsed laser systems):

- Identical cutting quality exists in all cutting directions
- Narrow heat-affected zone
- Narrow cutting gap
- Clean, burr-free and post-processing-free cut edge (depending on material)
- Low oxide layer or metallic-bright cut surfaces
- Small starting hole
- Production of small holes

#### Laser marking:

- High flexibility for complex components
- Very well suited for a large variety of materials
- High quality even with smallest marking
- Chemically resistant
- Cutting of hundredth foils by remote process (sublimation cutting by the laser marking machine)



Laser cutting and welding machine

### Customer benefits

- Qualified processes
- High reproducibility
- High precision joining of smallest components
- Fast and cost-effective manufacturing process for complex 2D geometries

### Key figures

Weldable material thicknesses  
of approx. **0.1 – 2.0 mm**

Material thicknesses that can be cut  
of approx. **0.1 – 3.0 mm**

**Your performance**  
is our everyday **commitment**

## Technical information

**Laser weldable materials:** nickel-based alloys, alloy and non-alloy steels, Zircaloy, non-ferrous metals, titanium, wires

Heat conduction welding:

- Intensity of the laser below the critical threshold (no formation of metal plasma)
- Absent deep welding effect resulting in a particularly flat weld

Deep welding:

- Most common variant of laser welding
- Intensity is higher than in heat conduction welding (evaporation effect)
- Laser-induced plasma is formed

Spot and seam welding:

- Production from the smallest weld spots to long weld seams with very narrow seam geometry
- Spot and seam welding produces joints of high strength with low heat load

Scanner welding:

- Neither the processing head nor the workpiece are moved to position the laser beam
- Instead, a galvanometrically moved rotating mirror is used to deflect and position the beam

**Laser-cuttable materials:** all metallic materials, ceramic materials.

Fusion cutting / nitrogen/argon:

- Use of inert (nitrogen) or inert gases (argon) as cutting gases
- Cuttable material is expelled from the kerf by the inert cutting gas jet
- Cut edges remain oxide- and burr-free with optimum parameter settings

**Laser markable materials:** all metallic materials, plastics

Material removal:

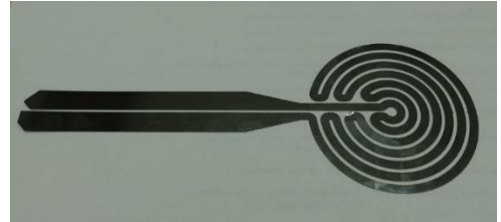
- Material removal by the laser beam
- Laser light is absorbed by the material, which heats up
- Material melts and evaporates in the affected areas, the recessed areas can be distinguished from the top layer of the material by their color, visible laser marking
- Both light and dark marking possible
- After processing the change of the material is difficult to make unrecognizable

Temper marking:

- Creation of annealing colors by oxide layers (reaction to a high temperature between the metal surface and the surrounding oxygen)
- Embossing of several layers by annealing process
- Superposition of the wavelengths reflected at the interfaces, resulting in amplification and extinction
- Color marking as a result



Welding example (Zircaloy material)



Cutting example (0.1 mm foil)



Marking example (text marking and barcode)

## References

Decades of experience in laser processing of core components. We also offer the possibility of processing CAD/CAM data in modern production facilities.

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