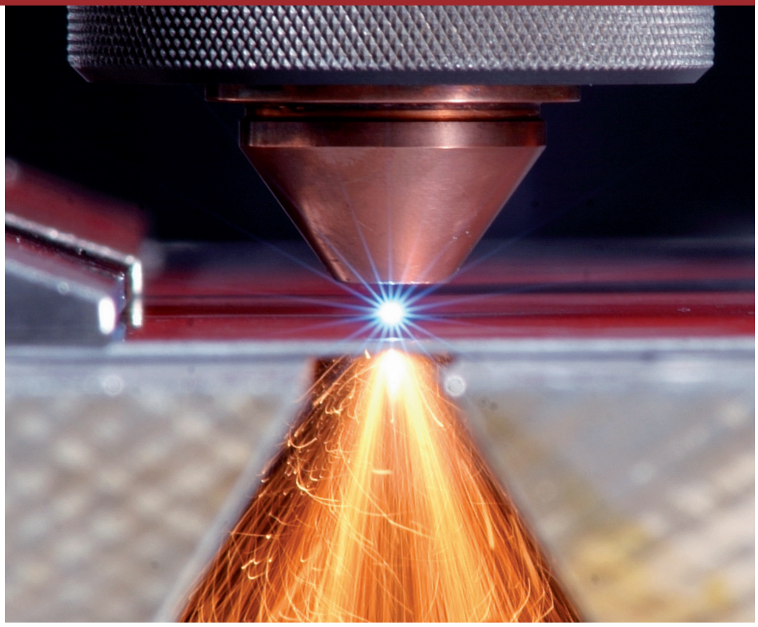
FRAUNHOFER INSTITUTE FOR LASER TECHNOLOGY ILT

LASER BEAM CUTTING



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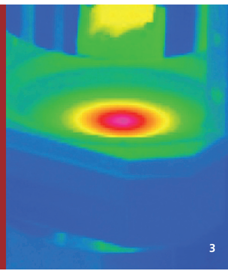
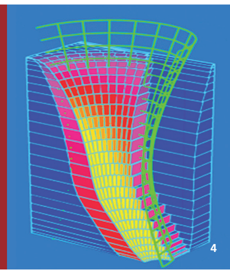
Fraunhofer ILT - Short Profile

With about 330 employees and more than 11,000 m² of usable floorspace the Fraunhofer Institute for Laser Technology ILT is worldwide one of the most important development and contract research institutes of its specific field. The activities cover a wide range of areas such as the development of new laser beam sources and components, precise laser based metrology, testing technology and industrial laser processes. This includes laser cutting, caving, drilling, welding and soldering as well as surface treatment, micro processing and rapid manufacturing.

Furthermore, the Fraunhofer ILT is engaged in laser plant technology, process control, modeling as well as in the entire system technology. We offer feasibility studies, process qualification and laser integration in customer specific manufacturing lines. The Fraunhofer ILT is part of the Fraunhofer-Gesellschaft with more than 80 research units, 18,000 employees and an annual research budget of over 1.6 billion euros.





LASER BEAM CUTTING

Increasing demands on processing quality and cost-efficiency, new materials and new beam sources offer opportunities and pose new challenges for laser cutting. The Fraunhofer Institute for Laser Technology ILT provides tailor-made solutions that create technically and economically optimized laser cutting processes and it supports customers from initial feasibility study right through to industrial implementation.

Process Development

Our experienced development team informs customers about the current state of the art and develops the laser techniques to handle new and particularly demanding cutting tasks. Cost efficiency, cutting quality, processing speed and robustness are the main criteria. In each case we select the beam source that best meets these requirements: high-power lasers for cutting thick section steel plates, ultrashort-pulse lasers for high-precision processing with no thermal damage, solid-state lasers of high brilliance for high-speed cutting of sheet metal. At present our main focus is on:

- improving cutting quality with fiber and disk lasers
- high-speed cutting with fiber lasers (e.g. 1 mm car body steel at 100 m/min)
- laser cutting of fiber composite materials
- combined cutting and welding in integrated process chains

Components and Processing Heads

A reliable and efficient cutting process requires adaptation of the laser beam and gas jet to the cutting task. We develop and optimize the tools needed for this. The processing heads are designed to achieve the best possible optical imaging properties, cutting gas flow, thermal and mechanical stability, functionality and flexibility.

Using theoretical flow models and Schlieren diagnostics of the gas flow in the kerf, the design of the nozzle is improved to meet specific criteria. The aim is to make the injection of the cutting gas into the kerf most efficient and the expulsion of material most effective and stable. Thus, the optimization of cutting nozzles contributes significantly to improving cutting quality. Innovative nozzles open the way to new techniques such as combined processing, in which an autonomous nozzle enables one head to be used for cutting and welding.

Simulation and Analysis of Cutting Techniques

The CALCut simulation software reveals the dependencies of the cutting results on the process parameters and makes them predictable. In addition to variables that can also be determined experimentally, such as the maximum cutting speed and the kerf width, the simulation also provides development engineers with variables which are difficult or impossible to attain. These include the melt film thickness, the absorbed laser beam power and the vaporization rate. For instance, it was simulation that made it possible to explain for the first time the positive, speed-increasing and the negative, destabilizing effects of multiple reflection when cutting with 1 µm wavelength lasers.

Monitoring and Control

Process monitoring and control increases the reliability and productivity of laser cutting systems and makes an important contribution to quality assurance. Fraunhofer ILT develops algorithms and systems for self-optimizing laser cutting machines. In the future these will make manual setting up and cutting parameter determination unnecessary as they will adapt the process parameters automatically to the requirements of the cutting job and the actual status of the process.

Facilities

- CO_2 lasers up to 20 kW
- Disk lasers up to 10 kW
- Fiber lasers up to 4 kW
- Lamp- and diode-pumped solid-state lasers up to 8 kW
- Short- and ultrashort-pulse lasers up to 1 kW mean output
- CO_2 flatbed laser cutting unit, Trumpf 6 kW TruLaser 5030
- Trumpf Lasercell TLC 105 with TLF2600t CO_2 laser
- High-performance scanners up to 8 kW
- 2D high-speed system, 4 g, 300 m/min
- Reis RLP16 laser gantry robot
- 6-axis robot, Kuka and Reis
- Various multi-axis processing systems
- Various cutting heads from leading manufacturers and own developments with lenses and mirror optics
- Laserfact combi-heads for welding and cutting
- High-power beam diagnosis (Microspot Monitor, Focus Monitor)
- High-speed cameras up to 100 kHz image rate
- Schlieren diagnosis unit
- Roughness and contour measurement equipment
- Scanning electron microscope with EDX
- White light interferometer
- UV-IR spectrometer

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1 Laser cutting of car body parts made of high-strength steel.
2 Cutting profile parts with a combi-head.
3 Diagnosing the thermal loading of a cutting optic.
4 Simulation of a cutting front with laser caustic, melt film geometry and temperature distribution.
5 Cut edges in stainless steel, thickness 12 mm.