

# Compact Cutting Machines with either Fiber Laser or CO<sub>2</sub> Laser, Ready for Flexible Use

The laser cutting machines of the type LASER-JET from KNUTH – Machine Tools have been well proven in many industrial branches for small series and single part production. Due to the compactness they need only small installation space. They are extremely flexible in use, ergonomically to handle, and very economical. As fiber lasers or CO<sub>2</sub> lasers can be mounted with a beam power adapted to the cutting task, a very large range of possible cutting applications can be dealt with.

At the present time, fiber lasers are more and more used for the cutting of sheet metal. This laser type is particularly advantageous for cutting higher reflective materials, such as stainless steel, aluminum and copper alloys, since, due to its ten times shorter wavelength compared to the CO<sub>2</sub> laser, the laser beam enables a smaller focus and is better absorbed by metallic materials. Hence, also the LASER-JET machine now can be equipped with fiber lasers. Different beam powers in the range from 0.5 to 4 kW can be chosen according to the cutting application in question.

Laser cutting with fiber lasers requires an enclosure that is optically dense for the laser wavelength of one micron. For that, the LASER-JET which is operated open at the top in the case of the CO<sub>2</sub> laser, gets an additional housing unit on top without need of the machine to be changed in its construction and function (see fig. 1). This enclosing unit consists of several components, the upper roof elements which can be pushed into one another optionally for loading sheets from above, the rear wall with doors to be opened by hand, and the two front elements which are pulled up and down by the machine itself. At the start of a cutting job, the housing closes automatically. By appropriate sensors it is checked whether the housing is completely closed, before the cutting operation is enabled. After the end of the cutting job, the enclosure re-opens, again automatically, and allows direct access to the working area of the cutting system. Therefore, it is not necessary to equip the machine with a

Figure 1  
Laser cutting machine LASER-JET 2512 FL 2000: Complete compact system for flexible use with an on-top protective housing for cutting with fiber lasers, shown with the front elements pulled down for loading (Photo: KNUTH Machine Tools)



cutting table to be pulled out manually, which in turn, reduces the need of space for the machine installation.

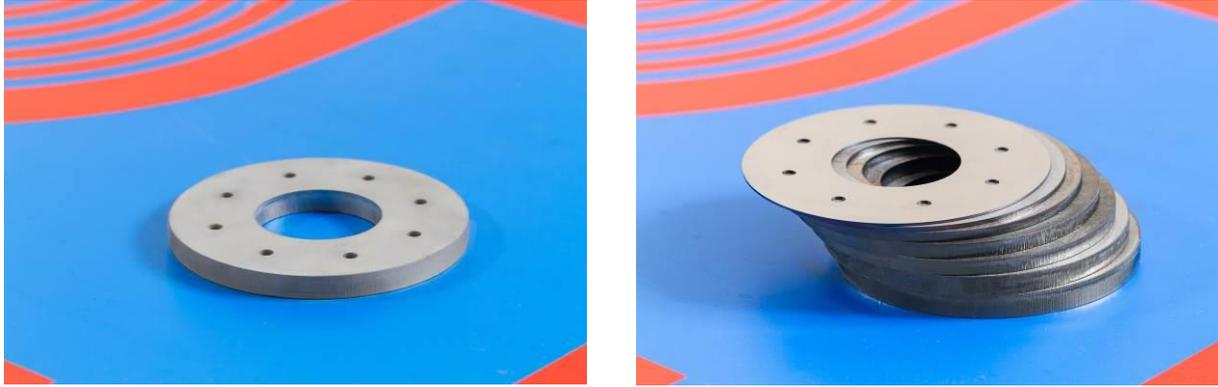
The almost maintenance-free fiber lasers allow a very easy use of the laser cutting machine. Also the beam transmission to the cutting head is maintenance-free due to the robust fiber-optic cable. In addition, fiber lasers have a significantly higher operational efficiency so that the energy costs per produced cutting surface are lower than those for CO<sub>2</sub> lasers. Finally, the lens wear is less because the cutting head includes an easily replaceable protective glass that shields the cutting lens from sputter and dust emitted by the cutting process.

For fiber lasers with beam power up to 2 kW, one can choose between two cutting heads with different focal lengths (see fig. 2). The head with the longer focal length of 200 mm is the more universal cutting tool which can be used for the entire sheet-thickness range that is accessible depending on the laser power and the type of material. It is characterized by a slightly wider kerf and an extremely stable cutting operation. The cutting head with the shorter focal length of 125 mm is optimized for cutting in the thickness range up to 5 mm. By this, highest cut qualities are achieved, and the resulting kerf is of minimum width. For laser outputs greater than 2 kW, the LASER-JET is equipped with a larger dimensioned cutting head which allows to exchange between the two focal lengths by using retractable lens cassettes.



Figure 2  
Cutting head of the LASER-JET of type LIGHTCUTTER with fixed cutting lens of focal length 125 mm (Photo: KNUTH Machine Tools)

The **LASER-JET with the 2 kW fiber laser** currently is the most requested laser cutting machine offered by KNUTH Machine Tools. It can be used for mild steels up to a thickness of 10 mm thickness with an excellent cut quality. In comparison with the other thermal cutting methods, the advantages are that structures can be cut with dimensions significantly smaller than the plate thickness (In the case of the 10 mm thick flange shown in fig. 3, holes are precisely cut with a diameter of 5 mm), and that the heat affected zones along the cut surfaces are only few hundreds of microns deep. With only 2 kW beam power mild steels can be cut even up to a thickness of 16 mm when restrictions in respect to the cut quality are accepted.



**Figure 3**

Laser cut flanges of mild steel with 5 mm holes.

a) Flange 10 mm thick after sandblasting (left side)

b) Stack of flanges 1, 2, 4, 5, 6, 8, and 10 mm thick (right side)

(Photo: KNUTH Machine Tools)

**Figure 4**

Cutting parts made of stainless steel 2 mm thick: highest cut quality and complex contours

(Photo: KNUTH Machine Tools)



Stainless steels can be cut by the 2 kW fiber laser up to a thickness of 6 mm with a very high cut quality. Here, since nitrogen is used as the cutting gas, the cut surfaces are smooth and bare metal, as well

as the bottom cut edges are without adhesive ridge. Thin sheets, on the one hand, can be cut with very high feeding rates of more than 10 m/min when elongated geometries are to be cut. On the other hand, very complex cut contours can be generated with sharp peaks and narrow bars (see fig. 4). Even thicker stainless steel plates up to 10 mm, possibly 12 mm, can be separated with clean cut surfaces, but with an adhesive ridge at the bottom cut edges that has to be removed afterwards (see fig. 5). If even thicker material is to be cut, the LASER-JET can be equipped with fiber lasers of higher beam power of 3 or 4 kW.

The laser cutting machines of the type **LASER-JET** is designed according to the following criteria:

- Ergonomic design for a fast manual loading of the material plates and easy removal of the cut parts (The machine bridge is orientated parallel to the long dimension of the machine axis so that one has access to the working area on both its long sides.)

- Easy to use machine-control interface with an integrated technology database for a fast and flexible preparation of the cutting jobs as well as for an easy and intuitive way to operate the cutting machine
- Ultra compact design so that only a small space is required and that only low requirements on the installation site have to be fulfilled.

Based on these criteria, the LASER-JET is ideal to process "small orders" in a highly economic manner. Here, single parts to be cut have not to be nested into large cutting jobs which often is not economical and leads to waiting times. The required parts can instead be produced individually and taken directly from the working area of the machine. Here, a sheet of material once used can be set aside in between and can be re-issued later. Material residues can thereby exploited to a very large extent which enables a highest degree of material utilization.



Figure 5  
Cut stainless steel parts: superior cut quality on 1 mm thin sheet metal and clean separation cut on 8 mm thick plate (Photo: KNUTH Machine Tools)

Contrary to the fiber laser, the CO<sub>2</sub> laser is the all-round usable tool. Due to the beam wavelength of 10.6 microns, the **LASER-JET with the CO<sub>2</sub> laser on top** is suitable for cutting not only of metals, but also of wood, of other natural materials, and of a wide variety of plastics, both for massive as well as for foam-like or woven materials. E.g., acrylic can be cut up to a plate thickness of 30 mm with smooth and completely transparent cut surfaces. In the case of wood the same thickness can be applied. Mild steels are treatable up to 8 mm sheet thickness with beam powers in the range of only one kilowatt in the case of laser oxygen cutting with oxygen as the cutting gas, since the iron combustion in the kerf generates a substantial proportion of the required cutting energy in addition to the laser power. Cutting of stainless steels and of aluminum, however, is restricted to thin sheets of thickness up to 3 mm, but the resulting cut surfaces and the cut edges are even more smooth and shiny than in the case of the fiber laser.

On the LASER-JET CO<sub>2</sub> laser beam power of 600 W, 1000 W or 1500 W is used. The LASER JET with 1 kW CO<sub>2</sub> laser is so far the most widely installed laser cutting machine of KNUTH Machine Tools, as it is very inexpensive to buy for the broad range of uses. Since the beam of the CO<sub>2</sub> laser cannot be transmitted through a fiber, an optical beam path with beam deflecting mirrors is required. Hence the maintenance work for cleaning the mirror and the cutting lens is greater. On the other hand, the laser cutting machine can simply be operated open (see fig. 6), since the protective window is automatically lifted up at the beginning of a cutting job, thus providing sufficient protection. The cutting process can be observed very directly and optimized, if necessary, by adjusting the cutting parameters during cutting.



Figure 6  
Laser cutting machine  
LASER JET with CO<sub>2</sub>  
laser on top  
(Photo: KNUTH  
Machine Tools)

The compact laser cutting machine is available in the versions **LASER JET 1512** and **LASER JET 2512**, whose working area are 1500 mm x 1250 mm in size, respectively 2500 mm x 1250 mm. Optionally, the LASER-JET may be provided with a rotary device for cutting tubes of round or angular cross section, which is hanged into the working area. Tubes up to a length of 1 m or 2 m, respectively, can be treated. For larger-sized sheet metal, the laser cutting machine series **LASER-JET HD** is available, ready to cut sheets up to a maximum length of 18 m and a maximum width of 3 m. The LASER-JET is a member of a large family of cutting systems offered by Knuth Machine Tools for jet cutting: laser cutting machines also with shuttle table systems and up to laser beam power of 6 kW, water jet cutting machines and plasma cutting machines.