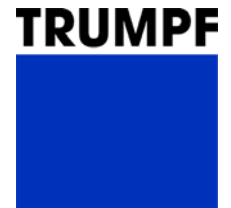


# Which laser for which cut?



## Laser processing options for the different segments of the sheet metal fabrication market

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### Summary

The segmentation of the already very diverse sheet metal fabrication market has recently increased. This is particularly apparent in the case of laser cutting. There are those who cut only stainless steel, companies that cut only electrical sheets, mass producers, and specialist companies that quickly deliver batches of one. One expression of this development is the increasingly vigorous discussion about the correct laser beam source for laser cutting machines. The debate focuses on the comparison between CO<sub>2</sub> lasers with a wavelength of 10 µm and solid-state lasers with a wavelength of 1 µm. The choice of laser ultimately depends on the application. From a physical point of view, the CO<sub>2</sub> laser is very well suited to universal machining owing to its continuous high quality and good feed speed. The solid-state laser has strong speed advantages when cutting thin sheet metals with a fusion cut, but is at a disadvantage compared to the CO<sub>2</sub> laser where thicker sheet metals are concerned. TRUMPF supplies a wide range of machines with different lasers and performance data in order to provide the best laser for every application.

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## 1. Segmentation of the laser cutting market

The density of machines in the field of laser cutting has continuously increased since the birth of the technology in the 1980s. Experts estimate that more than 50,000 laser cutting machines are presently in use all over the world (see also David A. Belforte; 1.9.2010 in Fiber laser cut into sheet metal fabricating). The installed cutting performance capacity has increased even more significantly than the number of machines. The biggest driving force behind this development is the significantly higher machining performance of the newer machines.

### 1.1 Increase in the importance of job shops

Whereas one could distinguish oneself from the competition with the technology in the infancy of laser cutting, there is increasing competition today between the users of different types of laser machines. A good half of the installed cutting capacity is to be found in companies that concentrate on contract or job manufacturing. Over the course of the time, the importance of these so-called job shops has continually increased. If one considers the development of the sales of TRUMPF machines in percentages, separated into contract manufacturers and end product manufacturers, it can be seen that, today, well over 50% of the machines are sold to the contract manufacturing segment, whereas 20 years ago, in 1990, the figure was only 30%. These job shops hardly differ in terms of the performance of the end products they manufacture, but rather by the way in which they shape their business activities. The range of services that they are able to offer plays an important role here. Apart from the technical feasibility, two additional aspects are becoming increasingly important: how will the offered product be manufactured; and, above all, how soon can it be manufactured?

### 1.2 Flexibility of product shops

The second largest group of laser cutting machine users consists of companies that manufacture products and sell them on the market under their own name. These end product manufacturers or product shops have to overcome other challenges. They are usually larger than job shops and therefore actually in a better position to obtain favorable conditions when procuring materials. Nevertheless, they are under great cost pressure. The necessity for flexible solutions intensifies as the volatility of sales figures increases, especially if a wide range of different products is manufactured. Companies attempt to realize cost advantages by organizing their processes according to the rules of lean production. This is done first and foremost by the reduction of the batch size in order to lower both warehousing costs and throughput times.

### 1.3 Cost pressure drives specialization

Everyone is under pressure to lower part prices. At the same time the tendency is for materials and labor to become more expensive. Hence, apart from the differentiation in job shops and product shops, an additional segment has emerged. There are an increasing number of specialized companies that are aligned entirely to their niche, for example, those who cut only stainless steel, laser machine users that cut only electrical sheets, others that manufacture exclusively mass-produced products and those that can deliver batches of one particularly quickly.

The trend towards segmentation can be felt worldwide and is being accelerated by the enterprisers' creativity. The challenge is to offer all of these market participants the right machine concept that will help them put their philosophy into practice in the best possible way.

## 2. CO<sub>2</sub> and solid-state lasers – currently the most important elements for differentiation

Before the individual TRUMPF products for the various market segments are examined in detail, it is necessary, on account of the current discussions and uncertainty in the sector, to make a coarse distinction and to explain: why some machines have a CO<sub>2</sub> laser and others a solid-state laser. Which laser beam source is the right choice for which segment?

With the wide range of laser beam sources available on the market, it is not easy for the user to know the technology that is suitable for its purposes. Therefore, the desire for THE laser beam source for all applications in laser material processing is ever-present. Practical experience shows, however, that the multitude and complexity of applications will continue to necessitate different laser technologies.

As a laser and equipment manufacturer, TRUMPF tries to offer its customers the most suitable and, hence, the most economical solution for their applications. This necessitates both broad knowledge of the different technologies and a wide range of laser beam sources. Only this abundance of lasers enables TRUMPF to determine objectively which laser best suits the customer.

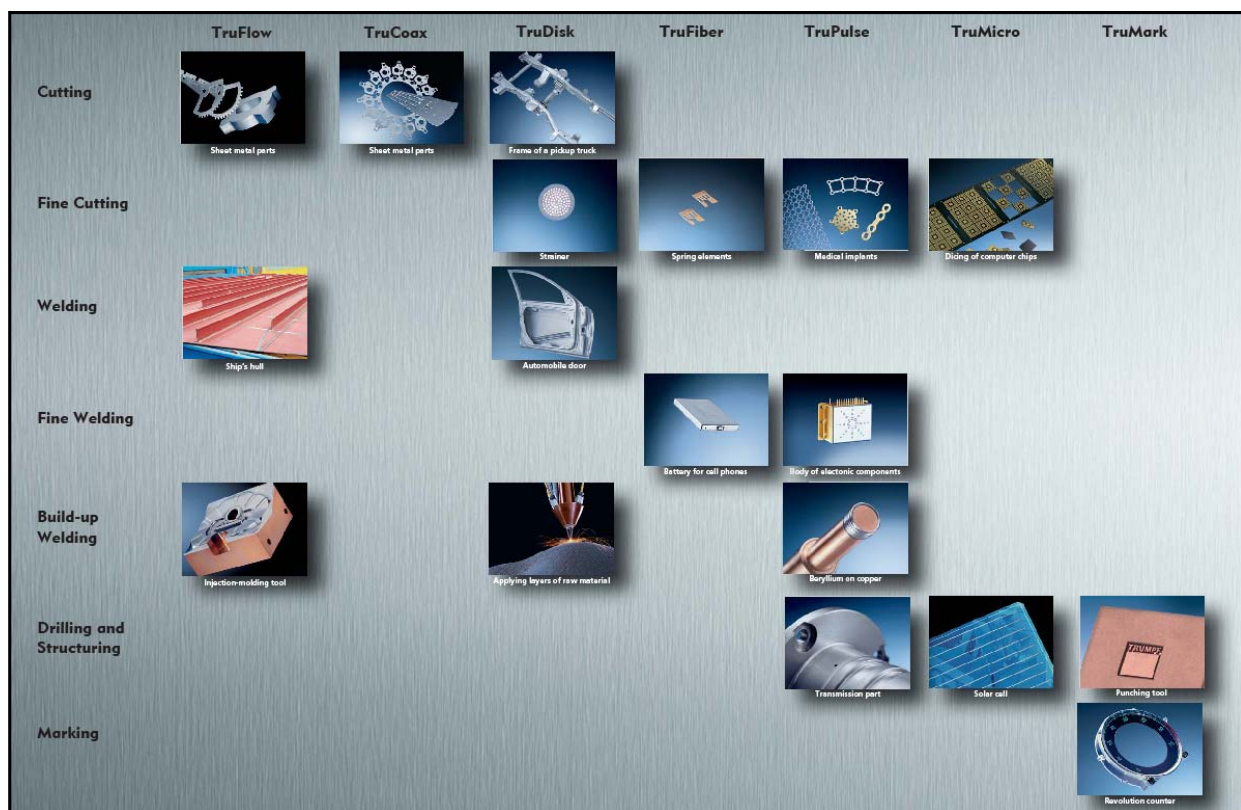


Fig. 1: TRUMPF's range of laser beam sources: the right laser for every application

The fact that the market with its applications and requirements determines the choice of the laser beam source is shown by the example of the fiber laser hype, which could still clearly be felt on the market two or three years ago. The euphoria has died down; the promise of some manufacturers that this technology would replace CO<sub>2</sub> lasers in a few years – especially in the laser cutting of sheet metals – has not come true. However, the discussion concerning the advantages of the 1 μm and 10 μm wavelengths continues unabated. So what advantages do the respective technologies offer the user, in particular from the economical point of view?

## 2.1 Laser cutting – 1 μm or 10 μm?

The decisive factor when selecting a suitable laser is the range of materials, sheet metal thicknesses, etc., that are to be processed. If flexibility and versatility are demanded across all sheet metal thicknesses, while maintaining very good cut quality, then the CO<sub>2</sub> laser is the beam source of choice – despite its lower efficiency in comparison with the solid-state laser. If the focus is on thin sheet metals, then the solid-state laser – i.e. the disk or fiber laser – can play to its strengths. Since all pumped solid-state lasers have a wavelength of 1 μm, they do not need to be distinguished further here.

If the absorption spectrum for iron (Fig. 4) is considered, it is noticeable that at 1 μm there is a very wide, almost constant absorption level over a varying angle of incidence from 0° to 60°. Around 78°, a pronounced plateau with a subsequent steep fall-off can be seen. Conversely, an increase in the temperature up to the fusion zone leads to a reduction in the degree of absorption at 1 μm.

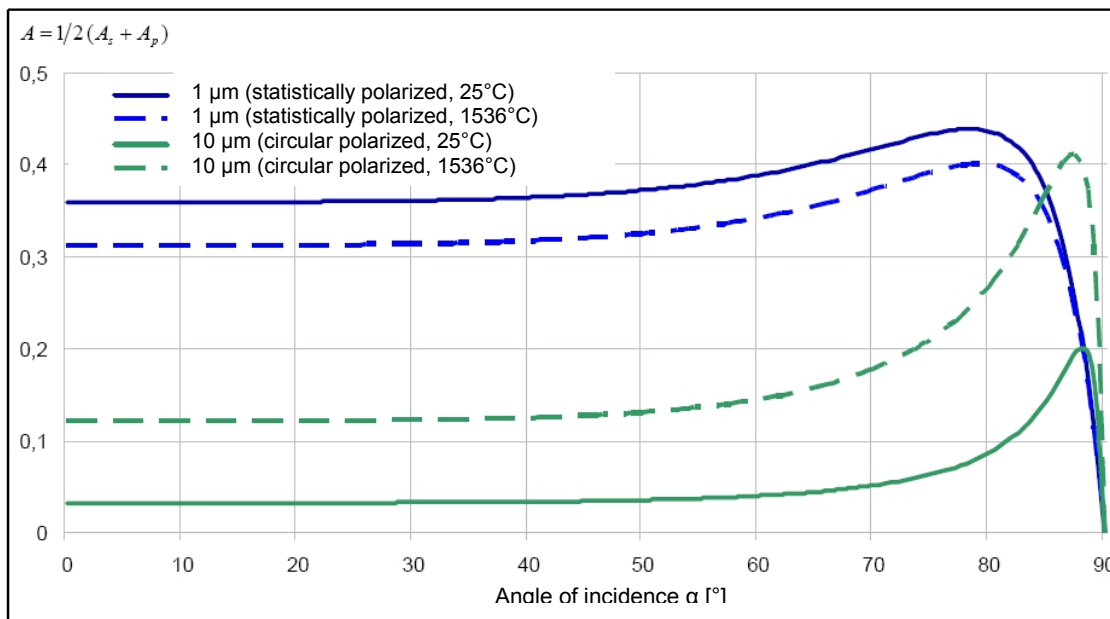
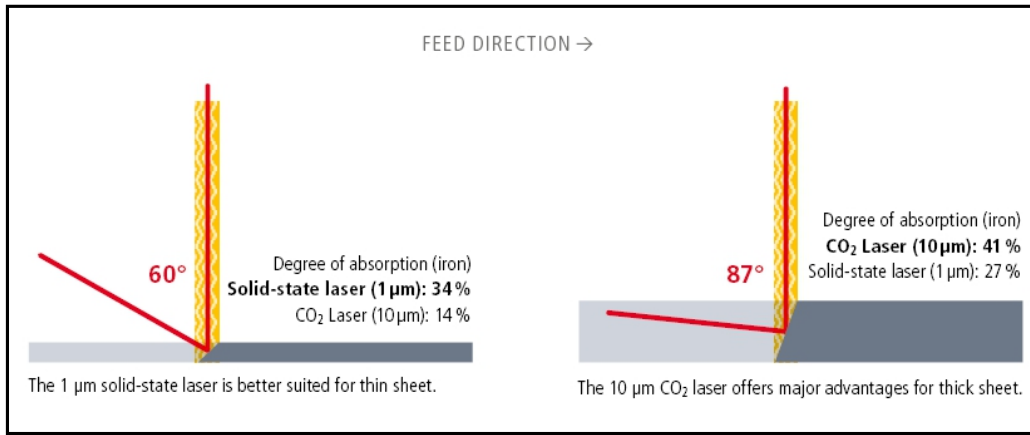


Fig. 2: Degree of absorption for Fe, 25 °C & 1536°C at  $\lambda = 1$  & 10 μm for varying angles of incidence

At 10 μm, conversely, a significant increase in the degree of absorption, and thus improved induction of the laser power into the material, can be seen as the angle of incidence increases (>80°), with a maximum at approx. 86°. This effect is enhanced considerably with increasing temperature and is most effective in laser fusion cutting with nitrogen.

For the sake of completeness it should be added: since the laser plays only a subordinated role in flame cutting with oxygen, there are no differences between the two laser beam sources in this case in regards to cut quality and speed. Productivity is comparable across all sheet metal thicknesses.

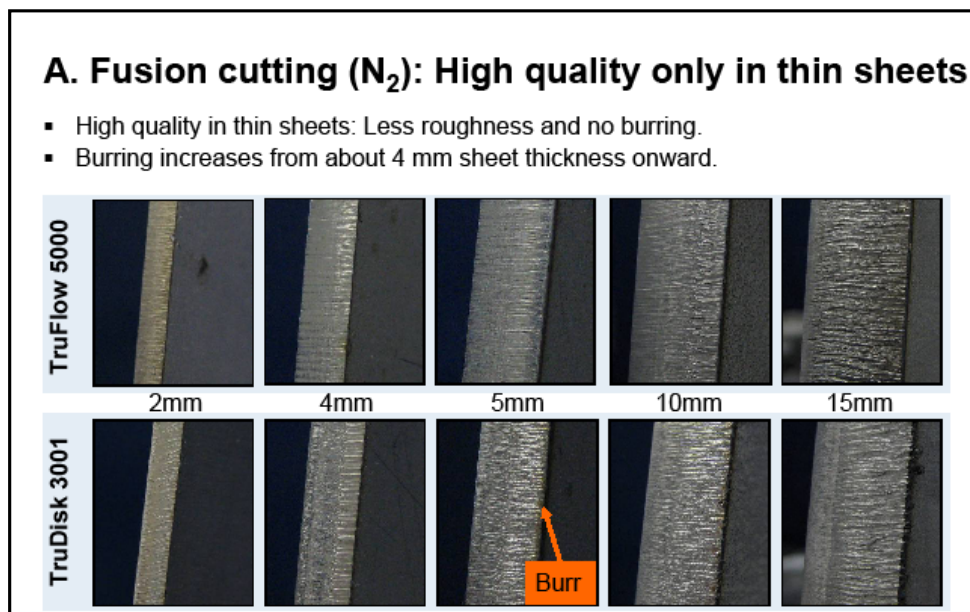


**Fig. 3: Degree of absorption for Fe, 25 °C & 1536°C at  $\alpha = 1$  & 10 µm for varying angles of incidence**

## 2.2 Solid-state lasers for productivity with thin sheet metals

With the generally high feed rate in thin sheet metals, a shallow-angled cutting front forms in the sheet metal, i.e. angles of incidence  $\alpha_1$  do not arise. This suits the solid-state laser and leads to improved induction conditions at 1 µm. As the thickness of the sheet metal increases, the maximum attainable cutting speed decreases, resulting in a steeper cutting front ( $\alpha_2 > \alpha_1$ ). In conjunction with the high melting point, this cutting front shape results in consistently high absorption behavior on the part of the CO<sub>2</sub> laser beam over the entire thickness of the sheet metal. The melt has a homogeneously low viscosity over the entire thickness of the sheet metal down to its lower edge and can be optimally driven out of the gap, despite the high melt volume, resulting in improved cut quality.

Therefore, in the fusion cutting of stainless steel sheet in thicknesses up to 5 mm, solid-state lasers exhibit clear advantages over CO<sub>2</sub> with regard to speed and productivity, with almost comparable cutting quality ( $s > 4$ mm: increased burr formation). Alternatively, comparable feed speeds, but with lower power than a CO<sub>2</sub> laser, can be achieved with a disk laser. For example, the performance of a 3 KW disk laser is comparable to that of a 5 KW CO<sub>2</sub> laser.



**Fig. 4: Useful area of application for the solid-state laser: thin sheet metal up to 5 mm**

In order to utilize the high productivity of the solid-state laser to its fullest, the dynamics of the machine must also be able to keep step with the performance of the laser. Users should bear this in mind, because a 700 HP engine won't turn a small car into a Formula-1 racing car.

One must also take into consideration that solid-state laser light is significantly more dangerous than CO<sub>2</sub> laser light. Whereas CO<sub>2</sub> laser light (10 μm) is absorbed by the cornea, solid-state laser light (1 μm) passes through both the cornea and the lens and damages the retina immediately and irreparably, even in the case of indirect stray radiation. Therefore, stricter safety rules must be adhered to for solid-state laser machines. Indispensable protective measures are the complete shielding of the laser beam after it emerges from the cutting head by means of local beam protectors or a completely enclosed machine room as well as safety glass designed for a wavelength of 1 μm.

### 2.3 Benchmark CO<sub>2</sub> laser

The CO<sub>2</sub> laser established itself years ago as a tool in sheet metal processing. Both today and for the future it represents the benchmark in laser cutting with regard to a universally attainable, very good cut quality over a wide range of materials and sheet metal thicknesses.

This flexibility in the area of application in combination with the well-known quality of the cut edge will continue to be referred to in future as a major deciding factor for job shops and will influence the purchase decision. The latest developments from TRUMPF underline the faith in this technology. The TruFlow laser product portfolio, with more than 15,000 successfully in use worldwide, both in the company's own laser processing machines and in the production plants of OEMs, has recently been extended by several developments. For example, the small series has been supplemented by two output levels of 8 and 10 KW respectively. Despite the long beam path required for such high outputs, it was possible to achieve a very compact laser construction by way of square beam folding.

### 3. Products available from TRUMPF for the different market segments

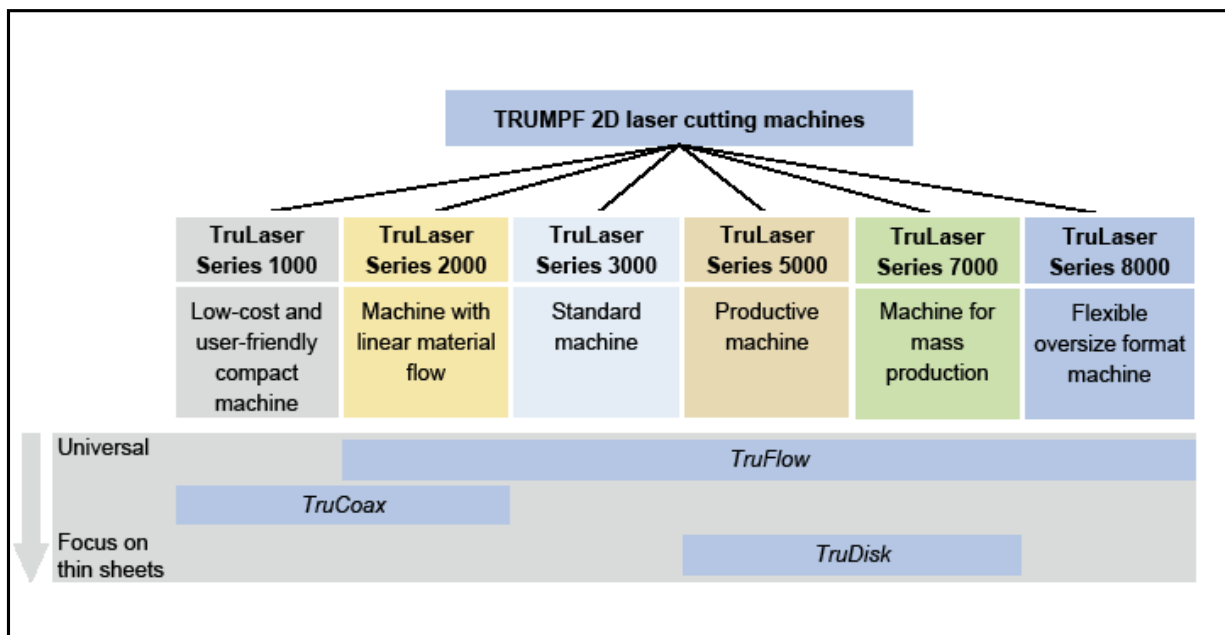


Fig. 5: TRUMPF offers the market a wide range of machines

### 3.1 TruLaser Series 1000: entry-level machine and autonomous production unit

Whatever the laser beam source: *the* feature of the laser is its high flexibility. It cuts any desired outline and, depending upon the system, does so completely without setup or with very little intervention on the part of an operator, for instance when manually replacing the nozzles or exchanging the cutting head. Laser machines are therefore recommended for modern just-in-time production structures, such as those that frequently exist in product shops. However, contract manufacturers can also benefit from this flexibility since the laser can quickly be used for other jobs,,making an important contribution to a warehouse-free supply chain.

The ideal entry-level machine for job shops that want to utilize these benefits for the first time is the TruLaser 1030. Sheet metal processors who have cut their material using hand-held devices, shears or punching machines, those who want to bring externally placed orders into their own company or who prefer sheet metal to solid material for reasons of cost, are relying increasingly on this machine. And in doing so, they are tapping new business areas with a strictly limited budget.



**Fig. 6: TruLaser 1030 – low investment, simple operation**

The machine is also well accepted by contract manufacturers looking to extend their sheet metal manufacturing capabilities. They produce, for example, prototypes and short production runs on the TruLaser 1030, in order to keep the remaining machinery free for larger orders. The TruLaser 1030 covers all of the basic needs of industrial sheet metal fabrication companies. It combines a robust drive system and a sturdy machine frame with a diffusion-cooled TruCoax laser. With a simultaneous axis speed of 85 m/min, the TruLaser 1030 cuts mild steel in thicknesses up to 15 mm at a high quality. It is very simple to operate and requires only 25 square meters of space, i.e. around half the footprint of a conventional laser cutting machine.

The machine is particularly suitable for product shops for another reason: fast reaction times are important for their just-in-time manufacturing process in order to achieve a short effective throughput time. Although the conflict between throughput time and the utilization of capacity, as described by Erich Gutenberg in his standard work 'The Production', can be reduced by modern production systems, it continues to exist in principle. That regularly leads to the fact that production equipment in modern just-in-time units exhibits a low utilization of capacity - and should therefore be accompanied by the lowest possible investment.

One possible solution for these requirements is the integration of a laser cutting machine into an autonomous production unit. It opens up the ability to offer a wide range of products without warehousing, and quickly. Especially well suited to these requirements is an inexpensive laser cutting machine with lower productivity, but with good part quality and availability. The TruLaser 1030 serves this segment without restriction.

### 3.2 TruLaser Series 2000: thin material production with integrated automation

The TruLaser 2025 and TruLaser 2030 compact laser cutting machines are specially designed for the cutting of thin sheet metal and facilitate an economical entry into automated laser processing. They were conceived from the outset to be compact, automated installations with a linear material flow and are easily accessible with an open machine design. The machine picks up the material on one side, processes it and places the finished sheets down on the other side. The direction in which the sheet metal moves remains constant, so that separate areas are created for the raw sheet metal and for the finished sheets. The good beam quality of the TruCoax laser produces parts of a high quality.



**Fig. 7: TruLaser 2030 with built-in automation**

The linear flow makes optimized logistics possible: crossing flows of material are practically eliminated. This allows mass producers to define feed and removal procedures very easily. The transparency of the material flow supports lean control through visual management. These important elements from the topical area of lean production are supplemented by the compactness and the investment benefit of the integrated automation.

### 3.3 TruLaser Series 3000: contract manufacturing with the universal machine

Two thirds of all flatbed laser cutting machines supplied by TRUMPF are based on the TruLaser Series 3000 – resulting in many thousands of installations around the globe. The machines from the TruLaser Series 3000, and in particular the best-selling TruLaser 3030, are universal machines with which all thicknesses of sheet metal can be cut cleanly and economically.

It is therefore particularly well suited to job shops that utilize only one machine. With four different laser outputs, optional tube processing and a modular automation building kit, the machine can be configured with flexibility for the respective main application. The TruLaser 3030 is designed to cut the entire range of sheet metal thicknesses with just one cutting head. Unproductive downtime to change the cutting head are a thing of the past. Setup time is also saved by the optional nozzle changer with 18 nozzles, which needs only a good 20 seconds to complete a change. The well-thought-out maintenance concept reduces the time required for maintenance activities to a minimum. The TruLaser 3030 is also very flexible with regard to installation: the pallet changer can be positioned transversely to the machine, reducing the footprint by around 20%.



**Fig. 8: TruLaser 3030, the world's top-selling laser cutting machine**

The TruLaser 3030 Lean Edition, which is based on the proven machine concept of the TruLaser 3030 and can be upgraded, from the basic version with manual pallet extraction to the fully automated installation, offers an inexpensive, modular entry into the world of laser cutting. It grows together with the customers' requirements.

### 3.4 TruLaser Series 5000: Versatile productivity

#### 3.4.1 TruLaser 5030: highly productive universal processing

Productivity is *the* keyword when it comes to describing the TruLaser 5030 (and its longer 'siblings', the TruLaser 5040 and 5060). With the single cutting head strategy, intelligent cutting head interface, integrated collision protection and automatic nozzle changer, it requires significantly fewer setup procedures than conventional machines. In combination with the optimized FastLine cutting process, high axis dynamics and comprehensive automation concepts, productivity can be increased significantly – increases of around 30% compared to the predecessor machine are no rarity. This machine plays fully to its strengths in conjunction with automation and warehouse connection. Such plants often work around the clock and continue to produce automatically, even in unmanned shifts.

The TruFlow 7000 CO<sub>2</sub> laser, which has been available since 2008 on the TruLaser Series 5000, increases the working flexibility of the machines for stainless steel and aluminum by a considerable amount: stainless steel parts of up to 30 mm in thickness and 20 mm thick aluminum can be processed. The TruLaser Series 5000's seven kilowatts result in significant increases in feed speeds in comparison with the previous maximum laser power of 6 KW – up to 40% for aluminum and up to 60% for stainless steel.



**Fig. 9: The TruLaser 5030 – the power pack in laser cutting**

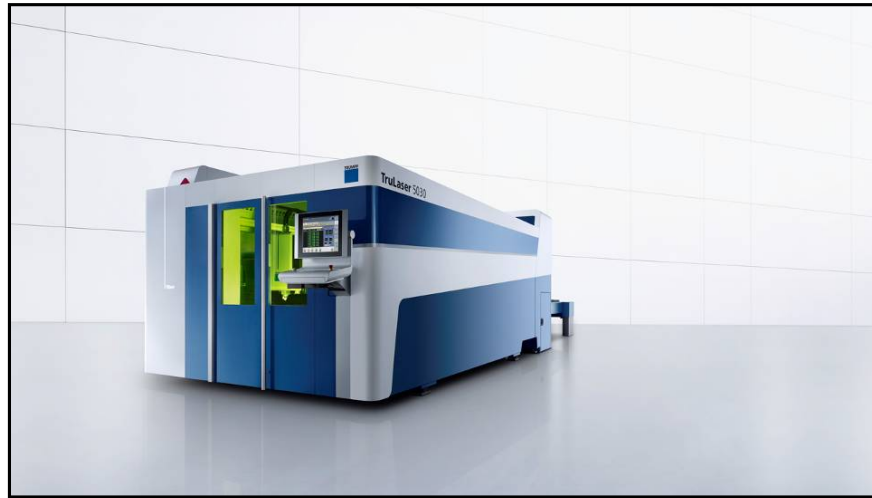
#### 3.4.2 TruLaser 5030 fiber: part-cost-optimized thin sheet manufacturing

Thanks to its high dynamics, the new TruLaser 5030 fiber flatbed cutting machine uses the advantages of the fiber-guided solid-state laser to the fullest and achieves very high cutting speeds in thin sheet metal. In fusion cutting, for example, the machine achieves feed speeds up to three times those of the CO<sub>2</sub> version, depending on the thickness of the material being processed. This reduces sheet times by 45 per cent and significantly lowers part costs (up to 20%). A CO<sub>2</sub> laser cuts 60 parts from a 2 mm thick sheet in one hour. The solid-state laser achieves 86 parts in the same time due to its higher cutting speeds. A part cut with the CO<sub>2</sub> laser thus costs the user around 4.02 Euros, but the same part cut with the solid-state laser only 3.32 Euros.

The sole reason for this difference is the higher productivity of the solid-state laser cutting machine, since all other cost factors have a subordinate influence on the part costs by comparison. Electricity and gas costs, for example, each account on average for only 3% of the cost per part. The new machine economically cuts not only mild steel, stainless steel and aluminum, but also non-ferrous metals such as copper or brass, resulting in a significant increase in material flexibility for the user.

A further economic benefit results from the use of the machines in thin mild steel. This can be cut on the TruLaser 5030 fiber more economically using nitrogen than on a CO<sub>2</sub> installation using oxygen – which is actually the less expensive cutting gas. Once again, the savings are due to productivity. The machine processes the thin material so fast that the resulting part cost advantage significantly outweighs the additional costs for the expensive cutting gas. If the parts are subsequently painted, all secondary processing costs can be saved, since the edges are already oxide-free.

Customer groups that value these benefits are on the one hand product shops, whose product portfolio lies within the thin sheet metal range, such as enclosure manufacturers, furniture manufacturers, façade element manufacturers etc. However, the machine is also popular with larger job shops, whose thin sheet production quantity is sufficient to be able to make full use of the capacity of a TruLaser 5030 fiber.



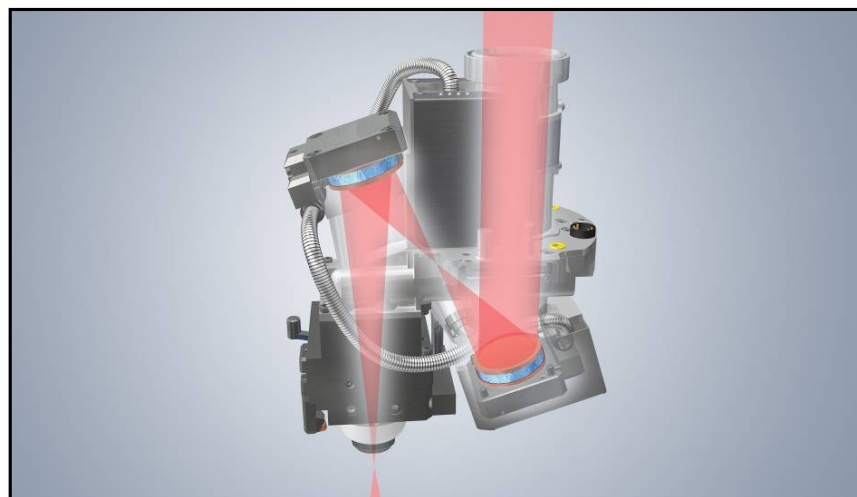
**Fig. 10: TruLaser 5030 fiber with fiber-guided TruDisk 3001 disk laser**

### 3.4.3 Mirror cutting head: maximum flexibility with special materials and thick sheet metals

The new mirror cutting head for cutting with high laser power is a trend-setting innovation in the CO<sub>2</sub> laser field. It allows economic access to a completely new field of laser cutting because unlike lenses, even greater degrees of contamination can be simply removed from the mirrors. This provides the user with novel possibilities to process materials outside TRUMPF's standard parameters because the mirrors can cope with possible splashes without permanent damage. The user can determine suitable laser parameters without risking destruction of the cutting optics.

Unlike the lens cutting head, in which the laser beam penetrates the lens, the mirror cutting head focuses the laser beam by means of reflection by two cooled mirrors. Unlike in the case of the lens, contamination does not lead to excessive heating and an alteration in the focusing characteristics.

Even contamination with which a lens would no longer be capable of cutting and is irreparably damaged has no effect on the mirror cutting head. This is ensured among other things by the continuous rear-sided water cooling of the entire mirror surface. It dissipates the heat generated as a result of laser radiation being absorbed by the contamination.



**Fig. 11: the mirror cutting head focuses the laser beam by the reflection of two cooled mirrors**

The new cutting head is available for the TruLaser 5030 2D laser cutting machine in conjunction with the TruFlow 6000 CO<sub>2</sub> laser. Since the interface to the cutting head holder is the same for both the mirror and the lens cutting heads, the cutting heads can be exchanged with a flick of the wrist – which is actually no longer necessary, because it can cut all thicknesses of sheet metal between 1 and 30 mm.

### 3.5 TruLaser Series 7000: high-precision mass production

#### 3.5.1 TruLaser 7025/7040: two lasers for large batch sizes

The TruLaser 7025 and its bigger sister, the TruLaser 7040, are intended for users who manufacture large batch sizes in multi-shift operations and whose applications are subject to very high precision demands. Specialized products such as electrical sheets, saw blades, seals or tailored blanks are classic cases for the TruLaser 7025/7040 when manufactured in large quantities. However, contract manufacturers also value the productive and precise two-headed machine as an extra machine for orders with large batch sizes. The part costs are usually lower with the TruLaser 7025/7040 than with a comparable single-headed machine, even from a batch size of 20. The biggest reason for this is the low investment for a second laser including beam guidance and cutting head and the associated double productivity of the machine. Personnel expenditure for machine operators and also the often underestimated logistics expenditure for material handling remain the same in comparison to a single-head machine.

Automotive part manufacturers with a high portion of mild steel use the machine just as economically as extremely specialized manufacturers of gardening equipment or computer housings, who use the machine for the production of just one product in correspondingly large batches. The target sectors of the TruLaser 7025/7040 are therefore both specialized ones (e.g. electrical sheet metals, hedge trimmer blades, saw blades etc.) and those producing in bulk (e.g. manufacture of housings and automotive parts).

The TruLaser 7025/7040 is characterized by a particularly rigid mechanical structure, which guarantees particularly high part accuracy in conjunction with linear drives in all axes and direct measuring systems. The particularly high dynamics, already present in the standard version of the machine, are enhanced with an optional motion unit made of a carbon fiber reinforced plastic (CFRP) that has been tested in motor racing. Along the way, the attainable part accuracies are increased with this light CFRP motion unit.

The two laser units of the TruLaser 7025/7040 are perfectly matched to each other and provide outputs of up to 6 KW each. The series-standard laser power controller ensures that the correctly dimensioned laser power is used in relation to the respective path speed of the laser along the contour, in order to guarantee the best possible quality of the cut edge as well as freedom from burrs and beads. Both the TruLaser 7025 and the TruLaser 7040 offer a work area width of 2.50 m.

#### 3.5.2 TruLaser 7025/7040 fiber: laser beam division or bundling at the push of a button

The two-headed machine, tried and tested over many years in the CO<sub>2</sub> version, has also been available for over two years with a solid-state laser for users whose applications lie primarily in the thin sheet range ≤5mm, but who want to be able to react with flexibility to enquiries in the thick sheet metal range. For thin sheet metal in particular, gains of up to 100% in feed speed and thus productivity are possible. The TruLaser 7025 fiber and the TruLaser 7040 fiber are equipped with a solid-state laser with a comparatively high laser output, the TruDisk 6001. Its laser power is divided across the two cutting heads for the cutting of thin sheet metal. Conversely, the laser beam is bundled at the push of a button and made available at one of the two cutting heads for the processing of thicker sheet metals. Users of the TruLaser 7025/7040 fiber employ this flexibility in order to gain a decisive advantage over their competitors: to have a suitable machine for the most diverse enquiries that brings significant cost benefits through its efficiency. For instance, the TruLaser 7025/7040 fiber is the first laser cutting machine that is able to cut 20 mm thick aluminum. In some cases it achieves considerable part cost

advantages with thin sheet metals. Beyond that it offers a wider range of machinable materials than the CO<sub>2</sub> version, since it can also cut copper and brass.

The TruLaser 7025/7040 fiber thus unites the advantages of the solid-state laser with thin sheet metals – in particular high feeding speeds and excellent cut edge qualities – with the unique features of the TruLaser Series 7000 with regard to dynamics and contour accuracy. It is the most productive laser cutting machine in the world – and is at the same time extremely energy-efficient. The TruDisk 6001, with which the machine works, is not only extremely efficient, it also features an economical standby mode. It requires almost no power when not cutting. The laser beam is guided via a fiber optic cable from the resonator to the cutting head and can be made available to other applications with the additional laser power outputs.

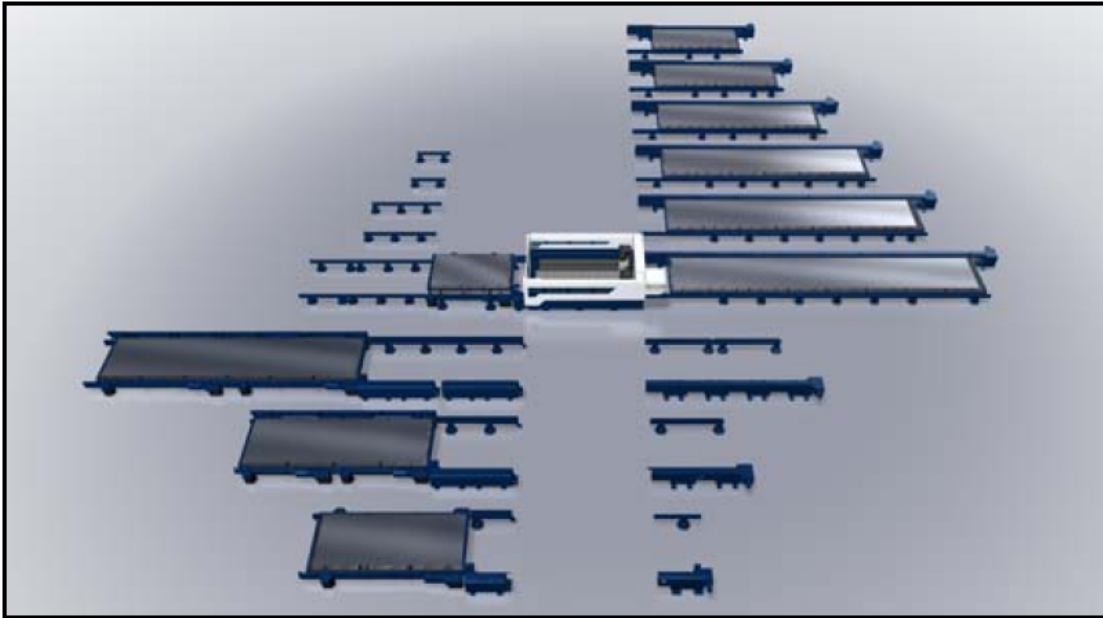


**Fig. 12: TruLaser 7040 fiber – the most productive laser cutting machine in the world**

### 3.6 TruLaser Series 8000: oversized manufacturing for large parts

The TruLaser Series 8000 is designed for processing particularly large sheet metal panels. The oversized machines are suitable for sheet metal panels in sizes of up to 16 x 2.5 m. The sheet metal is cycled through the machine in several steps. The TruLaser 8000 is the first choice for commercial vehicle manufacturers (e.g. production of HGV main chassis beams), shipbuilders and manufacturers of façade elements and other products that require work areas beyond 2 m in width and 4 m in length. Beyond that, the TruLaser 8000 is used in steelwork-related fields, such as steel service centers, where the large laser cutting machine can save a sometimes necessary intermediate machining step – cutting raw material to size before laser cutting. However, the classic job shops also use the TruLaser Series 8000 to secure profitable special orders with the cost-efficient processing of oversized sheets, or to produce with low manpower with large pallets for multi-sheet loading.

The basic machine has a work area of 4 x 2.5m and can be equipped with two cutting heads as an option. The maximum laser output of the TruLaser 8000 is 6000 watts per cutting head. Two pallet concepts are available: an oversized auxiliary pallet guarantees high productivity even with standard formats. It supplements the machine's fast, fully automatable pallet changer, which, with dimensions of 4.0 x 2.5 m, is available for the majority of production jobs. In addition, the oversized auxiliary pallet offers the ability to implement longer low-manpower production runs, e.g. night shifts, by loading with several smaller sheets. The oversized auxiliary pallet is available up to a length of 16 m.



**Fig. 13: maximum configuration diversity of the TruLaser 8000 with different formats**

The second pallet concept, the oversized pallet changer, is designed especially for the processing of oversized formats. The fast oversized pallet changer can be combined with a stable sheet metal stop system. The stop system facilitates the fast loading of the oversized pallets, since the sheet metal is usually brought in using a crane and is difficult to steer due to the comparatively heavy weights. The stop system can be folded up and is monitored by the controller. The shortening of the loading cycles achieved in this manner directly affects part costs, since the TruLaser 8000 achieves a higher laser duty cycle per unit of time. With the ability to load and unload entirely in parallel to the main production time, the TruLaser 8000 with oversized pallet changer achieves maximum productivity.

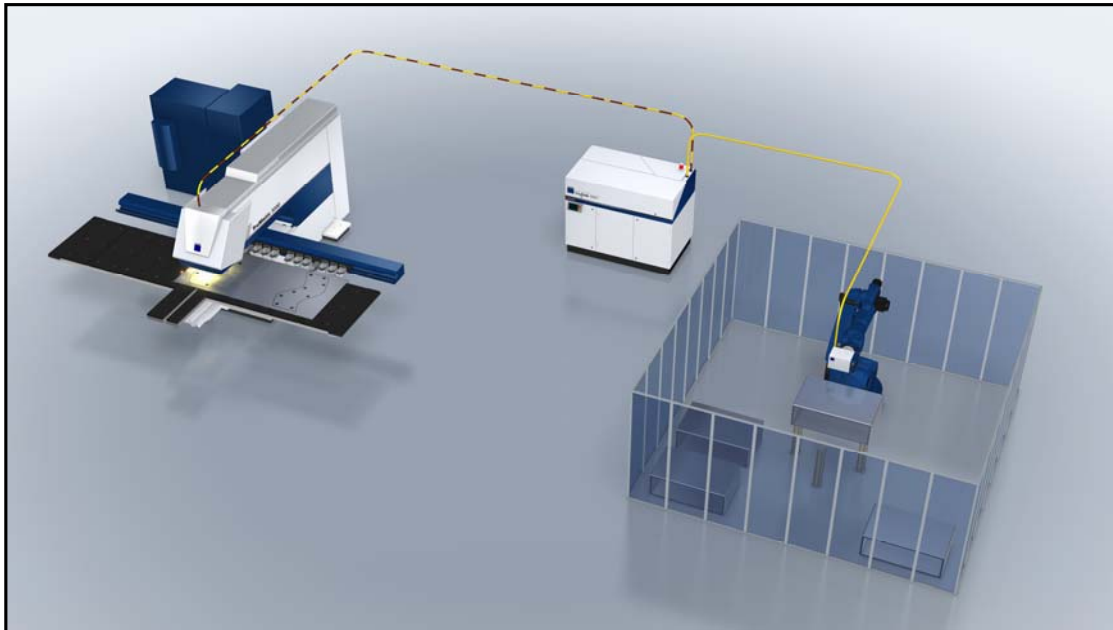
Intelligent process checks and material flow concepts prove that the TruLaser 8000 has been tailored entirely for maximum economy. All oversized pallets of the TruLaser 8000 are propelled by a thrust chain, which can transfer significantly higher forces than the conventional roller chains. The TruLaser 8000 processes oversized sheets significantly faster than conventional repositioning machines. However, this is not achieved at the expense of contour accuracy. Apart from the high-precision basic machine, which is equipped with linear drives and direct, high-resolution measuring systems, this is ensured by the patented coupling systems for the extremely precise indexing of the oversized pallets, intelligent approach strategies for transition-free machining when repositioning and the technological measures supported by the TruTops Laser programming system, which help to control the inherent stresses in the material.

### 3.7 Solid-state laser network: extended flexibility

Unlike the CO<sub>2</sub> laser, the laser beam is transported from the resonator to the workpiece by a laser light cable instead of by an open mirror beam guidance system. Therefore, they can be integrated with more flexibility in production lines and can easily be combined with industrial robots or other handling systems. The fiber-guided solid-state laser can be used for several installations, resulting in optimum usage of the laser and, in some cases, significantly lower investment costs.

The combination of several little utilized installations in a laser network is attractive for various target groups: for example, for newcomers to sheet metal processing, who can immediately offer a large part of the sheet metal process chain. Or for prototype constructors, who can manufacture complete prototypes from the sheet metal cut-out to the finished part. Or for so-called product customization meaning, the manufacture of uniform 2D blanks, which are adapted to the customer's requests only very late in the

production chain and processed into 3D parts. Each of the different processing stations is utilized only to a small extent, but this is offset by the low investment of the laser network and helps achieve the economic manufacture of various applications.



**Fig. 14: The TruMatic 3000 fiber is well suited to multi-station processing in the laser network**

A specific area to utilize such a TRUMPF laser network meaningfully is the common use of a TruPunch 3000 combined punching laser machine with a TruLaser Robot 5020 laser welding robot. In a midrange combination machine like the TruMatic 3000, which has only been available with a CO<sub>2</sub> laser until recently, the laser is frequently active for only 20% to 30% of the operating hours. The rest of the time it is idle because the machine is punching or being set up. Similar beam-on times also apply to laser welding machines, since jigs constantly have to be converted. There is a great deal of potential for an increase in efficiency here.

Combination machines have proven themselves over many years to be versatile and flexible work instruments for a sheet metal fabrication company. Recently, there has been great demand for this type of machine. Conversely, the conviction that laser welding can also be integrated profitably into the process chain has not by any means become generally accepted in sheet metal manufacturing. The new TruMatic 3000 fiber model opens up completely new possibilities here.

Apart from the common use of the laser, the two installations complement each other in another area. The combination machine offers a wide range of punching and forming applications. Among other things it can prepare the joint edges for welding. This facilitates the construction of jigs and makes even small batch sizes profitable. Thus, entry into laser welding pays off in several respects.