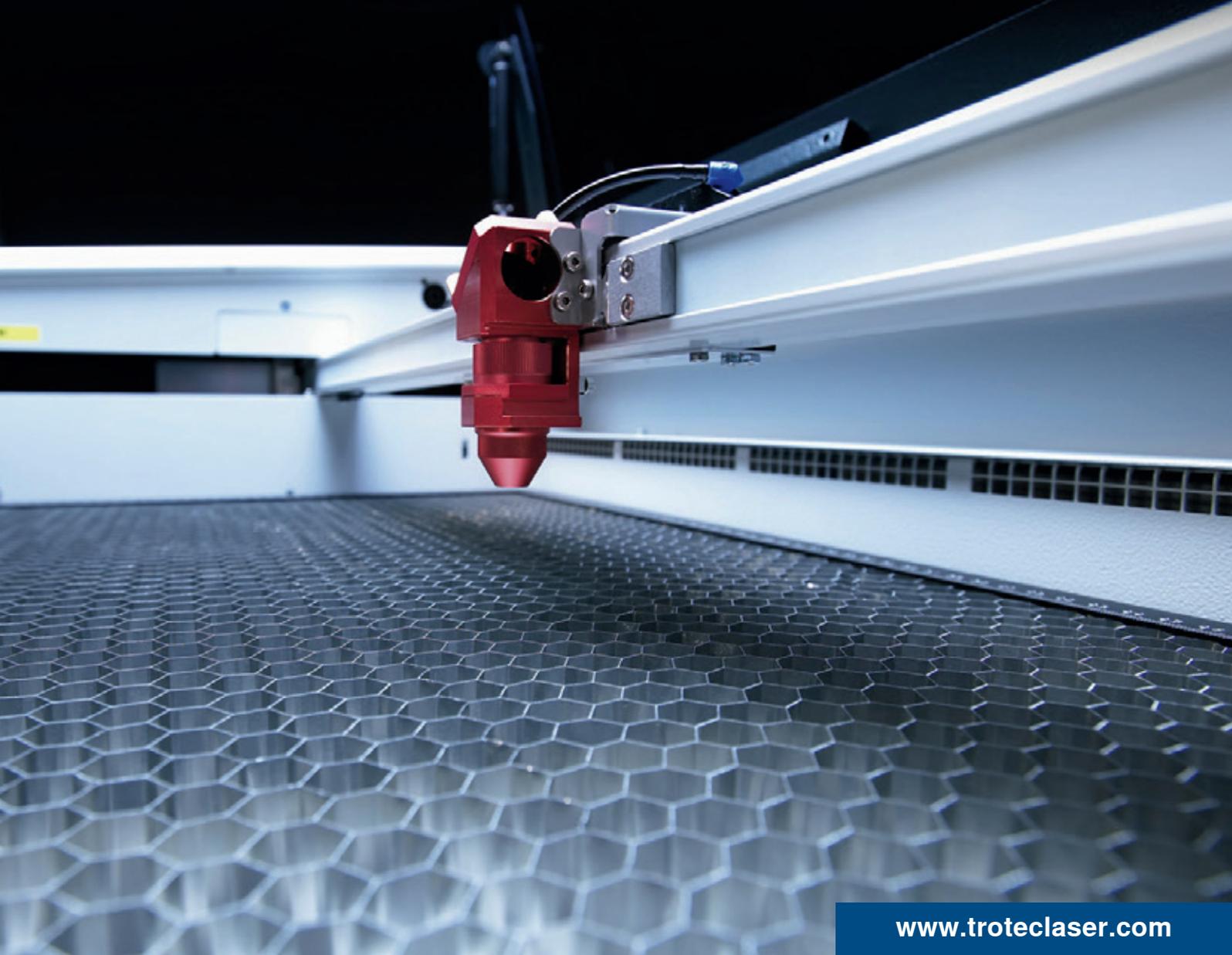


trotec[®]
laser. marking cutting engraving

setting
new
standards

Handbook for → Engravers



www.troteclaser.com

Tips & Tricks for working with the laser

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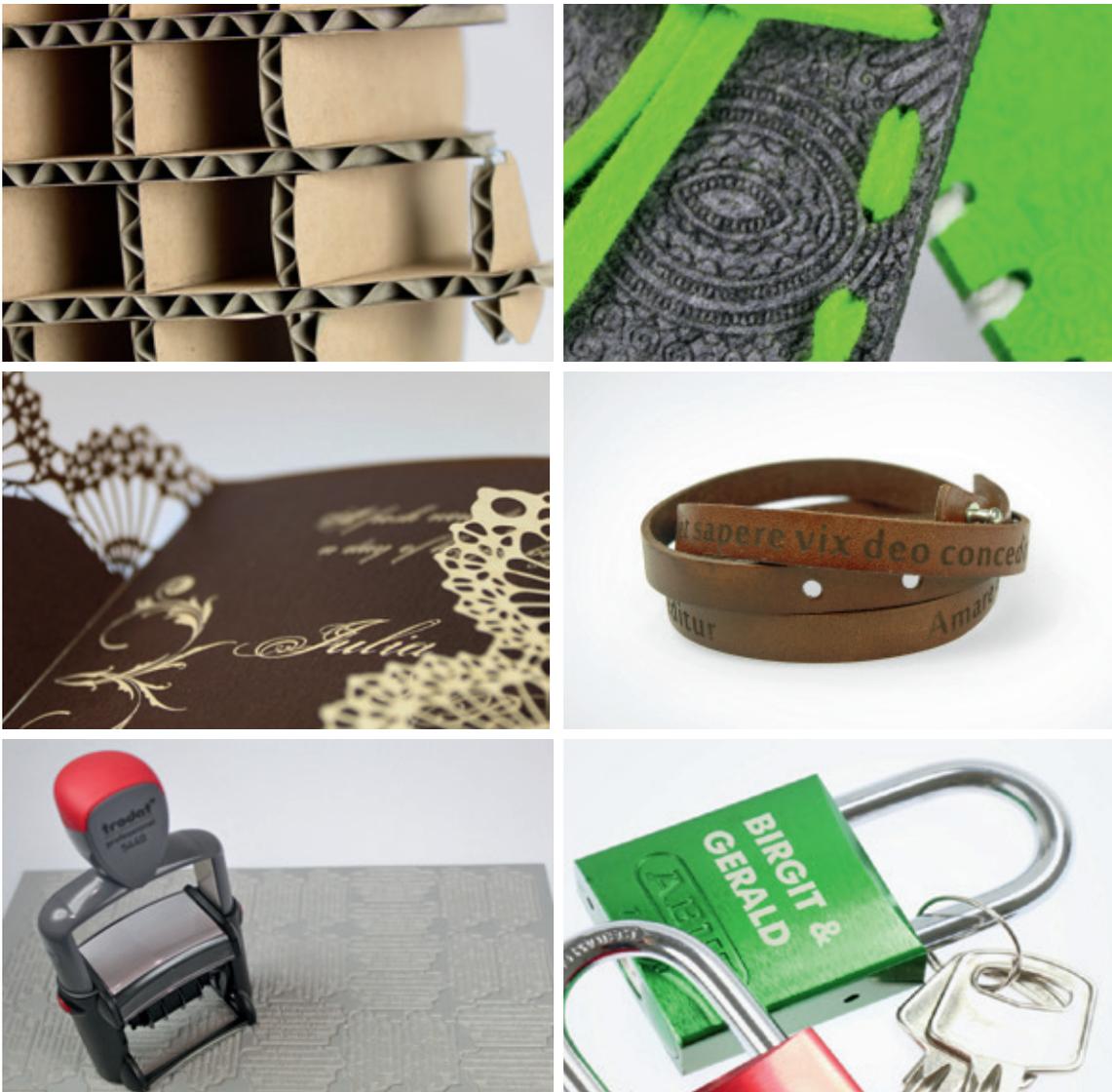
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→ Introduction

→ What can a laser do?

With an advanced laser engraver, you can process a variety of different materials. Wood, glass, leather, acrylic, natural rubber or stone are just a few of the wide range of materials used in applications, such as signs, stamps, promotional items and many more. With the wide range of laser engraving and marking systems offered by Trotec, you are ideally equipped for the future of your business!

Here are a few examples of our favorite applications:



A range of different laser applications

→ Laser sources and your options

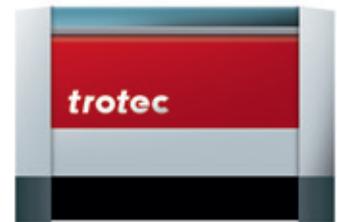
CO₂ and fiber lasers

The devices from the Speedy flexx series are equipped with a CO₂ and a fiber laser. Select a CO₂ laser with a power level between 25 to 120 Watt and combine it as desired with a 10, 20, 30 or 50 Watt fiber laser (for details on configurations see page 3). Use both laser sources in a single job without having to manually change the laser source, lenses or focus. The patented JobControl[®] laser software makes it possible. Simply assign the desired laser source to each color of the graphic.

flexx function

Thanks to the flexx function developed by Trotec, both laser sources can even work together on a single job. In other words only a single process has to be initiated to process two materials. The CO₂ laser for example can be used to engrave leather, while the fiber laser can mark metal parts. Likewise you can control both laser sources independently of each other. This feature is patented. In general all organic materials or non-metals can be processed with the CO₂ laser and all metals (even precious metals like gold and silver) can be processed with the fiber laser. Plastics are an exception. They can be processed both with the CO₂ as well as the fiber laser. On page 10 of the Materials chapter, you will find a summary table which shows in detail which substances can be processed with which laser source.

→ From an idea to the finished workpiece



Work process from an idea to the finished product

→ Step 1: What do I want to laser process?

Depending on the material that you want to process, you need to consider a few factors. First of all, ask yourself which laser source can be used to process the material. On page 10 you will find a table that maps the different materials to the laser sources. Furthermore, it may be necessary to use accessories, such as a rotary attachment or a special overlay to cut acrylic.

All of these points are described in detail in the Hardware chapter starting on page 26. In addition, material-specific hardware recommendations are described directly at the relevant point in the Materials chapter.



Laser processing is as simple as printing

→ Step 2: Graphics preparation

The desired graphics can be created in any graphics program. It is important that cutting lines are always vectors. Everything else can be freely designed to your liking. On page 7 you will find a description of how to prepare graphics for laser processing, so you can achieve optimum results.

Sending the job to the laser is as simple as printing because our lasers communicate with the graphics program via a printer driver.

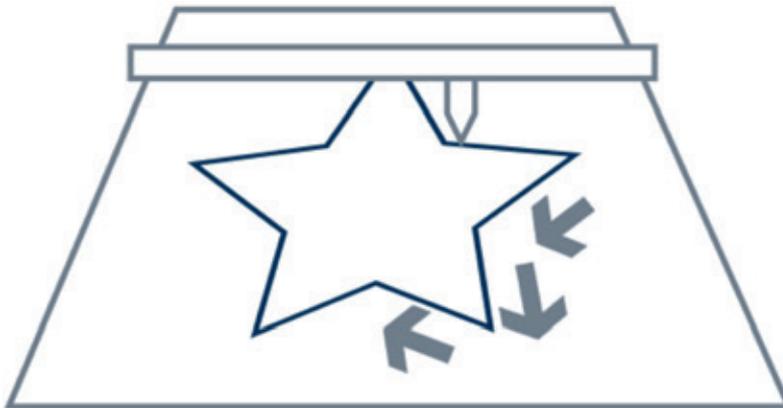


Speedy laser head

→ Step 3: Laser settings

Select the appropriate settings in JobControl[®] from an abundance of laser parameters. Position the graphic where you want it and you are ready to start the laser process.

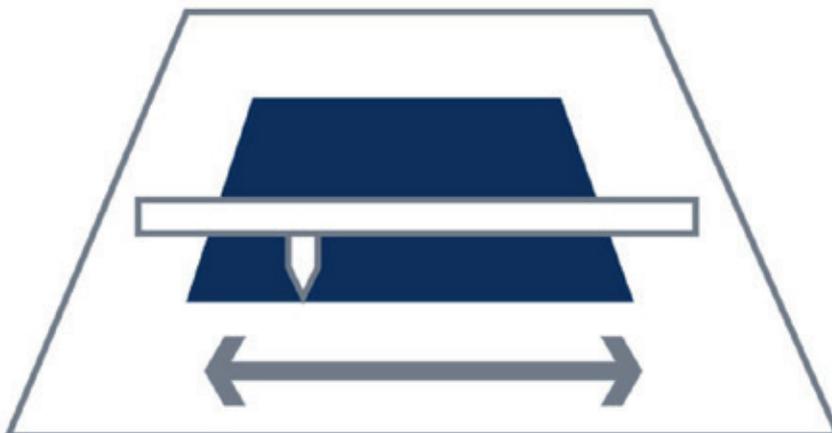
→ How does the laser work?



Laser cutting process

Process: Vector cutting

- How to use the milling head
- The processing head moves along a specific path (vector)
- Cutting paths are vector lines and arcs
- Vectors are processed one after the other
- Control via Hz (frequency)
- Slow X-axis and Y-axis movement



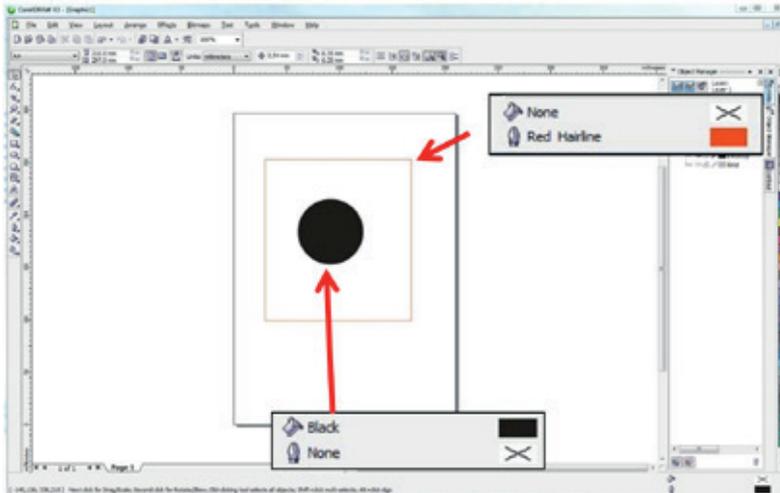
Laser engraving process

Process: Raster engraving

- Similar to a printer
- The processing head moves along on the X-axis from left to right
- Graphics are traversed row by row
- Graphics are rasterized bitmaps
- Control via DPI (dots per inch) and PPI (pulses per inch)
- Very fast X-axis, slow Y-axis motion

→ How to create a file for the laser

In order for the laser to know which lines of the graphics need to be cut and which must be engraved, they must be set in the graphics as follows.



Cutting lines must always be red, engraving elements black

→ Cutting lines:

- Must always be vectors
- Line width = hairline
- Line color = red
(RGB from the Trotec color palette)

→ Engraving area:

- Vectors and pixel graphics
- Filling = black 100%

Would you like to work with different laser parameters in a single processing step, for example to produce different engraving depths or effects? JobControl[®] can fill different laser parameters with up to 16 colors. Simply use the Trotec color palette to mark the areas in CorelDraw[®].

Material database

Standard / Standard

Thickness: 2.00 mm

Description:

| Color | Process | Power | Speed | PP/Hz | Auto | Passes | Air Assist | Z-Offset | Advanced |
|-------|---------|-------|--------|-------|------|--------|------------|----------|----------|
| 1 | Engrave | 30.00 | 300.00 | 500 | PP | 1 | On | 0.00 | Default |
| 2 | Cut | 30.00 | 2.00 | 2000 | He | 1 | On | 0.00 | Default |
| 3 | Skip | --- | --- | --- | --- | --- | --- | --- | --- |
| 4 | Skip | --- | --- | --- | --- | --- | --- | --- | --- |
| 5 | Skip | --- | --- | --- | --- | --- | --- | --- | --- |
| 6 | Skip | --- | --- | --- | --- | --- | --- | --- | --- |
| 7 | Skip | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | Skip | --- | --- | --- | --- | --- | --- | --- | --- |
| 9 | Skip | --- | --- | --- | --- | --- | --- | --- | --- |
| 10 | Skip | --- | --- | --- | --- | --- | --- | --- | --- |
| 11 | Skip | --- | --- | --- | --- | --- | --- | --- | --- |
| 12 | Skip | --- | --- | --- | --- | --- | --- | --- | --- |
| 13 | Skip | --- | --- | --- | --- | --- | --- | --- | --- |
| 14 | Skip | --- | --- | --- | --- | --- | --- | --- | --- |
| 15 | Skip | --- | --- | --- | --- | --- | --- | --- | --- |
| 16 | Skip | --- | --- | --- | --- | --- | --- | --- | --- |

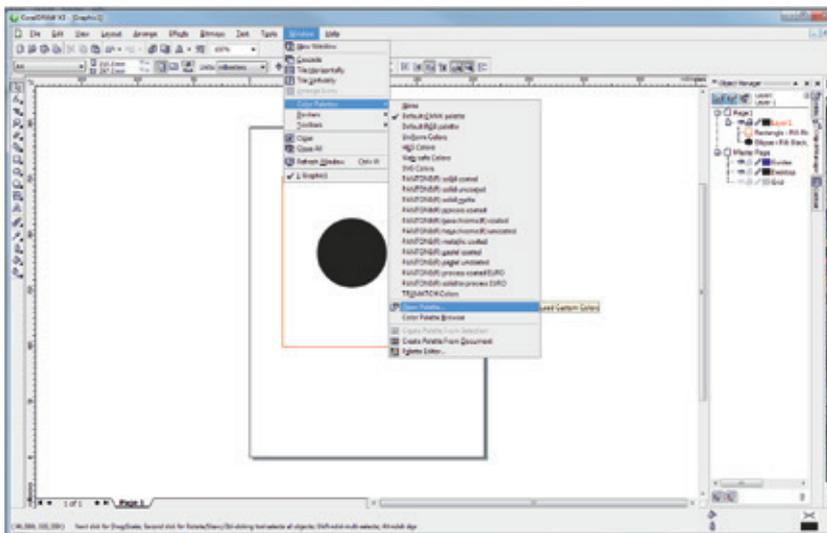
Overview of materials in JobControl[®]

➔ Import Trotec color palette

As already mentioned in the previous chapter, the laser needs accurate color information in order to be able to process the data. To make creating these settings as quick and easy as possible, we have prepared a ready-made color palette, which you can import into your vector program in two easy steps, for example into Corel Draw[®]. You can find the color palette on the CD delivered with your laser.

➔ Step 1

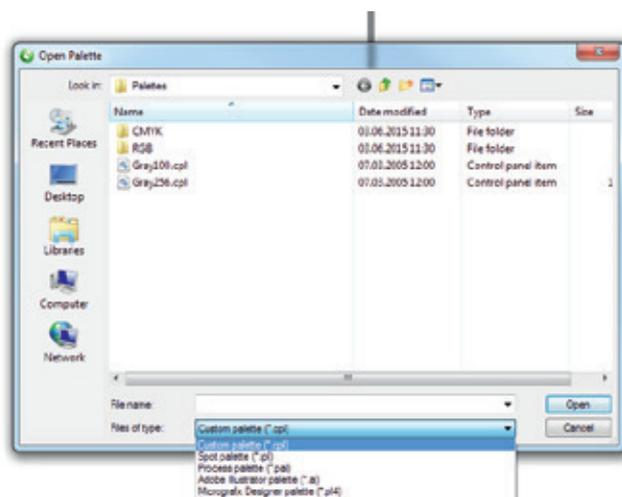
In the menu item “Window” under “Color palette” click on “Open color palette”. This will open a window where you can select the palette.



Overview of materials in JobControl[®]

➔ Step 2

Change the file type to *.cpl in the dropdown menu at the bottom of the window and choose the Trotec color palette. The Trotec color palette enables clear communication between the vector program, e.g. CorelDraw[®] and the JobControl[®] laser software. In this way you can process your workpiece using 16 different laser parameters in a single processing step.

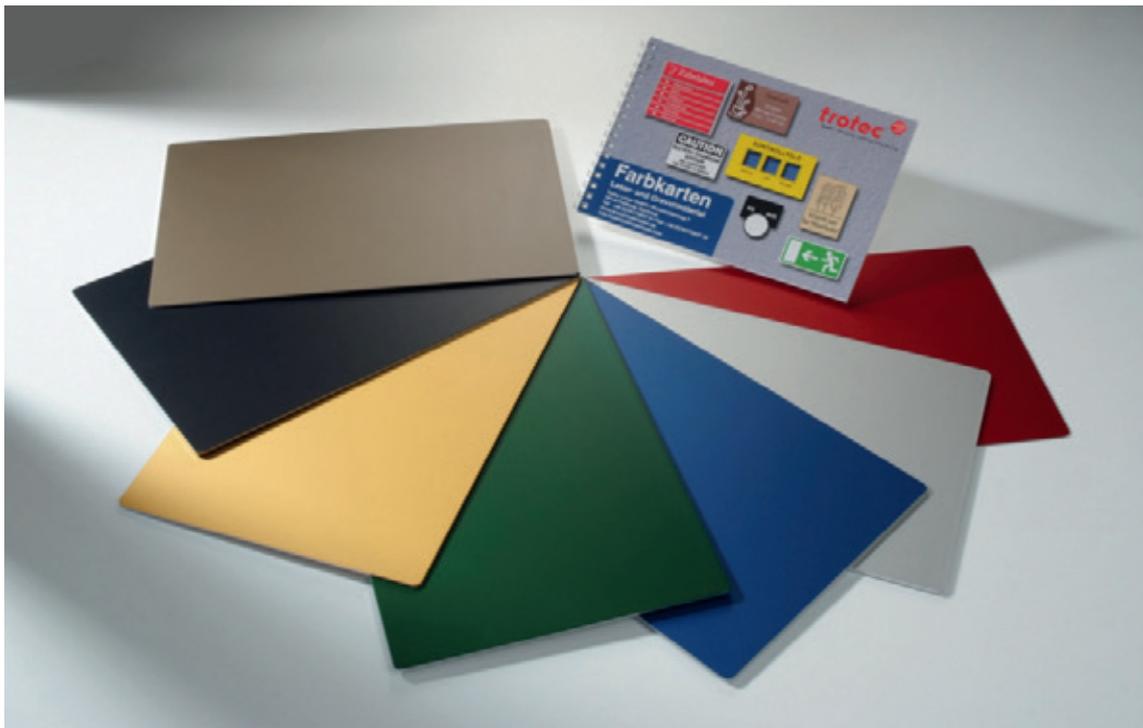


Importing a new color palette - Step 2

→ Materials

Here you will find processing tips and tricks for many materials. We have selected the most common and popular materials. This information has been compiled from years of experience of our employees and trial and error. You, too, will need to develop a bit of an instinct and experiment, in order to create your own perfect laser settings, as each material reacts differently to laser processing.

**Do you want to process other materials and do not know which parameters to use?
No problem: On page 37 you will find instructions on how to find laser parameters yourself quickly and easily.**



Various laminates

→ Overview of materials for laser processing

The following table gives an overview of which materials can be processed with a Trotec laser.

| Material | Laser source | | Machinability | Process |
|--|-----------------|------------|---------------|--|
| | CO ₂ | Fiber | | |
| Laminates | ✓ | ✓* | ✓✓✓ | Engraving, cutting, marking * Color change on black base material |
| Acrylic | ✓ | ✓* | ✓✓✓ | Engraving, cutting *soak-dyed acrylic |
| Natural rubber | ✓ | | ✓✓ | Engraving, cutting |
| PVC | NO! | NO! | ✗ | Must not be processed! Laser processing produces dioxin! |
| Thermoplastics (PC, PI) | ✓ | ✓ | ✓✓✓ | Cutting, marking |
| Thermoplastics (PMMA, ABS, PP, PE, POM, PA, PES) | ✓ | ✓ | ✓✓✓ | Cutting, engraving, marking |
| Thermoplastics (PS, PETG) | ✓ | | | Engraving, cutting |
| Thermoplastics (PI) | ✓ | | ✓✓✓ | Cutting |
| Thermoplastics (PBT, PPS) | | ✓ | ✓✓✓ | Marking |
| Ceramics | ✓ | ✓ | ✓ | CO2 engraving, color change with fiber laser |
| Paper | ✓ | | ✓✓✓ | Engraving, cutting |
| Foamed plastics | ✓ | | ✓✓✓ | Engraving, cutting |
| Textiles | ✓ | | ✓✓ | Engraving, cutting |
| Leather(ette) | ✓ | | ✓✓✓ | Engraving, cutting |
| Glass | ✓ | | ✓✓✓ | Engraving |
| Wood | ✓ | | ✓✓ | Engraving, cutting |
| MDF | ✓ | | ✓✓✓ | Engraving, cutting |

| Material | Laser source | | Machinability | Process |
|------------------------------------|-----------------|------------|---------------|------------------------|
| | CO ₂ | Fiber | | |
| Veneer | ✓ | | ✓✓✓ | Engraving, cutting |
| Plywood | ✓ | | ✓✓✓ | Engraving, cutting |
| Fiberglass | ✓ | | ✓✓ | Engraving, cutting |
| Stein | ✓ | | ✓✓ | Engraving |
| Aluminium | | ✓ | ✓ | Engraving |
| Anodized aluminum | ✓ | ✓ | ✓✓✓ | Engraving |
| Polished / unpolished brass | | ✓ | ✓✓✓ | Engraving |
| Hartmetall | | ✓ | ✓✓ | Polishing |
| Chrom | | ✓ | ✓✓ | Engraving |
| Polished / unpolished copper | | ✓ | ✓✓ | Engraving |
| Gold | | ✓ | ✓✓✓ | Engraving |
| Silver | | ✓ | ✓✓✓ | Engraving |
| Platinum | | ✓ | ✓✓ | Engraving |
| High-speed steel (HSS) | | ✓ | ✓✓✓ | Annealing / engraving |
| Brushed / polished stainless steel | | ✓ | ✓✓✓ | Annealing / engraving |
| Carbon | NO! | NO! | ✘ | Must not be processed! |
| Titanium | | ✓ | ✓✓✓ | Annealing / engraving |

- ✓✓✓ Easy to process, even at high speed
- ✓✓ Easy to process
- ✓ Difficult to process
- ✘ Cannot be processed

Note: Laser marking results on plastics using a fiber laser depend on the pigmentation of the material. Results may vary.

→ Acrylic and plexiglass®

There are almost no limits for the uses of acrylic. Laser cutting can be used to quickly and easily produce illuminated and neon advertising, signage or sales displays and many other plastic products. When laser engraving acrylic, the surface is removed by the laser. As a result, even the finest details can be displayed accurately. On transparent acrylic the result is a matte white engraving.

→ For optimal engravings: cast acrylic

Cast acrylic, which is slightly more expensive, has a structure that produces better engraving results for photos and very detailed engravings than more cost-effective, extruded acrylic materials.

→ Acrylic cutting table or acrylic lamellae

Back reflections of the laser beam from the cutting table are easily visible. Therefore, the white acrylic grid or the cutting table (lamellae) should be used.

→ Warning: Ignition is possible

A powerful exhaust system is important when cutting acrylic. Acrylic is prone to flame formation when gases are not extracted efficiently. Never leave the machine unattended!

→ Air Assist OFF

Turn off the Air Assist when cutting acrylic, as this will make cutting edges even clearer and grooves can be avoided.

→ Delrin

Delrin is used for the production of seal presses and is comparable to stamp rubber, however, it is much harder. A frequently encountered problem with seal presses is that thin paper is easily cut because Delrin edges are often too sharp.



Embossing on paper



Seal press

→ Defocusing

One of the problems with seal presses may be that the press cuts through the paper. Our tip: Set the laser to be out of focus by around 2 mm (= z-axis offset by 2mm). Embossing results remain the same, however, the seal's edges become more rounded and the process is therefore more gentle for paper.

→ Text size

Text or graphic elements should be at least 0.5 mm in size or no less than a five-point font. When using paper grades that are significantly heavier than 80 g/m², the size of the graphic elements should also be increased.

→ Engraving depth

The engraving depth should be at least 0.25 mm, however, a maximum depth of 0.50 mm must not be exceeded. Values smaller than the minimum depth lead to weak or illegible imprints, while values exceeding the maximum depth may tear the paper at certain points. Minimum and maximum depths can be set indirectly via laser parameters.



Wedding glasses
with fine engraving

→ Delrin

→ Wet paper for white engravings

Photo engravings on glass are usually most beautiful when you send them to the laser with 500 dpi. Use the 'ordered dithering' rasterizing function, to adapt image data perfectly to the material. In addition, we recommend to use a 70% gray setting rather than black, whereby lower temperatures act on the glass and results are even better. Please note that these settings are only suitable for photos. For small images, such as logos or texts, 1000 dpi and full black are suitable.

→ **Photo engravings on glass**

Photo engravings on glass are usually most beautiful when you send them to the laser with 500 dpi. Use the 'ordered dithering' rasterizing function, to adapt image data perfectly to the material. In addition, we recommend a 70% gray setting rather than black, whereby lower temperatures act on the glass and results are even better.

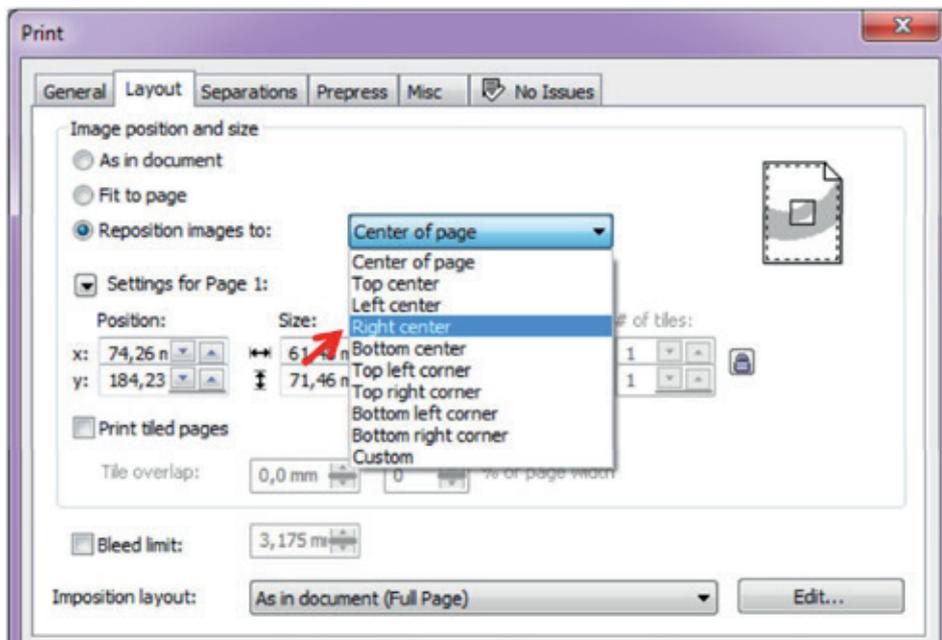
Please note that these settings are only suitable for photos. For small images, such as logos or texts, 1000 dpi and full black are suitable.

→ **Inexpensive glasses**

Inexpensive glasses are easier to process because they have a more homogeneous, uniform structure. Consequently, inexpensive, cast glasses are preferable to hand-blown crystal glasses.

→ **Working with the rotary attachment**

In order for the printing process to begin exactly where the laser pointer is, please enter "Positioning: middle right" in the print dialog.



Settings in the print dialog "Position Right Middle"

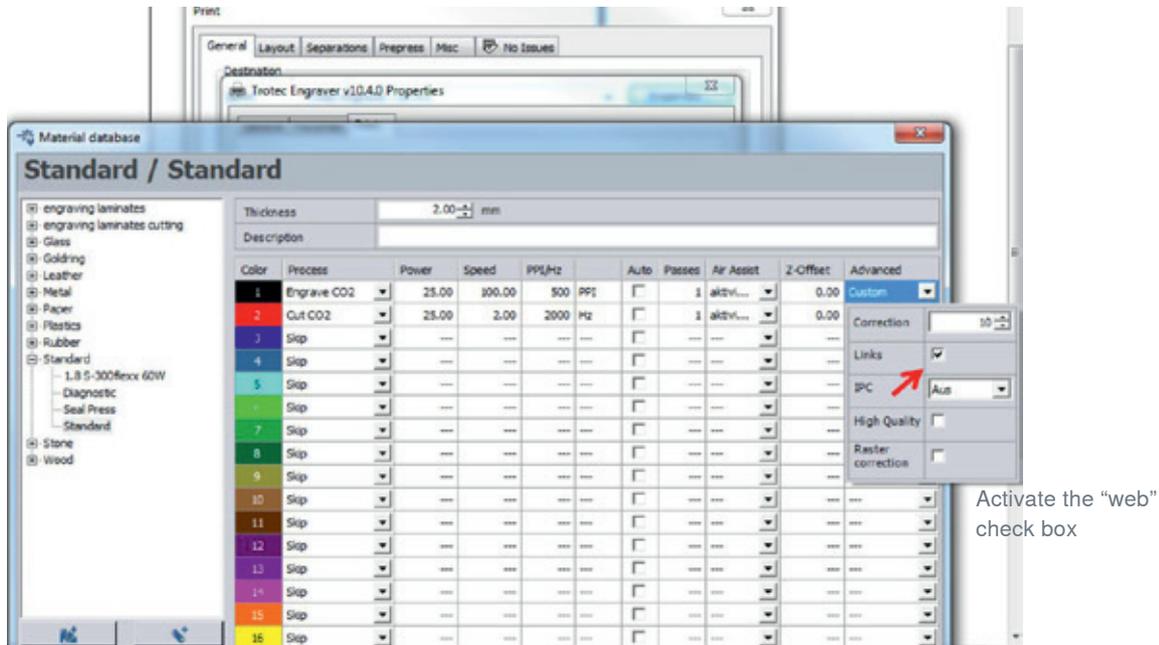
→ **Natural rubber**

→ **Direction of engraving and extraction**

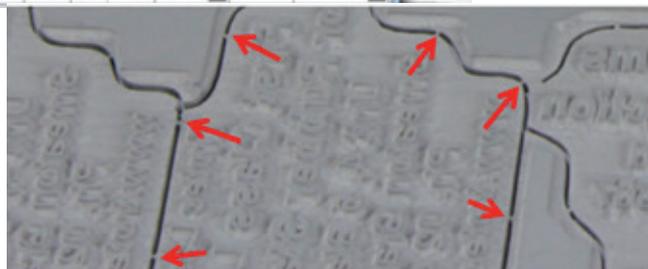
When processing stamp rubber, a lot of dust is created. It is, therefore, important that you engrave bottom up, so that dust and rubber parts are removed by the exhaust system and do not affect the rest of the engraving process. Please open the throttle, so that the exhaust system can operate at maximum. To see more information about the throttle, please turn to page 29.

→ **Webs**

Do you want to engrave a whole plate with stamp designs? Then use the “web” function in JobControl[®]. Small connections between the stamp motif and the base plate are created automatically. You can break out individual parts easily from the plate as a whole without losing the other parts.



Webs on the stamp rubber hold individual stamp plates in place



→ **Flanks for a beautiful stamp imprint**

Flanks, also called shoulders, can be set in JobControl[®] depending on the respective application.

| Steep | Medium | Flat |
|--|--|---|
| | | |
| Many elements in a confined space - there is a danger that flanks may overlap. | Generally well-suited to standard applications | Frames or tables Whenever a lot of material is removed around an element and the element may otherwise become a little unstable. |

→ Wood

Not all wood is created equal. Countless types of wood are available for sale, all of which in turn are processed and refined in a wide variety of ways. It is therefore very hard to make sweeping statements. Nevertheless, we have tried to summarize the most important tips and tricks for you.



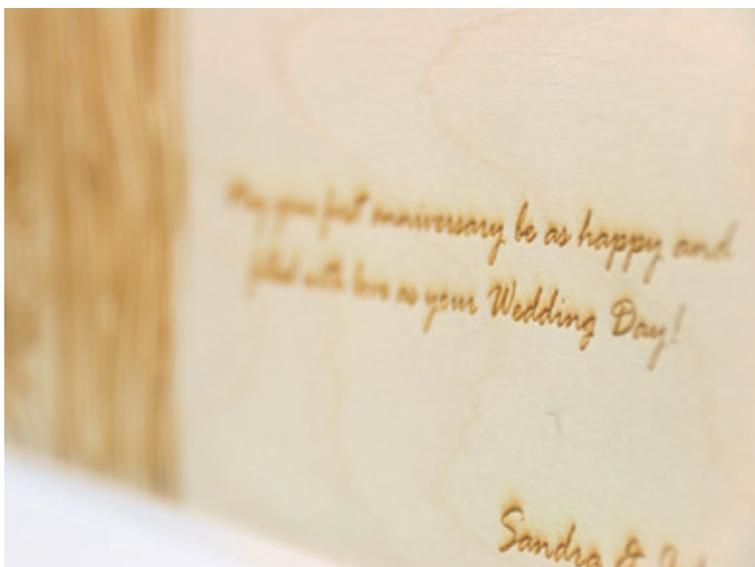
Engraving on wood picture frames

→ Cold cutting

When cutting wood please be aware that the material tends to get marked easily by smoke residues. Therefore, it is important to work at high speed (about 1-2%, depending on the material). Optimal results are achieved at low frequency, with a small lens and nozzle and activated Air Assist. As for almost all cutting projects, a honeycomb table is required (depending on application size). With the Speedy 400 or higher, you additionally have the opportunity to work with external Air Assist (recommended are 3 bar). All this makes it possible to remove heat generated by the laser during the cutting operation from the material as quickly as possible and consequently smoke residues are avoided.

→ Engraving - how to create high contrasts

When you engrave soft wood, e.g. poplar, you will achieve a deep engraving with relatively low contrast. Here we recommend that you defocus, which adds contrast to the engraving. In general, contrast levels in wood engravings can be influenced by defocussing, depending on the type of wood and the lens, it should be possible to defocus by 5 to 10 mm without any problems. The finer the details, the shorter the focal length of the lens should be. As a rule 1.5" or 2" lenses are suitable for almost any laser engraving on wood.



Detailed lettering engraved on wood

→ **Deciduous wood rather than coniferous**

Soft woods always have hard and soft growth rings, which influence engraving results. Deciduous hardwood is therefore better suited for engraving than conifers. The more uniform the grain of a wood species is, the better the engraving will show up. Of course, you can consciously choose to use the natural structure of the wood.

→ **Paulownia wood is ideal**

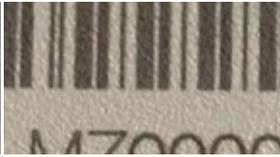
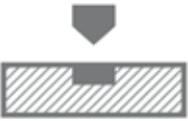
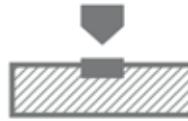
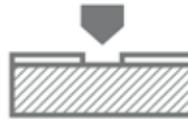
Paulownia is a Southeast Asian type of wood and is ideal for laser processing because the wood is bright and has a uniform grain. In addition, it is a very light and stable wood, which can be found in well-stocked hardware stores..

→ **Masking tape**

Apply masking tape to the desired processing surface and you can engrave and cut through the tape without problems. Then just pull it off and remove unsightly traces of smoke residues at the same time. When selecting masking tapes ensure that they are made of PVC-free material and removable. Masking tapes are available from different manufacturers, such as 3M. For smaller areas you can also use commercial painter's masking tape from your local hardware store. When selecting masking tapes ensure that they are made of PVC-free material and removable.

→ **Plastics**

Marking options on plastic

|  |  |  |  |
|--|--|---|--|
| Engraving | Color change | Foaming | Coating ablation |
|  |  |  |  |
| <ul style="list-style-type: none"> • Removal of material by melting and evaporation of the surface • This creates a depression • Very durable marking | <ul style="list-style-type: none"> • Results depend greatly on the composition setting of the plastic • Special plastic compositions with good laser marking capabilities are available • The surface will not be damaged during marking. | <ul style="list-style-type: none"> • Air inclusions in the material produce bulges in the material • Dome-shaped marking is created | <ul style="list-style-type: none"> • “Day & Night Design” / marking of buttons • Top layer is removed • High speed during marking |

→ Laminates

→ From the bottom up

Engrave laminates from the bottom up, so dust is extracted upwards and the top layer is not discolored. In JobControl[®] under “Plate” → “Set Plate” you can specify from which edge the laser should start the engraving.

→ “Two is better than one”

Engrave high-quality workpieces twice, in order to prevent discoloration and to increase the contrast of the engraving:

1. Remove top layer
2. Cleaning

In JobControl[®] you can select how often a work step is repeated:

The screenshot shows the 'Standard / Standard' window in JobControl. It features a tree view on the left with categories like 'engraving laminates', 'Glass', 'Leather', 'Metal', 'Paper', 'Plastics', and 'Rubber'. The main area contains a table with the following data:

| Color | Process | Power | Speed | PPI/Hz | Auto | Passes | Air Assist | Z-Offset |
|-------|-------------|-------|--------|---------|--------------------------|--------|------------|----------|
| 1 | Engrave CO2 | 25.00 | 100.00 | 500 PPI | <input type="checkbox"/> | 1 | aktivi... | 0.0 |
| 2 | Cut CO2 | 25.00 | 2.00 | 2000 Hz | <input type="checkbox"/> | 1 | aktivi... | 0.0 |
| 3 | Skip | --- | --- | --- | <input type="checkbox"/> | --- | --- | - |

JobControl[®] you can select how often a process is repeated

→ Defocus to avoid grooves

Sometimes engravings seem to have slight grooves. A Z-offset of 0.5 to 2 mm avoids grooves and you will achieve smooth and clean results.

→ Multiple cutting passes

2-3 cutting passes at low power are often better than 1 pass at a power level that is too high. Avoid sticky edges and unsightly bulges of material along the cutting edge.

→ Dark laminate with a bright top layer

Are you familiar with this problem? You are engraving the bright top layer of a dark laminate, then cut the workpiece and by cutting it the remaining bright top layer gets dirty.

Our tip: Engrave the desired motif and then apply masking tape or painter’s masking tape, this protects the light-colored material during the cutting process and you can simply pull off the resulting dust along with the tape.

→ How to clean laminates after laser processing

If smoke residue occurs on the workpiece during laser processing, we recommend that you clean them off using methylated spirits. Simply wipe off with a cloth moistened with methylated spirits, followed immediately by a wipe with a clean, dry cloth. Nano sponges (often referred to as dirt erasers) can also be very helpful when cleaning laminates.

Caution on glossy surfaces: Please first carry out a test on a sample piece, in order to ascertain whether the surface is affected by the methylated spirits, i.e. whether it turns matte for example.

→ Leather

→ Warning: PVC free leatherette

Please note that leatherette often contains PVC compounds and therefore cannot be laser processed. There is a danger that harmful gases may be released.



Engraving and cutting of leather causes no problems at all

→ Masking tape

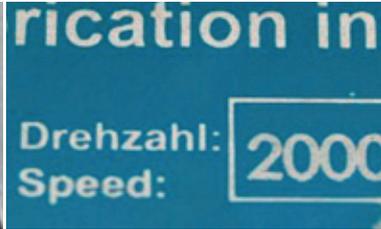
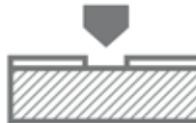
As already mentioned previously, masking tape can be very helpful when processing delicate materials. This is also the case with natural leather. When applying the masking is tape it is important to:

- Cover the entire engraving or cutting area
- Apply the tape without air inclusions or wrinkles
- Use a squeegee to press down firmly on the material

You can apply the tape just before cutting or engrave through it immediately, depending on the motif you choose. Particularly for very fine motifs, it is advisable to apply the tape only after the engraving process. In general, it can be said that relatively little power is required for engraving leather, in order to achieve best results.

→ Metal

In contrast to laser processing with a CO₂ laser it is important to distinguish between different processes when marking metal with a fiber laser:

|  |  |  |
|---|---|--|
| Engraving | Annealing | Coating ablation |
|  |  |  |
| <ul style="list-style-type: none"> • Metal is partially vaporized during the process • This creates a depression • Very durable marking • High energy is required | <ul style="list-style-type: none"> • Stainless steel, titanium,... • Local temperature rises to just below the material's melting point • An oxide layer is created just below the material's surface • The surface is not damaged • High contrast marking of material | <ul style="list-style-type: none"> • Anodized aluminum, painted metal, foil • Top layer is removed • High contrast Marking of material • High speed during marking |

→ Cleaning with a sponge and water

Smoke residues on the material surface are the result of rapid temperature rises during engraving and explosive vaporization. Consequently, engravings appear hazy. The edges of the engraving look washed out and the quality of the engraving seems inferior.

|  |  |  |
|--|--|---|
| Without cleaning | Cleaned with a sponge and then air-dried | Cleaned with a cloth |
| <p>For perfect results, the engraved workpiece must be cleaned with water and a sponge and then air-dried.</p> | | |

→ **Processing metal with a CO₂ laser - spray and paste make it possible**

CO₂ users commonly use ceramic powders, in order to mark metal. This powder must be applied to the workpiece as a spray or paste and then be washed off again after the laser process. During laser processing the powder is burnt into the material.

When this process is used for laser marking metals, high contrasts can be achieved with a CO₂ laser on absorption-weak metals. Sprays and pastes are available from manufacturers, such as TherMark™ or CerMark™.

→ **Paper & cardboard**



Individual invitation on multi-layered paper
The effect is created by removing a layer of paper.

There are countless types of paper – with and without coating – in addition there are different types of cardboard, corrugated cardboard, dyed or multi-layered and many more.

→ **Small lens for small details**

In order to best recreate detailed images on paper, we recommend that you work with a 1.5" lens. The smaller laser spot makes particularly precise and fine engravings possible.

→ **Work in focus**

In general, it can be said that the focus must be perfect, in order to achieve perfect results. We recommend that you do not set the focus until the vacuum table is switched on, so that the paper is resting on it as firmly as when you are processing it with the laser.

→ **Vacuum and adhesive tape**

A vacuum table also helps to ensure that the paper lies flat on the table and that resulting vapors are extracted. In addition, it can be helpful to fix the paper in place with adhesive tape. If you are not working with a vacuum table but with a honeycomb table, then the Air Assist can help reduce the amount of smoke residue that builds up along the cutting gap.



JobControl Vision[®] camera mounted on a Speedy laser head

→ **JobControl[®] Vision – exact cutting of printed matter**

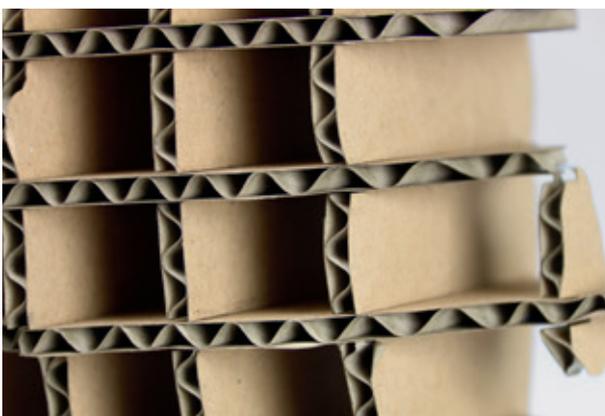
When printed material is to be cut, JobControl[®] Vision helps to compensate for distortions. Pass marks are printed on the edge of the design. The camera attached to the laser's processing head 'reads' the pass marks prior to cutting and compares the 'read' positions with the positions provided for in the original file. Adjustments are made automatically for any deviation found and no manual alignment is therefore required.

→ **Fading colored paper**

Colored paper can be made to look faded at low power levels and white areas can thus be created. If the paper should turn yellowish or brownish, too much power was used and the paper was burnt.

→ **Removal of one or more layers in multi-layered papers**

In multi-layered papers one (or more) layers can be removed. Depending on the type of paper the parameters vary but it can be said, that higher power levels are required than for fading paper.



3D objects can be created by assembling or gluing together for example corrugated cardboard.

→ Stone

As with wood and paper, here, too, you cannot really speak of 'stone' as a singular type of material. In general dark, regular stones are very well suited for engraving, for example:

- Slate
- Granite
- Dark marble
- Salt crystals



Engraved and polished granite slab



Photo engraving on a stone slab

→ Polished or natural

The surface of the stones does not have to be polished, natural stone structures are also well-suited to laser processing.

→ Synthetic resin for contrasts

In order to achieve a stronger contrast, you can fill the engraving with resin or varnish. Especially with polished stones, the engraving has a rougher surface to which color or rather resins can adhere.

→ Photo engraving on stone

As stones have an uneven surface, they are best suited for coarsely rasterized images (250-333 dpi). Very fine and detailed images may be difficult under certain circumstances, however, this very much depends on the structure of the stone.

→ Textiles

The term textiles covers a wide range of materials. Here, too, we have of course tried to gather the most important tips for you. As the industry continues to develop new blends and finishing techniques, a myriad of different materials and laser processing options now exist.

We have prepared a small selection of our favorite textiles here:

→ Fleece and Softshell

Both materials are very well suited for processing. For perfect engraving results, we recommend that you use a 4 inch lens and work with a resolution of 250 dpi.

→ Jeans

Denim material also delivers beautiful engraving results or rather it can be faded. The engraving area turns white, once the material has been cleaned of smoke residues. The easiest option is to put the item into the washing machine after laser processing

→ Felt (synthetic fibers)

Felt made from synthetic fibers can be processed very well with the laser. During cutting the fibers seal themselves (“agglutinate”) along the cutting edge and this prevents fraying. Art felt is also suitable for engraving, as you can see on this picture:



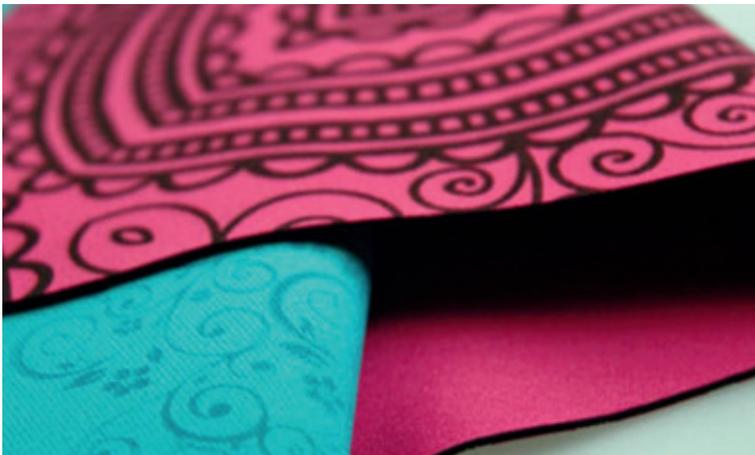
Pattern engraved on felt

→ Alcantara

The microfiber material, which looks like artificial suede, is perfect for engraving and cutting. One advantage is that cutting edges are sealed (this is true for almost all man-made textiles). The material washes well and can look incredibly like real leather.

→ Neoprene

Neoprene is an extremely versatile material and available in various colors and thicknesses. Normally it consists of a black or dark gray core, which has been coated in colored fabric layers on both sides. When cutting neoprene the cutting edges will seal themselves and thus prevent fraying. When engraving the top layer, it is possible to completely remove it, so that the black core is revealed. This option delivers great contrasts, especially where a very gaudy top layer has been used. The other option is to engrave the top layer at low power and thus to achieve a bleaching or darkening of the engraved area.



Different forms of engraving on neoprene

CAUTION! There is more than one kind of neoprene

Only SBR (styrene-butadiene rubber) is suitable for laser processing. Please do not use any other neoprene blends, such as CR (chloroprene rubber) or SCR (styrene chloroprene rubber), as these are not suitable for laser processing.

→ LaserFlex - as easy as ironing

LaserFlex is a high quality, multi-layered polyurethane film that has been specifically designed for processing with the laser. Finish textiles with designs of your choice, logos and lettering with a screen-like finish. Optimal laser settings vary depending on the laser power level and the speed of your laser plotter. We recommend processing from the bottom up while using the highest possible exhaust power level. This way any dust produced is no longer drawn across the already laser processed area. We also recommend that you work with a vacuum table, as the wafer-thin film may otherwise arch slightly.



Finished application of LaserFlex film on a black T-Shirt

→ Other tips and tricks

→ Computer hardware

How to select the correct focus lens

Best results with laser engraving or cutting are achieved by using different lenses. Just as different camera lenses are used for close-ups or wide-angle shots.

The decision, which lens should be used, depends on a number of factors:

- Laser power level
- Material type
- Detailing and resolution of graphics (dpi)
- Thickness of the material
- Viewing distance

A general rule of thumb is: The more detailed the graphics, the shorter the focal length used during laser engraving. The thicker the material to be laser cut, the greater the focal length.

The depth of focus (focus tolerance) in turn indicates the range where the laser beam is optimally focused. The longer the focal length, the longer the depth of focus, i.e. the depth of focus of a 5 inch lens is about twice as long as that of a 2.5 inch lens. That is why, for example, the resultant cutting edge of thicker materials is straighter with a 5 inch lens than when using a 2.5 inch lens.

→ Technical information

At the same time the diameter of the laser beam focus increases in size the bigger the focal length of the focusing lens is (in a 5.0 inch lens it is twice as big as that of a 2.5 inch lens, i.e. there is a linear correlation). As a result, the laser's performance (wattage) is distributed over a larger area. This decreases the intensity (power per unit of surface area) and with it the laser's maximum resultant temperature across the (enlarged) focus area. The use of a lens with a larger focal length might therefore represent an advantage when working with materials which are sensitive to temperature (e.g. laminates). The larger focus diameter means a bigger line width. This allows filling lines to be further apart and thus to be more quickly lasered.

Find out how you can increase the life of your lenses through regular maintenance from page 41 onwards in our Lens cleaning guide.

Here we have summarized all lenses for our Speedy lasers along with optimal application areas.

| Lens | Application areas for engraving / marking | Application areas for cutting |
|-------------------------------------|--|--|
| 1.5 inch CO2 | Graphics with fine details, (> 500 dpi resolution), Stamps with fine writing | Low laser power levels, thin materials (e.g. paper), Acrylic < 6 mm, Wood of medium hardness < 8 mm. |
| 2 inch CO2 | Graphics with medium details and resolution (500 dpi resolution; with reduced sharpness to 100 dpi resolution), standard engravings | Medium laser power levels, Acrylic < 8 mm, Wood of medium hardness < 12 mm. |
| 2.5 inch CO2 | Graphics with less detail, low resolution (<500 dpi). Engravings on heat-sensitive materials (e.g. laminates), when large areas are to be removed completely. | High laser power levels, Acrylic < 12mm, Wood of medium hardness < 15mm Delivers better edge quality during laser cutting than lower focal lengths |
| 2.5 inch CO2 Maximum distance | Used exclusively for cutting | See 2.5 inch lens. Increases the distance between laser head and material. Especially useful when an increased distance is required due to the nature of the material and the graphics. |
| 2.85 inch flexx | Standard lens for the Speedy flexx series. Permeable both for CO2 lasers as well as fiber lasers. Both beam sources can be used without changing the lens Other features as for the 2.5 inch CO ₂ lens and the 3.2 inch fiber lens | Features as for 2.5 inch CO ₂ lens and 3.2 inch fiber lens |
| 3.2 inch fiber | Standard lens for fiber lasers with an extremely small focal diameter. Graphics with fine details, (> 500 dpi resolution) | |
| 3.75 inch CO2 Circular engraving | Special lens for SP500 rotary attachment. Allows processing of circular engraving objects that are less than 50 mm in diameter | This lens is not used for laser cutting |
| 4.0 inch CO2 | Fire engraving of wood, laser engraving of graphics with low detailing using high laser power levels | Foam rubber |
| 5.0 inch CO2 | Is not used for laser engraving | High laser power levels, Acrylic < 25 mm, Wood of medium hardness < 20 mm Delivers better edge quality during laser cutting than lower focal lengths |

| Lens | Application areas for engraving / marking | Application areas for cutting |
|---------------------------|---|--|
| 5.0 inch fiber | Lens for a fiber laser, when materials are to be marked that are not absolutely flat. The larger focal length offers greater tolerance when focusing. | |
| 7.5 inch CO2 (for SP1500) | Is not used for laser engraving | High laser power levels, Acrylic < 40 mm Delivers better edge quality during laser cutting than lower focal lengths |

Please keep in mind that not every lens is available for every device. We are happy to advise you.

Exhaust system

A good exhaust system is essential for the safe and clean operation of your laser device. Dust and gas must be removed from the processing area. Furthermore, an exhaust system filters out smells produced during laser processing. In addition, exhaust systems ensure the quality of your lasered end products. The correct removal of dust and gases protects your materials from contamination.

A detailed overview of which Trotec exhaust system is best suited for each device can be found on our website www.troteclaser.com. Of course your local contact person will also be happy to advise you on which system best suits your needs.

Tip: In order to direct the exhaust system's extraction performance onto the processing surface, simply cover the slits with magnetic strips or adhesive tape.



Atmos exhaust systems are available in a range of sizes to match your needs

The correct throttle setting for your application

The Trotec air throttle regulates the airflow between the exhaust system and the 75 mm suction connections on the Speedy 300, Speedy 400 or SP500 when using a vacuum table.

By reducing airflow into this port, the table's extraction power level is automatically increased and higher vacuum pressure is thus created or rather the removal of vapors via the table is increased. This leads to an improved hold of films, paper and other thin materials. In addition, the cut quality of acrylic or other plastics is increased as resulting fumes are extracted immediately, which results in clear and shiny cutting edges.

Setting the throttle is very simple:

| closed | partially open | open |
|--|--|--|
|  |  |  |
| <p>Full exhaust performance on the vacuum table No exhaust performance via the exhaust slits in the processing area</p> | <p>The less you open the throttle, the more pressure acts on the vacuum table and the fewer fumes are removed via the Speedy's back wall</p> | <p>Exhaust performance at the table and in the processing area is normal, as if no throttle had been installed</p> |
| <p>Ideal: Cutting</p> | <p>Ideal: Combined engraving and cutting with low dust generation</p> | <p>Ideal: Engraving with high dust generation (e.g. stamp rubber)</p> |

The Trotec table concept - offers the right table for every application

Depending on the application, it may be necessary to adjust the processing table. For example, foils or paper require a vacuum table with high exhaust power levels, in order to achieve optimum results. When cutting acrylic, however, as few contact points as possible are desirable, in order to avoid back reflections - here an acrylic cutting grid or lamella cutting table would be suitable. In the following paragraphs we have summarized all of the tables and matching applications.

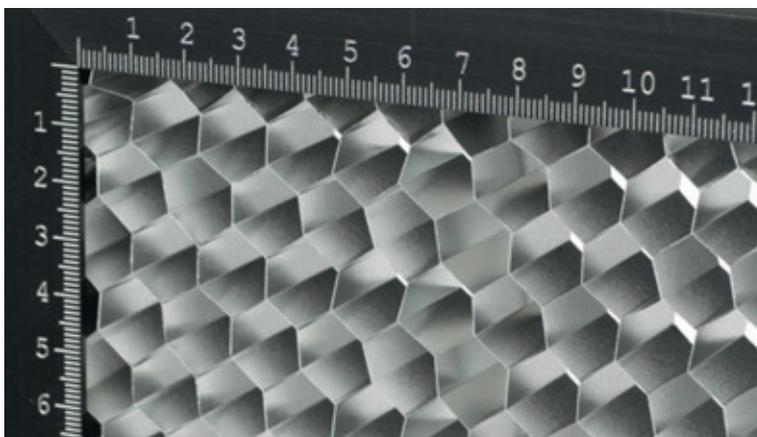
The ideal table for every application can be selected and replaced easily.

Engraving or standard table:

In laser engraving, cutting or marking the evenness of the processing table is an essential criterion for optimal results, since it is a prerequisite to achieving correct focus across the entire surface. Consequently, the processing table is very robust and perfectly flat as well as being ferromagnetic across its entire surface. This means that you can easily fix thin materials, such as paper or foils in place using magnets.

Honeycomb table top:

- With small honeycombs: The fine honeycomb table provides greater stability thanks to more support points. Furthermore, very small parts, for example in model construction applications, can be processed more successfully using the fine honeycomb top as parts cannot fall between individual honeycombs as easily.
- With large honeycombs: The honeycomb table with large honeycombs has the advantage that the material rests on fewer points and therefore fewer back reflections arise. Due to the large distances between individual honeycombs this table does not offer as much stability as the fine honeycomb table and you should therefore avoid placing heavy materials on the large honeycombs, as this can cause damage.



Detailed view of the honeycomb table

Vacuum table:

The vacuum table holds the material firmly and guarantees, for example, that films or paper lie flat. Furthermore, vapors are removed quickly from the material, which means that smoke residues have little chance to settle.

Aluminum grate cutting table:

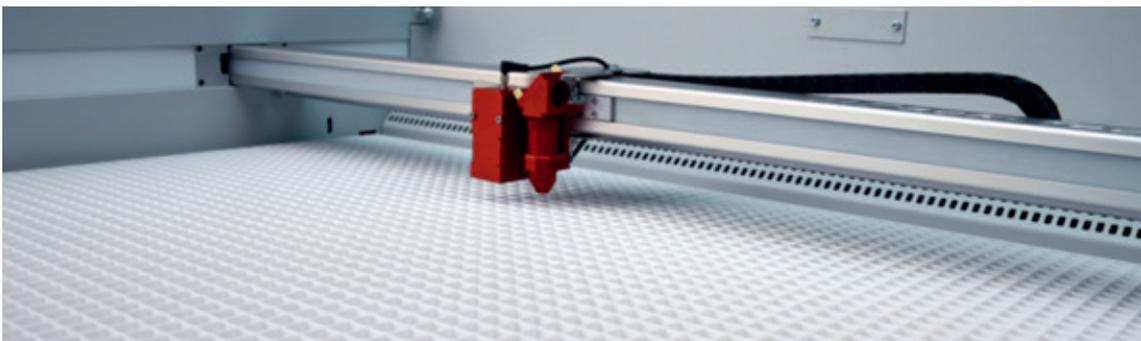
The cutting grate offers a lot of stability and still leaves large gaps between support points. This table is an all-rounder and suitable for a variety of applications.

Lamella cutting table:

Lamellae can be placed individually, consequently, the table can be adjusted to each individual application. Aluminum lamellae are suitable for large and heavy workpieces. Acrylic lamellae provide a perfect work surface for acrylic cutting applications.



Lamellae can be removed individually and reinserted flexibly



Acrylic cutting grates for perfect results in the processing of acrylic

Acrylic grates and lamellae:

For cutting acrylic, laminates or plastic films, there are special acrylic grates or lamellae to prevent back reflections. Please do not cut wood or other materials on the acrylic grate as soot particles can easily cause flame formation.

→ JobControl[®]

Materials database

You will find a wide selection of pre-tested laser parameters in the Trotec JobControl[®] software. Choose between 52 different materials and thereby save time testing for optimum parameters. JobControl[®] gives you the opportunity to export and import parameter files. This has the advantage that you can import pre-tested parameters into your database at a click of the mouse, which not only saves you time but also avoids mistakes.

Are you already familiar with our sample database, which contains many creative ideas and examples for working with the laser? At www.troteclaser.com you will find templates and the corresponding JobControl[®] files for free download. Let yourself be inspired and discover more application options with which you can expand your portfolio.

Exporting a parameter file

Furthermore, it is also possible to export the entire materials database, individual groups of materials or single materials, in order to secure them for example on an external drive or to use them at another workstation.

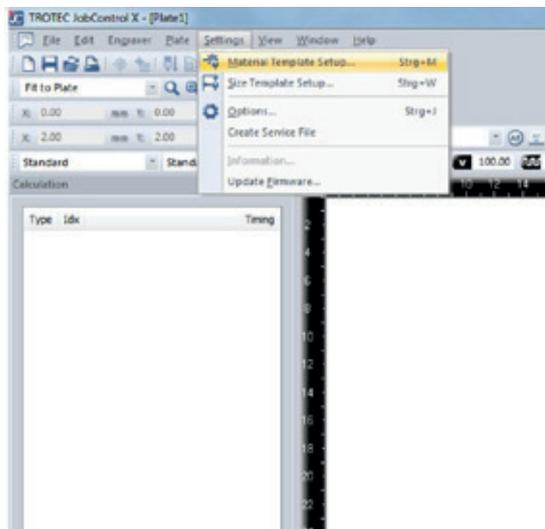
JobControl[®] files are stored in an .xml format and reimported. In order to export a file follow the step-by-step instructions:

Export the entire materials database, a material group or a single material

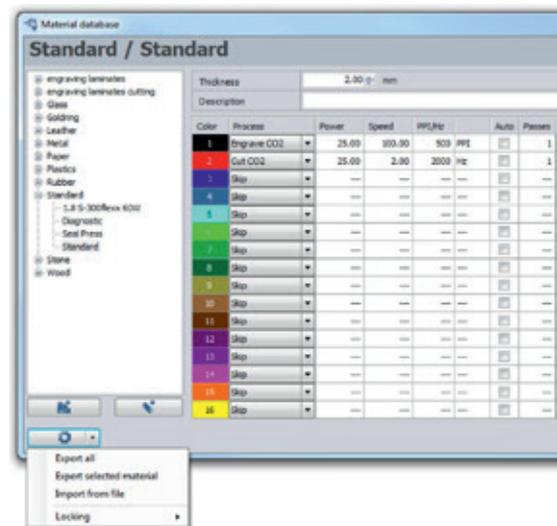
- Open JobControl[®] X on your computer
- Select “Settings”
- “Define material template Ctrl + M”
- The materials database opens

You can also open the materials database by double clicking the processing area.

- Highlight the materials group
- Use the left mouse button to click on the arrow of the “Settings” symbol
- The selection window opens
- Now choose whether to
 - export the entire materials database, i.e. “Export All”
 - export the selected materials group, i.e. “Export the Selected Group”
- A dialog box opens and you can save the exported material data as an .xml file on your desktop or in a directory of your choice
- Click “Save”



JobControl[®] Settings → Material template definition



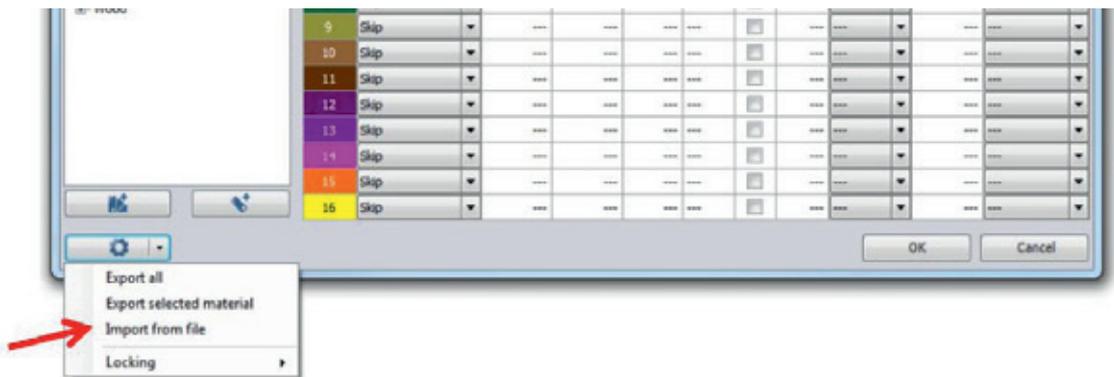
Export the desired material or even the whole database

Tip: When exporting multiple files, we recommend that you rename them accordingly, in order to be able to identify them more easily when importing them again at a later date.

Importing a parameter file

It is as easy to import of parameters as it is to export them, simply follow the steps and JobControl[®] will be ready to start laser processing immediately.

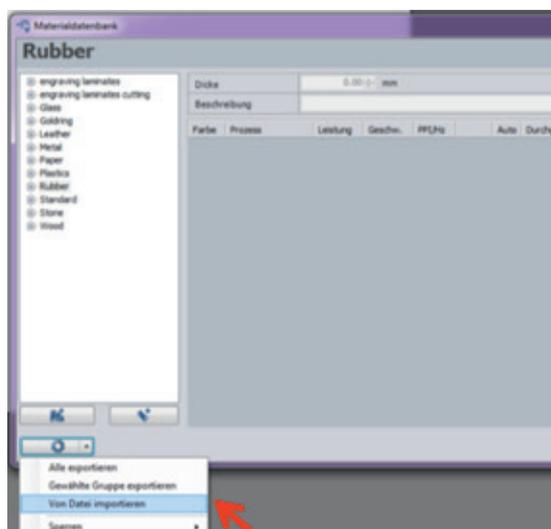
- Open JobControl[®] on your computer
- Select “Settings”
- Define material template (Ctrl + M)



JobControl[®] Settings → Define material template

With a double-click on the processing surface, the material database opens.

- The JobControl[®] X materials database opens
- Create a new materials group by clicking on “Create Material Group” and
 - thereby creating said group in your directory (option 1)
 - Highlight a pre-existing materials group, into which you want to save your file to be imported (option 2)
- 2)
 - Now with the left mouse button click on the arrow of the “Settings” icon
 - The selection window opens
 - Click on “Import from File”



Import new parameters, for example from our pool of sample patterns available online at www.troteclaser.com

- Select your file and click on “Open”
- Another dialog box opens and the materials designation of the file to be imported is shown
- Now you can choose, whether
 - a) to import the desired material and create a copy using the same material designation or
 - (b) whether to import the desired material and replace an existing file with same material designation

Tip: Select option a) in order not to lose existing settings, you can always administer changes to the materials database in JobControl[®] X manually at any time



- the desired materials setting are now imported into the materials database and displayed by JobControl[®] X
- in order to save changes in the materials database, click on “OK”
- the .xml file held on the desktop can now be deleted (data is secured in JobControl[®].)

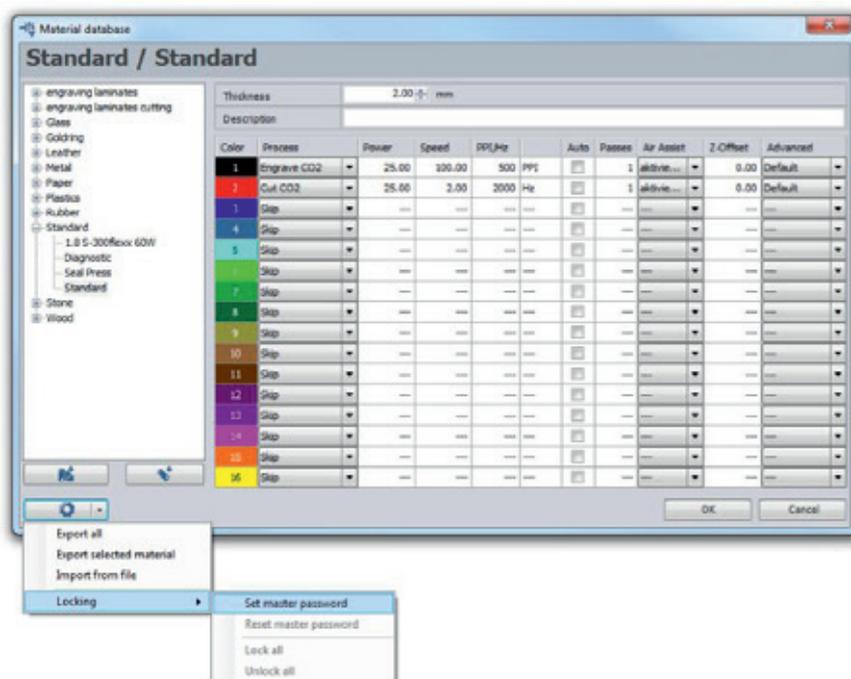
Determine where your new parameters are to be stored

Tip: When dealing with multiple files upload each file into the desired materials group separately and only click OK once the upload is complete.

Password protected materials

Has this happened to you? You have unintentionally overwritten the parameters in JobControl[®] and cannot remember the original values. No problem: As administrator you can password-protect individual materials or entire material groups.

- Use the left mouse key to click on the arrow of the “Settings” symbol
- The selection box opens → now select “Lock”
- “Set main password”
- With this function you as administrator can lock material groups or individual materials and / or unlock them, locked data is identified with a lock symbol
- Click on “OK” to save the changes



Lock materials or groups

JobControl[®] functions that make laser processing even easier



Standard: The most commonly used engraving and cutting process.



Photo-optimized: Optimizes high resolution images to maximum quality.

A third-party image editing software is thus not required because the image is automatically rasterized.



Stamp: Your layout is automatically mirrored and inverted, stamp edges can also be optimized. The webs function, in which the cutting line is automatically interrupted, so that the cut stamp plate remains connected to the raw material, further facilitates production.



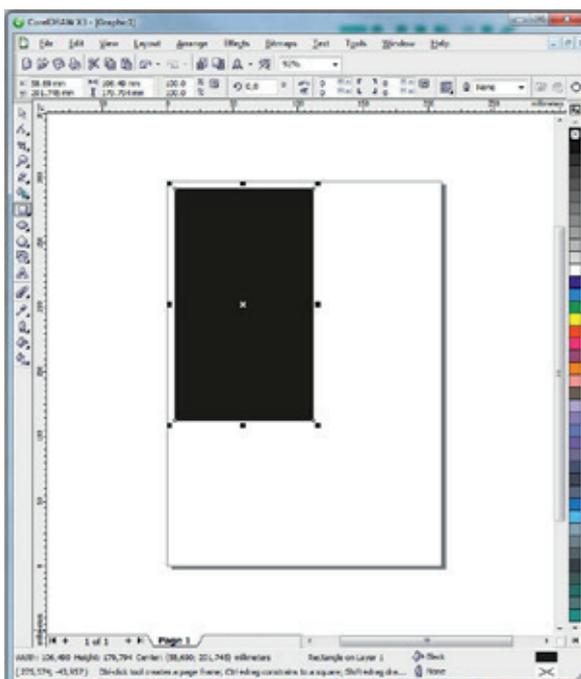
Seal press: Is used in the production of laser engraved and cut seals for seal presses. Automatically creates positive and negative die plates to match the selected paper thickness as well as cutting lines and the positioning nose.

→ How do I find the perfect laser parameters?

In the Materials chapter from page 9 we have compiled tips and tricks for the most popular materials. Of course, there are also materials that we have not yet tested ourselves. We recommend you use the following tool to test out the appropriate parameters:

Engraving

In order to find the best possible engraving parameters for an unknown material, draw a black contourless rectangle in CorelDraw[®]. The size of the field is dependent on the size of the material - as a standard size 50 x 50 mm is recommended.



Engraving template to test parameters

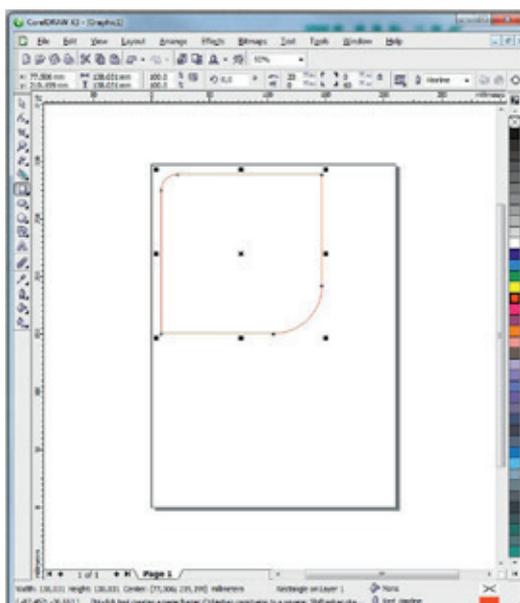
Send the field at low power (about 10-20%), maximum speed and 500 dpi to the laser. As soon as you then start the job, the bidirectional communication between the laser and JobControl[®] allows you to change the parameters during the engraving process. If no result is visible at low power, you can directly adjust both the power and speed in JobControl[®]. We recommend to double the power level as a first step. Depending on how the result looks, double or reduce the power level to until you find the best settings for you.



You can change the parameters 'on the fly,' simply by entering the values in the edit line and pressing Enter

Cutting

The following graphic is advisable, in order to test cutting parameters:



The rectangle with two differently rounded corners offers the advantage that both straight cutting lines as well as more complex shapes are possible with the tested settings.

Template to test cutting parameters

→ Shortcuts – key combinations

Everyone knows Copy and Paste nowadays. Other keyboard shortcuts and combinations can also help to make your everyday life easier and save you time. Here we have compiled a small selection of the most important key combinations for you and listed them on the following pages.

→ JobControl[®]

| Keyboard shortcuts | Description |
|------------------------|---|
| F1 | Help |
| Ctrl + - or Ctrl + + | Zoom out or in |
| Ctrl + 0 or Shift + F4 | Zoom on plate |
| Alt + 0 or F4 | Zoom on job |
| F8 | Marker to laser |
| Ctrl + N | New plate |
| Ctrl + O | Open plate |
| Ctrl + S | Save plate |
| Ctrl + P | Print |
| Ctrl + A | Select all jobs |
| Ctrl + R | Reset selected jobs |
| Ctrl + G or F12 | Start |
| Ctrl + F | Pause |
| Ctrl + E | Stop |
| Ctrl + D | Duplicate job (either on the plate or in the queue) |
| Remove | Delete selected jobs |
| Ctrl + delete | Delete selected marker |
| Ctrl + M | Open materials database |
| ← (back) | Job back in queue |
| Ctrl + space bar | Rotate job |

→ CorelDraw[®]

Align and arrange objects

| Keyboard shortcuts | Description |
|---------------------------|---|
| C | Align object(s) centrally and vertically |
| E | Align object centrally and horizontally |
| P | Align object centrally on the side |
| L or R | Left-aligned or right-aligned |
| T or B | Align at the top or bottom |
| Shift + A or Shift + P | Distribute distances vertically or horizontally between objects |

Text

| Keyboard shortcuts | Description |
|----------------------|---|
| Ctrl + B | Bold |
| Ctrl + I | Italics |
| Ctrl + U | Underlined |
| Ctrl + 4 or Ctrl + 6 | Increase or decrease font size by one increment |
| Ctrl + L or Ctrl + R | Left-aligned or right-aligned |
| Ctrl + F12 | Spell checker |

F-keys

| Keyboard shortcuts | Description |
|--------------------|---------------------------------------|
| F1 | Help |
| F2 | Jump to zoom tool once |
| F3 | Reduce size of drawing |
| F4 | Show all objects |
| F5 | Draw lines and curves (freehand mode) |
| F6 | Rectangle tool |
| F7 | Circle / ellipse tool |
| F8 | Text tool |
| F9 | View full page |
| F10 | Node edit (anchor) |
| F11 | Color gradient |
| F12 | Contour pen |

→ Finishing

→ Lens cleaning

Clean optics are a prerequisite for perfect engraving and cutting results. Certain materials, such as wood or stamp rubber, create more dust during engraving than other applications. Depending on the respective application optics should be cleaned at regular intervals. This ensures the longevity of the laser as well as consistently high quality of engraving.

How does that work?

It is really easy to keep optics in good condition. A brief check of the lens and the mirror on the processing head should be part of your daily laser care routine. It is best to check the side mirrors once a month. Depending on the material used these intervals may have to be shortened. Thanks to proprietary Trotec InPack technology™ lenses and mirrors are protected from dust. This reduces the amount of cleaning required enormously.

Step 1 - Blow away loose particles (dust, fluff)

A small bellows helps to remove lint and dust. Alternatively, you can of course also use the laser's compressed air supply. If the optics are still dirty, just continue with step 2.

Step 2 – clean with cleaning fluid and cloths

Carefully remove the optics from the laser device. Rinse the lens with cleaning fluid and place it on a clean cloth. Now wet the lens surface with cleaning fluid and leave to soak in for about a minute. Then dampen a cloth and wipe down the surface of the lens without exerting any pressure on it. If the lens or mirror is still dirty, simply repeat the process. That's it!



Template to test cutting parameters

Optics: More sensitive than glass

It is very important to treat the optics extra carefully. Never use any kind of tool, which could scratch the surface. We recommend that you use the cleaning liquid and cloths supplied in the accessory box. Alternatively, you can also use cotton swabs.

→ General cleaning

You should check at least once every day, whether dust has accumulated inside the engraving system. In case of soiling, the machine must of course be cleaned. How often you clean the machine does of course depend on the type of materials that are processed.

CAUTION: Due to a lack of cleaning, flammable components may build up in the interior and in the exhaust area and significantly increase the risk of fire.

- Bring the engraving table into a position where you find it easy to clean the surface with window cleaning agents and paper towels.
- Make sure that the appliance is switched off and unplugged. Open the lid.
- Remove all loose debris and deposits carefully from the machine's interior.
- Clean the laser tube cover.
- You can clean the viewing window with a cotton cloth. Do not use paper towels, as these could scratch the acrylic.

→ Vacuum cleaner

Do you work with rubber or other materials that cause a lot of dust? A vacuum cleaner helps to remove dirt and dust particles from the machine and saves a lot of time!