

LASERCUT WORKSHOP

A COMPREHENSIVE GUIDE FOR THE LASERCUTTING NOVICE



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ABOUT THIS DOCUMENT

WHAT EVEN IS THIS? – BENEFITS OF LASERCUTTING

You are probably reading this document because you attended the Sk8erbois workshop, you've found this document on the SmartXp wiki or you've gotten it from somewhere else.

Either way, you are interested in lasercutting right? **GOOD!**

This document will explain you the basics from start to finish. After going through this document, you should be able to easily construct basic lasercut pieces. Lasercutting is simply assembling a puzzle made from flat pieces. Curved pieces can also be achieved with lasercutting, but this document will not go into that. You can look [HERE](#) for more information about making wood bend in curves if you're interested.

Lasercutting is a wonderful tool you can use to make a lot of things, especially when you are prototyping as it is quite quick and yields nice results in various materials. You can even use lasercutting to make a final product as it can be quite sophisticated and appealing, especially if you like the aesthetics of lasercut products.

I hear you asking yourself: *Why should I bother lasercutting at all?* Here are some of the benefits lasercutting can offer:

- Hard to achieve these results with other methods
- High accuracy and precision cuts
- Low costs
- Different materials can be used
- Unlimited complexity is possible
- Can be used as a base for further development of a product
- It looks cool!



WHAT IS A LASERCUTTER?

MACHINE - AVAILABILITY - MATERIALS

A lasercutter is a magic machine that produces a highly concentrated beam of light and projects it on a surface. Depending on the strength of this beam it can completely cut through the material or engrave its surface (with varying degrees of depth). With a maximum cutting surface of 1000mm x 600mm that we have available to us in the SmartXp, this one can cut pretty large pieces of material. The DesignLab also has one available that is even larger. Inside the machine is the lasercutting head. This head moves along the X- and Y-axis using movable tracks. These can move very accurately, allowing for smooth curves and tiny details.

Attached to this giant machine are a couple of air filters. By cutting and engraving these materials a lot of (nasty) fumes can get released. The filters catch these fumes and make sure that the harmful particles don't end up in our lungs or the air outside. Basically, a giant vacuum is attached to the main lasercutting machine.



As Creative Technology students, Interaction Technology students or as Proto members you can use the lasercutter in the SmartXp. Alfred de Vries, the SmartXp technician is the one responsible for the machine and he is the one that will process your lasercut request. If you are stuck on how to design your lasercut file, you can always discuss it with him as well. Alfred has a wealth of knowledge and experience when it comes to lasercutting, and he might have some good ideas for your lasercutting problems.

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Using the machine is free, the materials unfortunately are not. Luckily, like mentioned in the intro, the material is very cheap. You can engrave and lasercut paper, grey cardboard, acrylic and most popular: **PLYWOOD**. Here is an overview of the thickness, size, and price of the plywood available.

THICKNESS	SIZE	PRICE
4mm	600mm x 300mm	€ 2,=
4mm	1000mm x 600mm	€ 7,=
6mm	600mm x 300mm	€ 3,=
6mm	1000mm x 600mm	€ 10,=
8mm	600mm x 300mm	€ 6,=
8mm	1000mm x 600mm	€ 11,=
10mm	600mm x 300mm	€ 7,=
10mm	1000mm x 600mm	€ 12,50

Have a look at the [SMARTXP WIKI](#) for the full list of the materials that are suitable for the lasercutter, some even with websites where you can order these. Make sure that the material you want to use is suitable, if you're unsure, discuss it with Alfred.



VECTOR SOFTWARE

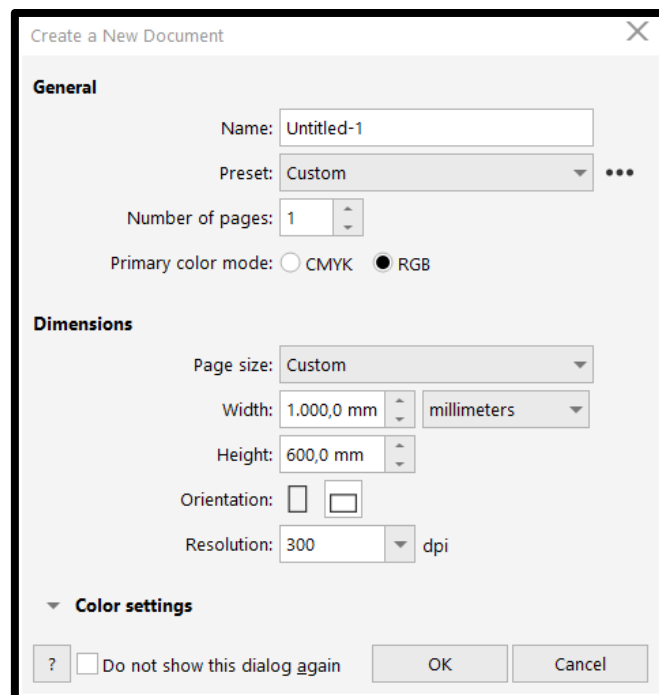
CORELDRAW – ALTERNATIVES – WORKSPACE SETUP

To make lasercutting files you need vector software. Vectors differ from bitmaps in the sense that vectors make their lines and curves with, obviously enough: **VECTORS**. Vectors are very simply put a combination of a lot of mathematical formulas that calculate the path that the line should take. Therefore, vectors are infinitely scalable, whereas bitmaps if you enlarge them a lot become very pixelated. The lasercutter needs these vectors to determine the path that the cutting head should take. The term **CURVE** is also used to describe a line made up of multiple vectors. It is usually very clear in vector software what a curve is and what is not.

Alfred uses CorelDraw for all his lasercutting endeavours. This is therefore recommended, as if you are stuck, Alfred can help you out with the files. This guide will be based around CorelDraw. To get CorelDraw you can buy a [CORELDRAW LICENSE](#) for a discounted price for students or scour the dark web for a less-legal version at your own risk. The computers in the SmartXp also have CorelDraw installed on them, so you can use the program there as well.

If you don't want to use CorelDraw for whatever reason, it is possible to make the files in [ADOBE ILLUSTRATOR](#), Adobe's vector software included in Adobe's Creative Cloud. Make sure that the settings of the file that are discussed later in this document, are correct. Otherwise, it won't work with the machine. Other vector programs like [INKSCAPE](#) might also work, but that would be something for you to try out yourself.

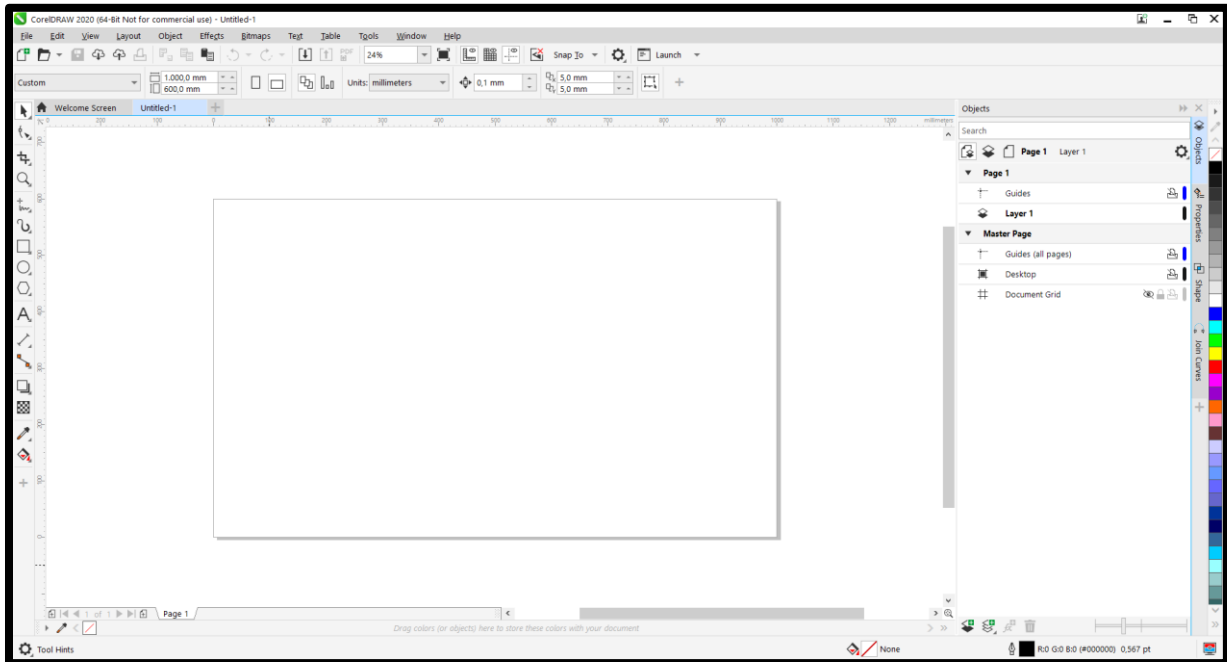
To make your life easier, a good setup is needed when starting up CorelDraw. You can already define the design space and colour palette used throughout the whole file, which makes it a lot easier when working on the files. Open CorelDraw and create a new document like you see in the following window.



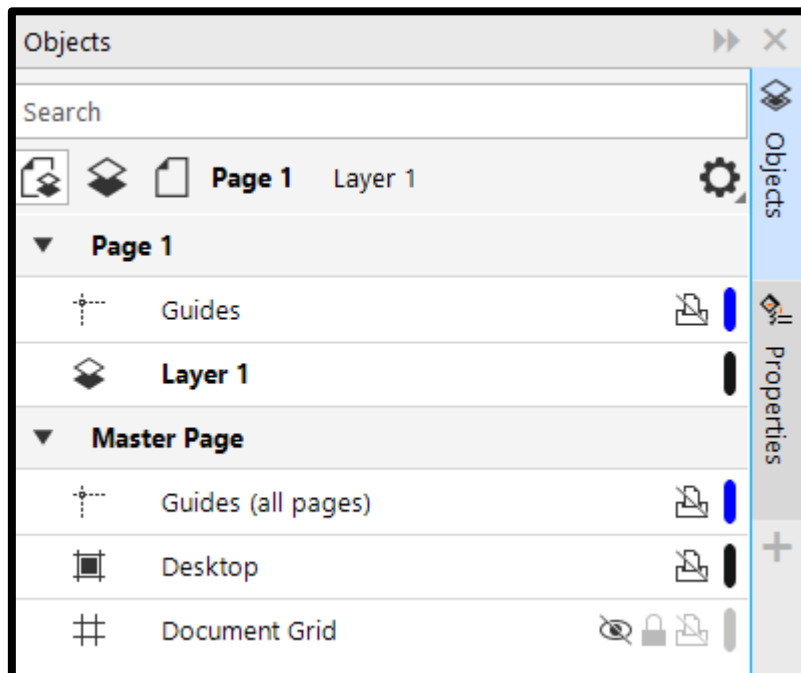
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If you look closely at the settings, there are a few important factors to keep in mind before starting the design work. Namely the primary colour mode: **RGB**, the Width and Height set at **1000MM** and **600MM** respectively. Lastly, the resolution should automatically be set up to **300DPI** for those high-quality designs. Once that's done, click "OK". What you'll see next is the general work environment of CorelDraw shown below.



On the left you have the toolbar; we will go into that a bit later. For now, we look on the right at the menu-bar. The menu bar might require some adjusting if it's your first time booting up CorelDraw, there might be some menus missing. Be sure that you have the **OBJECTS** and **PROPERTIES** menus. If you don't have those, make sure to add them with the **+** button on the right.





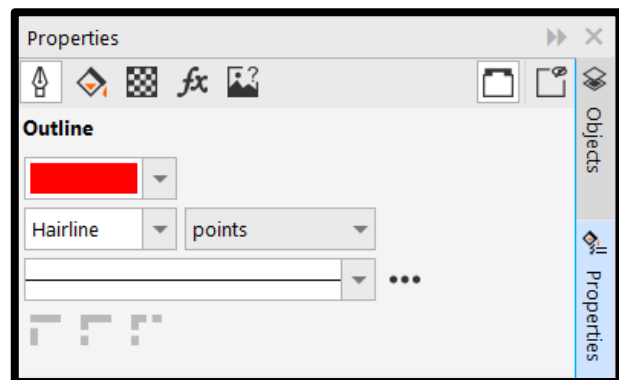
DESIGN A FILE TO CUT

VECTORS – PROPERTIES – BOXMAKER

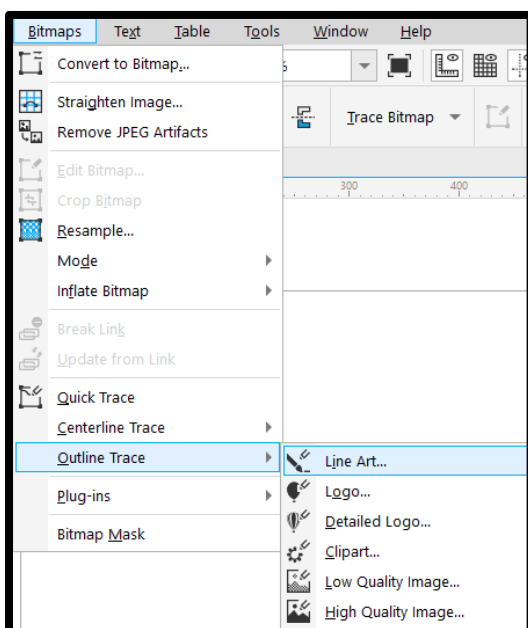


To use the laser at maximum power to cut through the material you need to first draw or copy the shape you want to cut. On the left of the CorelDraw workspace, you see the toolbar. The ones shown here on the left are generally the ones you can use to draw these items or to trace a template, drawing, sketch, or anything you want. When talking about **TRACING** we use the term in the context where you take the curve-drawing tool (the squiggly line with the + above it) and literally copy the image you want to make by drawing on top of it. Similar to how you copy an image using a lightbox when drawing on pen and paper. The **BÉZIER** tool is really nice for curved shapes.

To make sure that the lasercutter knows that you want to cut the line it is very important to give the **OUTLINE** the **RGB RED** colour (**255, 0, 0**). You can do so by selecting your object or curve, going to the **PROPERTIES** menu in the **OUTLINE** option and selecting the colour. Next to that, you need to make sure that the outline is of **HAIRLINE** thickness. This is a line with a thickness of less than 0,11mm. CorelDraw has a dedicated hairline thickness, so just select that. Make sure that the line you want to cut is pure RGB red and hairline, otherwise it won't work.



When drawing or tracing an object it is also important to avoid overlapping cutlines. When two lines overlap the lasercutter will go over that line twice, which might result in unsightly cuts with weird burn flares or even big burn marks as the material catches fire.



To trace an image to get the outline of a logo there are a few easy steps to follow. First, get yourself an image. A clear image, ideally one colour is easiest to trace. Icons are perfect for example. Next, go to the top menu bar to **BITMAPS** → **OUTLINE TRACE** → **LINEART**. Play around with the different sliders to get your image traced the way you want. This will create curves that you can then give the red hairline outline to cut the shapes. Sometimes another Outline Trace “type” works better. It just depends on the image, its size, its quality etc.



DESIGN A FILE TO ENGRAVE

VECTORS - BITMAPS - PROPERTIES

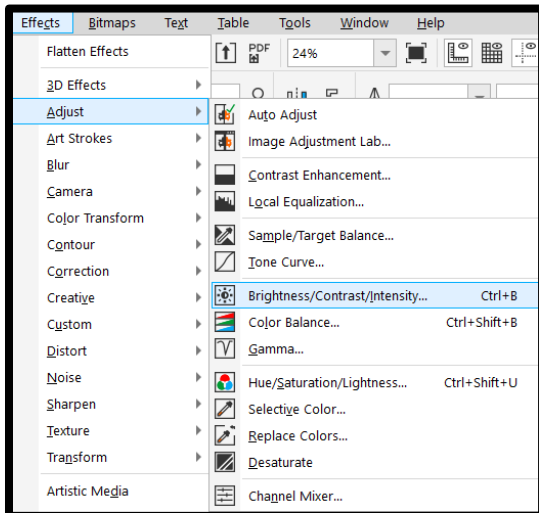
You can also engrave the material instead of cutting it. This “cuts” into the material’s surface at different depths, without cutting completely through it. To do so the lasercutter looks at the concentration of black in an image. **RGB BLACK (0, 0, 0)** engraves at maximum power while **RGB WHITE (255, 255, 255)** does not engrave at all. This means that you can engrave a variety of Black & White images onto the material’s surface.

First, you need to get yourself an image you want to engrave. If you want an opaque, cohesive, and overall level of engraving your image needs to be fully black. If you want to engrave different levels or want to engrave an image it’s best to have **HIGH CONTRAST**, so a lot of black, and clear distinctions in the different levels of black (so different greys). Icons like the one on the right work very well and give a clear image as it is a solid black image. The image



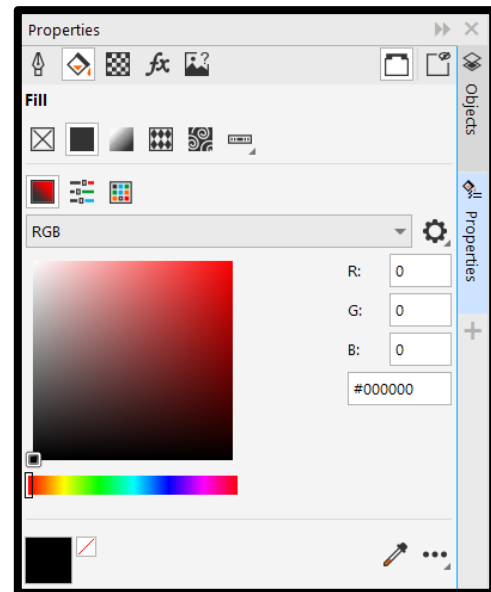
shown below will also work well, as the contrast in the sky and water is high and there are not many subtle gradients. The different shades of grey in the buildings might need more contrast to avoid it becoming a blurry engraved mess.





You can tweak the image to have a higher contrast to make it engrave better. You can do this in any photo editor, but even in CorelDraw itself. You can do so by going to the top menu bar to **EFFECTS** → **ADJUST** → **BRIGHTNESS/CONTRAST/...** Play around with the different sliders to get the contrast you're looking for.

If you find an image to engrave, but it is too small for your projects, you can **TRACE** it to turn it into a vector. This vector you can then in turn enlarge infinitely to fit your project. To do so, go to the top menu bar to **BITMAPS** → **OUTLINE TRACE** → **LOGO**. Play around with the different tracing options to see which trace works best with your image. Make sure to fill your image to the correct level(s) of black to get your desired outcome. This can be done in the **PROPERTIES** menu on the right under the **FILL** option.



TIP: to make sure the engraving does not take up too much time you need to place the largest parts along the **X-AXIS**. The lasercutter moves fastest along this axis so if it can make the longest passes there while engraving it will be faster. See the example below.

FAST

UNIVERSITY OF TWENTE.

SLOW




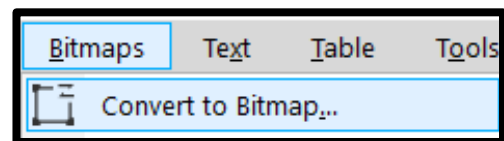
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SEND A FILE TO GET LASERED

ALFRED - FILE SPECS - EMAIL

To get the file cut, Alfred is your man! He is the technician of the SmartXp and manages the lasercutter (amongst other things). Alfred accepts the file formats cdr, dxf, eps, pdf & ai. In the case of CorelDraw, you can export it to a variety of file formats, but cdr and pdf are the easiest. Make sure that if you have a newer version of CorelDraw that you save it as one of the older versions as Alfred uses an older version of the software. CorelDraw 11.0 should be no problem. When using a font that is not standard, make sure to include the font  save the document as a pdf, that correctly embeds the font. What you can do as well is to convert the font into a bitmap by going to the top menu bar to **BITMAPS** → **CONVERT TO BITMAP**.



When cutting and engraving the material, the lasercutter works in the order from back to front. So, in the object list from CorelDraw, this is from bottom to top. It is best practice to always first engrave the material and then cut it. Because cutting can make the piece drop or shift slightly, so it might not engrave properly. So put the parts that need to be engraved on the bottom of the object list in CorelDraw. This is usually not a bit problem but is best to avoid.

Make sure that you state in your e-mail what material you want to use and the thickness. You can even mention how deep you want to engrave the maximum engraving because Alfred can adjust that in the settings. For example, you can say *“the engraving can be pretty deep”* or *“the engraving needs to be very light”*. Then Alfred will set the maximum power for the black-value.

TIP: put the **MATERIAL** and the **THICKNESS** you want in the **FILE-NAME**, so Alfred can clearly see it and avoid making a mistake.

If all is in order you need to e-mail your design to Alfred at A.P.DEVRIES@UTWENTE.NL.



FINISH YOUR LASERCUT PIECE

CLEANING – GLUING

Lasercut material when it comes out of the lasercutter can use some refinement and clean-up if you want. Let's look at the two most commonly lasercut materials: wood and acrylic.

WOOD leaves quite an odour when cut. Some people love it, some people can't stand it. The cut edges can also give off some charred-like dust or smear. When engraved, for one the smell is more apparent, but the lasercut surface gets a bit sticky. The wood's surface is broken and some of the glue and wood resin get to the engraved surface. The surface also gets a bit of "lasercut flaming" due to the heat that is released next to the area where the laser touched the wood.

All these issues can be resolved in a very easy way. Just take a (clean) dishwashing brush or something similar with the tiniest amount of dishwashing liquid. Scrub away at the surface and edges under hot water to get the piece cleaned up. Don't scrub too hard, because that will break the wood's surface a bit and create micro-splinters that start sticking up, resulting in the surface being less smooth. You can see the difference this makes in the engraved areas in the image to the right.



To glue this material, it's obvious that wood glue is the best option. That binds to wood really well for a long-lasting connection. If you want a quick hold that is still pretty strong, a hot glue gun will do the trick.

ACRYLIC does leave a burnt plastic odour, but this does not linger that much. When making sharp-cornered cuts with acrylic they can break off a bit, leaving a sharp barb. You can sand these down or cut them away with a Stanley knife.

Engraved acrylic does require a bit of clean-up, but not as much as engraved wood. When acrylic is engraved it leaves a fine white dust on the engraved surface. You can wash this off under running water with a bit of soap, or just use a damp rag to wipe it off.

To glue acrylic Alfred has a special glue called **ACRIFIX**. This glue will almost melt both acrylic surfaces that touch each other with the glue to make a permanent bond. **DO NOT** use superglue, this will leave a white foggy appearance on the acrylic which you cannot remove.



EXTRA INFO

BOXES - GLUING

One of the absolute staple objects you will lasercut is **BOXES**. Have a look at [MAKERCASE](#), this is the ideal website to create a box template that you can directly open in CorelDraw. The nice thing about this website is that you can customize all your measurements and see a 3D preview immediately.

Make sure that you put your settings in millimetres for ease, pay attention if you're working with the outside or inside dimensions of the box, that the thickness is set correctly and that you choose the edge joints that you want. See them highlighted below.

The screenshot shows the MAKERCASE website's box creation interface. On the right is a 3D preview of a yellow box. On the left is a settings panel with the following elements highlighted by red boxes:

- Units:** A dropdown menu with 'Inch' and 'Millimeters' options.
- Width:** A text input field containing '100' and a unit dropdown set to 'mm'.
- Height:** A text input field containing '100' and a unit dropdown set to 'mm'.
- Depth:** A text input field containing '100' and a unit dropdown set to 'mm'.
- Are these inside or outside dimensions?:** A dropdown menu with 'Inside' and 'Outside' options.
- Material Thickness:** A dropdown menu with '4mm' selected.
- Open or closed box?:** A dropdown menu with 'Open' and 'Closed' options.
- Edge Joints:** A dropdown menu with 'Flat', 'Finger', and 'T-Slot' options.

Below the 'Edge Joints' section, there is a 'Finger Size' slider with a blue dot and the number '9.5' below it.

Have a look again at the [SMARTXP WIKI](#), you can find a lot of useful resources there as well. Most of the details and tips mentioned there are also mentioned in this document, but make sure to follow them carefully for the ultimate lasercutting experience!

HOPEFULLY, THIS DOCUMENT HAS PROVIDED YOU WITH A GOOD BASIS FOR YOU TO DISCOVER THE WONDERFUL WORLD OF LASERCUTTING.

THANK YOU SO MUCH FOR READING! :)