How to use the laser cutter

Guide

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DESIGN
HÖGSKOLAN

1. How to use the laser cutter

With the laser cutter you can do many things, anything from embossing flat surfaces in a range of materials to cutting wood, paper and plastic to making kits you can build. You can make detailed work that would be hard or close to impossible to cut by hand a breeze to create.

However, there are some things to think about, and some words of caution.

Examples of what can be done with a laser cutter.

2. Materials

The first thing which needs to be taken into consideration is which material to use for your design. The laser cutter is capable of cutting and engraving a wide range of materials from plastic, to wood to even glass, but some materials which seem utterly harmless are on the other hand not usable in the laser cutter at all. Also, the limitation is that the material needs to be flat, both against the bottom and the top for it to be able to lay in the machine and the laser cutter head to pass over it.

2.1 Plastic

The most common material to either engrave or cut is no doubt acrylic plastic. Here at school we have a lot of acrylic in different thicknesses and colors. Currently you can get hold of casted acrylic between 2-6mm and extruded acrylic between 1-5mm.

Casted? Extruded? What does it all mean? We can basically divide them by saying that one lasers suberbly well whereas the other doesn't. The proper acrylic to use in the laser cutter is casted acrylic, available from a separate cabinet with laser plastic. Access there can be gained by talking with workshop responsible student or staff. This material will cut sharply and engrave evenly and with high quality. In structure it is somewhat similar to glass in that it is hard and will shatter if handled too violently. On the other side you have extruded acrylic which will not engrave evenly nor cut sharply, instead of the burnt material turning into a fine dust as with the casted acrylic the extruded instead melts creating molten and smooth plastic edges, and the cut itself will also be wider than with the casted acrylic. If you still want to use casted acrylic it can be found in the materials storage in the workshop, and for less exact applications it may work quite well.

Other sheet plastics available in the school are vivak and styrene. Vivak can be used in the laser cutter but cuts really dirty, the white plastic leaving a brown burnt edge with a less than pleasant smell. Styrene should not be used in the laser cutter due to health and safety concerns.

Thicker plastics might require longer time to cut through, or several passes, which might result in distorted edges around the cut due to the temperatures involved and the width of the laser beam.

Rubber is both cuttable and engravable though with both severe soot covering your finished piece as well as much of the laser cutter. Do the right thing and help with the clean up!

2.2 Wood

Wood is a great material to engrave as it creates a nice burnt depression. For cutting thicknesses up to 6-7mm cuts well where thicker woods will grow progressivly worse as the strength needs to be adjusted and more heat (more burn) will have to be applied to the cut area.

Different woods laser differently, which is important to take into consideration. Some woods, when laser cut/engraved, seep out inner resin which discolour the wood and might have to be sanded away after lasering. Some woods cut with black edges that do not discolour things it touches whereas other woods have a much sootier black edge. Sometimes it depends on the moisture level of the wood wheras other times just by the wood chosen.

Fiberboard (MDF) is also possible to laser cut, at least the thinner variants. Another popular wood to laser cut is veneer which can after be sanded and inlaid in different things, or used in other applications. It is important to note that since you're cutting the fibres of the wood the wood might be brittle after cutting, depending on your design. The longer the connecting fibres you keep the more strenght will remain.

If you plan on engraving an edge that you're going to glue against it is important to note that if the glue needs to sit well you need to sand away the burnt parts as it has effectively sealed the surface preventing glue from penetrating the wood. The glue will still hold but the joint will be comparatively weak.

2.3 Glass

Indeed, even glass can be put in the laser cutter. You may not be able to actually cut glass but you can create an engraved surface that looks like it has been frosted. Bear in mind though that the newly lasered glass needs to be handled with care as it is covered in microscopic glass shards which needs to be cleaned off and the engraved part needs to be scrubbed to dislodge any loose glass particles, preferably under running water. Ceramic, just as glass, can be lasered and the glossy surface even quite depressed depending on type of ceramic. Of course, as with all materials, the material needs to be fairly flat.

2.4 Metals

Whereas the laser cutter here at school is not by far strong enough to cut metal there is still one kind of metal which you can use in the laser cutter. Brushed aluminium is possible to lightly engrave and will make a light grey engraving.

2.5 Paper

Paper has some things to consider as well. Most papers can be cut absolutely without problem, even thicker cardboards up to a few millimeters, for the most part no different than cutting fiberboard. Thinner papers, such as copy paper, needs to either be taped down or have a jig to hold it down to prevent it from flying off. Inside the laser cutter is a small jet of compressed air to blow at the cut area when its in use, this small jet will cause your paper to fly away if precautions are not taken. Even foamcore can be cut, the center part is polyurethane plastic which lasers without issues, although expect some darkening of the cut edges.

2.6 Warning!

Important! If you are unsure what kind of material you have and plan on lasering then you need to find out. As an example using PVC plastic in the laser will release chlorine gas which is highly toxic. Not only that, when combined with moisture in the air it results in hydrochloric acid which will corrode the insides of the laser cutter. That means no, you cannot laser your Moleskine notebook. Other materials may have other issues, for instance kevlar produces hydrogen cyanide, highly toxic and all around bad for your health. If you have any hesitations google the material you have and see what happens to it when it is burned, if it looks like something either dangerous for the laser or toxic for humans then rethink your choice of material.

Do not under any circumstances use reflective metals, or any other kind of reflective material in the laser cutter. It will bounce the laser back up and damage the laser cutter. That is why it's important in the case of for instance aluminium to use brushed aluminium and not polished.

Be careful with materials which catch fire easily, such as very dry wood for instance. What you think might be a really nicely engraved piece of wood might, depending on settings, be a nice piece of char due to catching fire and the laser cutter needing service or at worst being destroyed.

3. Preparations

First thing you need to think about is size. If you plan on lasering something that doesn't fit within 400x600mm you ought to reconsider your design as it will not fit the laser cutter. Bear in mind that you should also leave some space over for margins as lasering at the very edge of the material is rarely a good idea. You should also leave room, or have an additional piece in the same material, somewhere to test the laser cutter settings to make sure that it engraves at the depth you want and manages to cut through the material. This needs to be tested every time since the laser cutter's strenght varies from time to time due to factors such as dust and dirt. There is no one setting which will always work.

3.1 Preparing the file

Now on to the fun part. You have a design that you want to laser? Fantastic! There are two ways you can use the laser cutter, one with vector data and one with black and white (greyscale) images. Whichever route you choose you still should take the trip through Adobe Illustrator. In Illustrator make a new file, dimensions do not matter, but make sure the file is in RGB color space. Start by setting up three layers and for your own sake name them as "engrave", "cut outside" and "cut inside", and order them with the "engrave" layer on top, then "outside" followed by "inside" at the bottom.

3.2 Cutting

The laser cutter uses two colors to control what to cut and what to engrave. For cutting the laser needs lines in red (RGB 255, 0, 0) color, and the lines need to be set at 0,0001pt thickness for it to be recognized correctly at a later state in the process.

Layer order
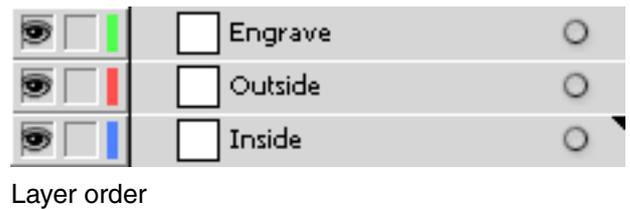
The laser cutter has an order to how it cuts files, it starts with the vector data that is lowest in the file, that is the reason why you put the "inside" layer at the bottom. In cases where you want to cut a hole in something, imagine that you want to create a donut shape, the inside hole needs to be cut before you cut the circumference of the donut. If this is done in reverse the donut might fall down and shift before the inner hole is cut making it less precise and at worst if shifted out of the focus of the laser will not cut through. So anything that you have as inside pieces needs to be put into this layer.

Anything else that you want to cut you put in the outside layer and treat with the same color and line thickness.

3.3 Engraving

Engraving is done with black color, or levels of grey. Completely black (RGB 0, 0, 0) will create the deepest engraving and the closer to white you get you'll get progressivly less depth. This data can come from vector shapes and lines or from pixel data in images pasted into Illustrator. Make sure you convert them to greyscale before pasting into Illustrator. Also bear in mind that using greyscale images often requires a lot of tweaking before getting even close to the result you want. Oftentimes it can be beneficial to convert the image from greyscale to a completely black and white picture with a noise or halftone pattern and let the density of the dots create the engraved image instead of the depth of the engraving.

Make sure your engraving data is in the engrave layer.

3.4 Text

An important thing to note is if you have any text whatsoever in your document you need to convert the text to outlines. This is done simply by right-clicking the text in Illustrator and choosing "Create outlines" from the dropdown menu. If this is not done the text will not look the way you want due to the font being replaced with a default font on the laser computer.
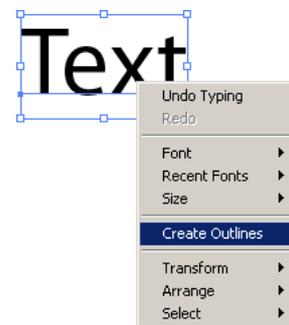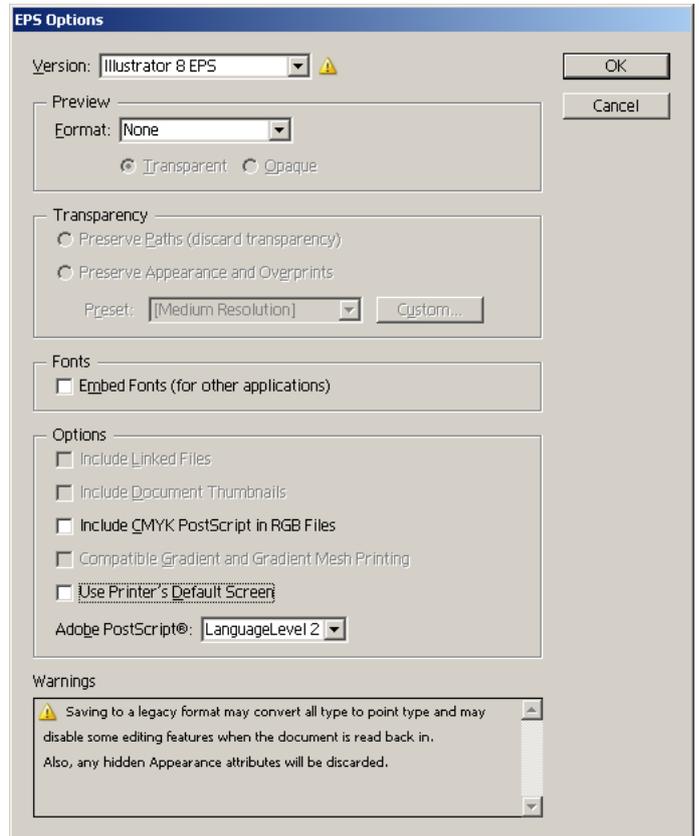

Settings for Save As, EPS Options

3.5 Saving

Now the trick to get the laser to read the file is to save it as an Illustrator EPS file (not as AI) and to save it in Illustrator EPS 8 format. The program used to control the laser cutter is CorelDraw and to be able to import files successfully you need to save it into an older format. Also important is in the saving dialogue to deselect all check-boxes and to change the thumbnail option to "none" otherwise your file will not import into CorelDraw and you will have to resave the file.

Put the file on a USB stick and talk with a person entrusted to run the laser. Usually one to two people in each class has the laser licence as well as the workshop staff.

Settings for Save As, EPS Options

3.6 Precision

How precise do you want your piece? Are you making pieces that fit together? It is important to understand that while the laser can be incredibly precise with a lot of testing, retesting and a lot of work it is also important to understand the limitations of your material. The laser has something called a "kerf", which is basically the width of the laser beam as it cuts. This kerf is approximately 0,2mm but can change wildly depending on thickness of material and what the material is. Wood has a wider kerf due to material burning whereas casted acrylic tends to have a narrower kerf. The kerf will also increase the thicker the material you're cutting through.

Your precision in engraving depends also on material choice. The laser basically reads engraving information in the same way a printer does and tries to "print" in dots per inch. What this effectivly means with the laser cutter is if you set it to laser at 300dpi it will make 300 travels from left to right and back to engrave one inch of material. If you have a large area to engrave it will take a long time (even hours) to finish. Some materials are pointless in engraving in higher DPI, such as wood, as it will look no different if it was engraved at 300dpi versus if it was engraved at 500dpi, the only difference is loss of time. Acrylic can on the other hand support higher qualities and can be engraved easily at 500dpi and still keep its quality.

4. After laser cutting

After you're done you might need to do a little bit of work to make sure your piece looks right. Since the laser cutter burns away material and this material needs to go somewhere (no worries, most goes out through the ventilation) some will settle back on your piece. Acrylic can have a cloudly white residue on it, especially after engraving. This residue can simply be polished away with a little bit of fabric and some toothpaste. Woods can have black soot residue which might need to be taken away with a fine grit sandpaper. Glass, as I mentioned earlier, leaves probably some of the most dangerous particles and needs to be dealt with accordingly.

5. Final words

To summarize everything, make sure you have more material than you need so you can test, make sure you weigh the quality versus time well both not to waste time but also to respect other people at school. During degree work times there are usually many people wanting to use the laser cutters so a queue builds up, if you can by careful preparation make the time you use the laser less the happier everyone will be. Also respect if the people with the laser license does not have time to help you, they have their own projects and their own concerns which are just as important and will help you if they have time to do so.

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