

Using the Laser Cutter

What is a Laser Cutter?

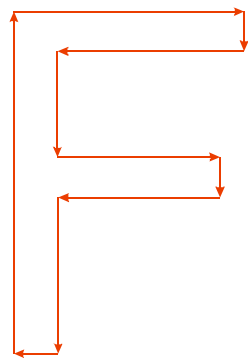
A Laser Cutter is a machine that uses a laser to cut materials, and is typically used for industrial manufacturing applications, but is also starting to be used by schools, small businesses and hobbyists. Laser cutting works by directing the output of a high-power laser, by computer, at the material to be cut. The material then melts, burns, vaporizes away, or is blown away by a jet of gas, leaving an edge with a high-quality surface finish. Industrial laser cutters are used to cut flat-sheet material as well as structural and piping materials.

What can you do with a Laser Cutter?

The lasercutter enables the user to cut materials and/or etch or engrave patterns into the surface of materials. It cuts on a 2D plane with the laser head (cutting point) moving in two directions (X & Y). The depth of the cut is dictated by calibrating the laser's power and speed. If the power and speed are reduced so the laser does not cut through the material it will then etch the line or fill area into the surface of the material.

The Laser Cutter has three potential outcomes:

- Cutting vector lines to create shapes with planar and curved edges;
- Etching vector lines/patterns into the surface of materials at different depths
- Raster etching (engraving) fill areas at different depths to create patterns in the surface of materials.



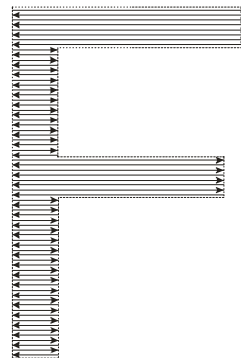
Vector cutting / etching



Cutting the square only



Engraving and Cutting the square



Raster etching / engraving



Engraving the square only



Engraving depth profile depending on percentage black

All three outcomes can be combined in the one job to create 2D shapes with patterns composed of vector lines and fill areas etched at different depths into the surface.

How to indicate the Laser Cutter what to do?

The different outcomes in cut depth are achieved through the application of different power and speed settings to assigned 'pen colours'. 'Pen Colour' refers to vector line colours which the Laser Cutter software interprets as different power and speed settings. Each colour can be associated with different settings to achieve different results. We use **black only for raster etching / engraving**.

Other colours are used for vector cutting / etching. Colours are handled by the laser in the sequence as indicated in the below table. This enables control of the sequence in which the cutting operation is performed. **Generally because of accuracy it is advisable to first perform the inner cuts before cutting the outline of the shape to be created.**

No.	Colour	RGB colour model			CMYK colour model			
		R	G	B	C	M	Y	K
1	Black	0	0	0	0	0	0	100
2	Red	255	0	0	0	100	100	0
3	Blue	0	0	255	100	100	0	0
4	Desert Blue	51	102	153	40	20	0	40
5	Cyan	0	255	255	100	0	0	0
6	Green	0	255	0	100	0	100	0
7	Grass green	0	153	51	60	0	40	40
8	Forest green	0	102	51	40	0	20	60
9	Olive	153	153	51	0	0	40	40
10	Brown	153	102	51	0	20	40	40
11	Walnut	102	51	0	0	20	40	60
12	Plum	102	0	102	0	40	0	60
13	Purple	153	0	204	20	80	0	20
14	Magenta	255	0	255	0	100	0	0
15	Orange	255	102	0	0	60	100	0
16	Yellow	255	255	0	0	0	100	0

Some words on materials

While a wide range of materials are compatible with the laser cutter some must be avoided for health and safety reasons and due to the density of some materials. All new materials should be discussed with staff. **The cutting area of our lasercutter is limited to maximum 700 * 400 mm.**

Materials that can be used include:

- Textile materials (leather, suede, felt, hemp, cotton)
- Wood (balsa, burch, plywood, mdf up to 9 mm thickness)
- Vivak
- Paper
- Cardboard
- Acrylics (also named PMMA, Plexiglas, perspex)
- Rubber
- Solid polystyren
- Delrin (POM: Polyoxymethylen, polyacetate)
- Self adhesive sheets.

Materials that **cannot** be used:

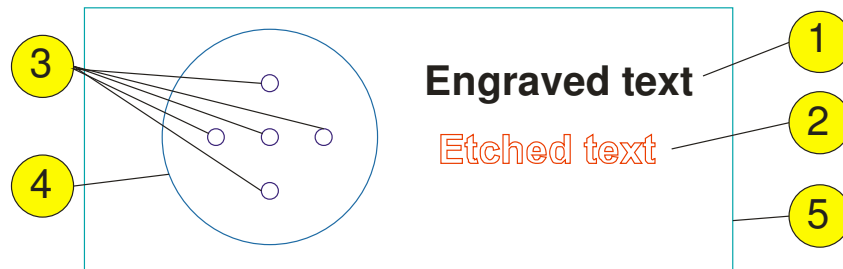
- Metals (reflect the beam)
- Foam board (foam will start burning)
- Any material containing chlorines e.g. PVC (corrosive gases, dioxines)
- Polycarbonate (Lexan)
- ABS (tends to melt rather than vaporize)
- HDPE (high density poly ethylen, “milk bottle plastic”)(gets gooey, catches fire.)
- PolyStyrene Foam (catches fire easily, melts)
- Fiberglass
- Coated Carbon Fiber (thin carbon fiber mat can be cut, with some fraying. However, once coated with epoxy it will emit noxious fumes)

How to prepare files for the Laser Cutter

We use CorelDraw (version 15) to open the files. CorelDraw can open or import a lot of file types including older versions of AutoCAD dxf and dwg , Adobe Illustrator ai (CS4 files and earlier), and eps Encapsulated postscript and pdf files.

General remarks.

- **Scale.** Draw on 1:1 scale on a 700 * 400 mm canvas or page. Keep some clearance on the edges.
- **Colour.** Use coloured lines (see above table) for cutting or etching, use black for engraving.
- **Cutting sequence.** The sequence when cutting is controlled through usage of colour. Use them in sequence of the before table. Because cut parts can change position due to airflow, the sequence should be:
 1. Engraving (Black)
 2. Etching curves (Red)
 3. Cutting of holes in objects containing holes (Blue)
 4. Cutting outline of objects containing holes (Desert Blue)
 5. If needed cutting of outside frame (Cyan)



- **Lay out.** Lay out (nest) the various parts on the canvas or page in order to reduce material usage. Pay attention when sharing cutting lines, see next point.
- **Shared lines.** Be careful when parts **share cutting lines: usually this leads to double lines meaning cutting twice** (may lead to loss of accuracy, melting, burning, or warping of material). Delete redundant copies of lines! Especially pay attention when you use tiles built by using rectangles sharing sides. As an aid for removing duplicate lines in Adobe Illustrator you may decide to use the script WR-removeDuplicates available from website <http://illustrator.hilfdirselbst.ch/dokuwiki/en/skripte/javascript/uebersicht>.
- **Sharp corners.** If you have any sharp corners, you might consider rounding them (called "adding a radius" to a corner, or "adding a fillet") so your parts will be less likely to crack around the corners. Sharp corners can be made however when needed.
- **Adjusting for removed material thickness.** You may want to adjust for the kerf (the thickness of the laser beam), which is about 0.1 mm. (The laser centers itself on the lines you draw and takes off about 0.05mm of material from either side of the lines.) For example, if you would like the hole in your part to have a diameter of roughly 10 mm, you should draw a hole with a diameter of 9.95mm". If you would like a circular part with a diameter of about 15mm, draw a circle with a 15.05mm diameter. (These numbers are approximate and can vary depending on the material and its thickness.) In CAD programs, this can be achieved using an offset of 0.05mm. It is advisable to make a few test cuts when you need this accuracy.
- **Details.** Small details should not be too small compared to material thickness, especially for thin materials. For thick materials we need more power and the material might burn away. We can attempt to cut thinner pieces, but the part will likely warp and be very fragile. Also in this case a small test is advisable.
- **Text and fonts.** If you use uncommon fonts, text should be converted from a font to line art (often called "breaking apart text to lines or polylines" in CAD, or "converting text to curves" or "create outlines" in other drawing programs). Otherwise, if we do not have the font you are using, our programs will substitute your font with a different one.
- **Engraving versus etching.** Consider etching (shallow cut, not completely through material) lines, markings, outlines of text instead of engraving them as **etching is much faster** compared to engraving. When engraving curves make them at least 0.1 mm wide otherwise they will be invisible.

How to prepare files in Adobe Illustrator

If not already done before: set illustrator units to mm (Edit / Preferences / Units & Display Performance)

Set your art board to 700 * 400 mm, landscape format.

Convert text to outlines. Do this at the end of your design work, because after the text is converted you will not be able to edit it anymore using text tools. It may be wise to save the non-converted version of the file separately. Use a fill depending on whether you want to cut, etch or engrave.



All information for the laser has to be on **one layer**. Be sure to also **remove all the other layers** from the Illustrator file, except the one with your cut instructions, otherwise the file cannot be imported in CorelDRAW!

Save your file as Adobe illustrator *.ai. We can handle CS4 and earlier.

Submitting files

- Be aware of the maximum size 700 * 400 mm.
- Check the cutting sequence (colours).
- **Remove all multiple lines** (see above). Multiple lines means multiple passes of the laser. We will reject files with a lot of multiple lines.
- Time required for cutting may vary between a quarter of an hour to few hours for jobs with a lot of lines and engraving (average is about ¼ hours). We prefer to use etching instead of engraving because etching is a lot faster.
- **In the filename please include your name, the material** (mdf – acrylic, own material) and **thickness**. Also indicate how you want to have the material cut. We try to save material by combining more jobs on a single sheet. If you don't want this, please indicate clearly (e.g. centred on a sheet). Also indicate what you want to do with black objects (engraving or etching).
- We prefer if you **submit your files through e-mail** to d.search.id@tue.nl