

# Dragon Powered Laser Cut Plywood Box Maker instructions

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## Introduction

These are general instructions which apply to all my laser cut ply boxes. Each box design may also have separate instructions if the box has some unique features. The instructions for making my all ply hinges are also in a separate document.

## Tools & Materials

I design boxes to be cut from 4mm birch ply and 6mm poplar ply. Each design will only work with the thickness I designed it for. Other sheet materials of the correct thickness may also be suitable.

The 4mm birch ply I buy is actually between 3.7mm and 3.8mm thick. I have designed the boxes with this in mind. If you have sheets more than about 3.9mm thick, the design may need to be modified.

To make a lid gluing jig, you will need 4mm laser quality MDF. The amount needed will be explained in each box's instructions.

Tools:

- A block of something to direct a rubber band's pressure inwards while gluing the hinge to the box. I use an offcut of the 15mm foam I lined my workshop floor with. You could use a block of wood, with some thin foam to protect the hinge.
- Two spring clamps. I highly recommend modifying these by sticking 1mm foam to the clamping face to protect the ply. The clamps I use are 15cm or 6 inches overall.
- Four to six modellers clamps. You could probably get away with using larger woodworking clamps if you already have those.
- At least four and preferably eight of my corner clamps. These spread the clamping pressure of the rubber bands when gluing the lid and box.
- Four 15cm or 6 inch rubber bands. The length refers to the length when the band is laid flat. Larger boxes will require even larger bands. I make my own long bands from slingshot elastic joined with zip ties.
- Sanding will be a lot easier with a random orbital sander. You could also sand by hand. For a power sander, I suggest 220 grit discs.



- Good quality wood glue. I recommend Titebond III Ultimate.
- Finishing oil such as Osmo Polyx or Danish oil.

## Cutting

The DXF files have drawing units of 1mm. Plywood less than about 12mm thick is not guaranteed to be flat, and my experience is that 4mm birch ply is not at all flat. The 6mm poplar I buy is pretty flat and easier to handle. Here are my top tips for laser cutting plywood:

- Hold the sheet flat while cutting or the laser is likely to go out of focus. Use a jig, magnets, sticky tape or whatever works for you. There's an article on my blog about cutting 4mm birch ply, there is a link in the appendix.
- Make test cuts to find out how much power and speed is needed. Using far more power than is necessary will result in wide cuts and the risk of setting the work on fire.
- Use a honeycomb bed or other method to hold the sheet clear of the cutter's bed. This will reduce smoke staining.
- Unless the ply surface is very rough, don't bother sanding before cutting.
- Use laser quality ply and not external ply. Laser quality ply uses a glue which cuts more cleanly than standard ply. I have also found cutting non-laser ply needs more power and leaves sooty edges which will make a mess if not cleaned carefully.
- Inspect the ply sheet carefully to find the flattest area for the top of the lid. This is important if the finished box is to have a well fitting lid. Also consider the grain of the wood and select the area that pleases you most for the lid if it is also flat. It may be necessary to move the items around in a drawing application although I have never needed to do this. Remember the outside of the lid will be facing downwards in the cutter.

Where it is important, the parts have letters engraved to identify them. In the DXF files, these letters are dark blue and must be cut with far less power than the actual cuts. The letters are placed where they won't be visible when the box is assembled.

**Important:** If you use a jig to suspend the sheet above the table, the order of cutting is important. The holes must be cut before the outside edges in case the parts drop before the laser attempts to cut the holes. The cutter files have different coloured lines for the parts that must be cut first. Be sure to order them correctly in your laser cutting software. Some laser cutter software claims to be intelligent enough to know which parts must be cut first. In practice, mine is easily confused and so I order the cuts manually.

## My top tips for a well fitting lid

If the lid is not flat, there will be a gap at one side when it is shut. To get a really fine looking box, it is important the lid is flat. Here are top tips for achieving this:

- Examine the ply sheet by sighting along the edges looking for a flat area to cut the lid top from.
- Assemble the lid using the lid gluing jig.
- Clamp evenly and carefully. Don't over tighten clamps.

## Assembly

The assembly sequence:

1. Laser cut all parts.

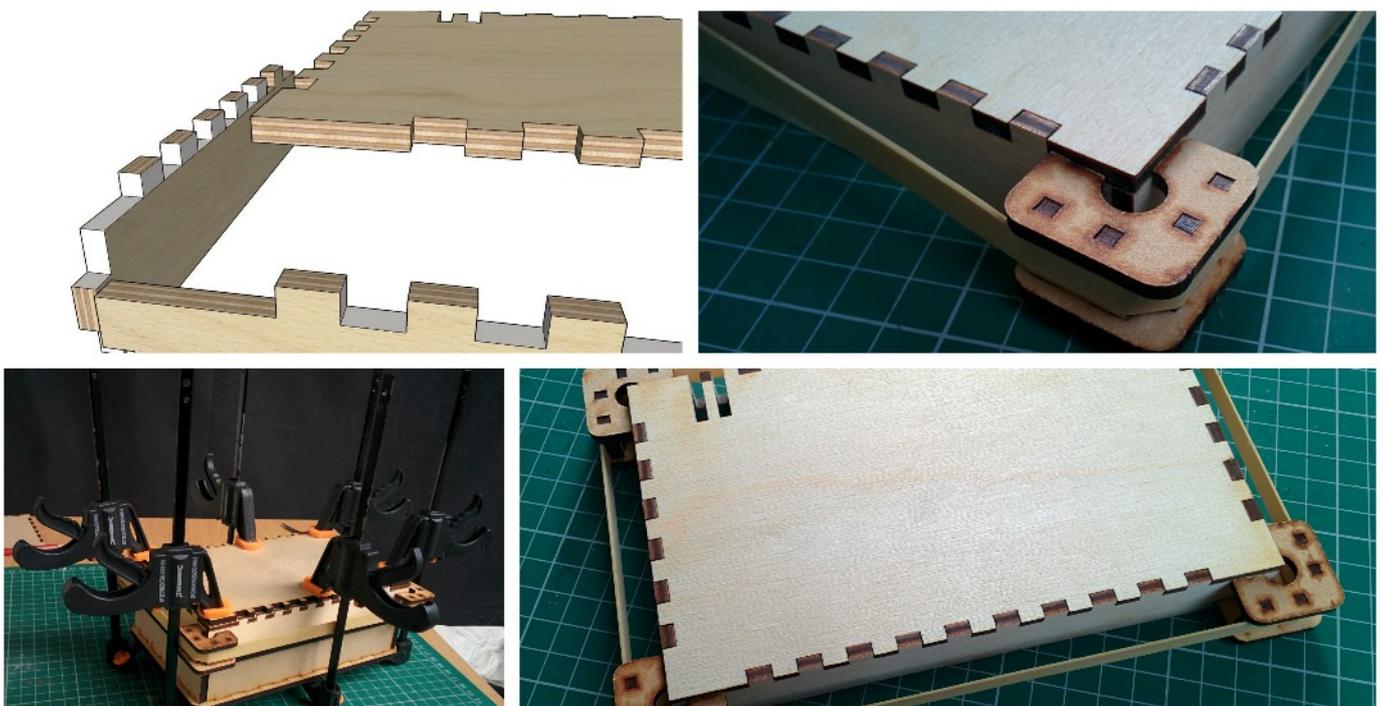
2. Sand the **inside** of all the parts. (The outside will be sanded after the box is assembled). Careful not to sand off the letters that identify parts.
3. Assemble the hinge jig and any gluing jigs included in the project. This is described in separate instructions included with the download.
4. Assemble the lid.
5. Assemble the hinges.
6. Assemble the box. Again, match the identifying letters and put the letters on the inside of the box.
7. Sand the **outside** of the lid and box. The “fingers” at all the corners can be sanded to be flush with the sides.
8. Glue the hinges to the lid.
9. Glue the hinges to the box.
10. Apply a finish if you wish.

## Gluing

Leave the glue to dry for as long as recommended by the glue manufacturer. I don't recommend leaving the parts clamped for longer. If parts are left clamped overnight, for example, there is a risk the clamping pressure will distort them.

## Assembling the lid

Use a small brush to apply glue to the inside and face of the “fingers” as shown in the picture. Match “L” to “L” and “R” to “R”. All the identifying letters go **inside**. Put a rubber band around the outside of the lid and then fit a corner clamp to each corner. Add a second rubber band. Clamp the lid to the gluing jig if one was included in the project. If you don't want to make the lid gluing jig, you could place the lid on a flat surface and weight it.



Note that no glue is applied to the lid, only to the back, front and sides. Notice that the lid is clamped to the gluing jig using the spreader which is part of the jig project.

## Assembling the box

Apply glue to the inside and face of the fingers of the back and front but not the sides (which would lead to double gluing). Apply glue to the edges of the box base. Assemble the parts and put a rubber band around the top. Invert the box and insert a corner clamp at each corner. Put a rubber band over the bottom of the box, roughly where the base is. Put the box the right way up and insert a corner clamp at each corner. Now add a second band to each set of clamps.

Check the box is square by standing it on a known flat surface such as a work bench or desk. If the box can be rocked diagonally, gently twist until all four feet touch the flat surface.

## Fitting the hinges

Glue the hinges to the lid first. Test fit a hinge and notice where it touches the lid. This is where glue will be applied. Apply the glue, including the edges of the lid cutout, and fit the hinge. Use finger pressure to hold the hinge against the top and back of the lid and fit a spring clamp to hold it in place. Use a corner clamp to offset the spring clamp inside and use clamps modified with 1mm foam to protect the hinge. Set aside for the glue to dry.



Test fit the lower part of the hinge and notice where it touches the box. This is where the glue will be applied. Glue both hinges at the same time. Apply glue where the hinge will touch the box, including inside the cutout edges, and fit the hinges to the back of the box. Put a rubber band around the box, over the hinges. Use a spacer to send some of the band's pressure so it presses the hinge against the box. Set aside for the glue to dry.

## Finishing

The surface of the box can be finished in a variety of ways. I prefer to use Osmo Polyx oil, a low solvent drying oil. This gives a very tough surface. You could use Danish oil or furniture wax.

## Resources

In the UK good quality laser grade birch ply and MDF are available from Hobarts, <http://hobarts.com>

Again in the UK, 6mm poplar ply is available from Kitronik <https://www.kitronik.co.uk/>

In other territories, I anticipate ply and MDF will be widely available.

Sundries like rubber bands, wood glue and finishing oil are widely available including from eBay.

## Appendix

There is an article & video on cutting ply using a jig on my blog: <http://dragonpowered.co.uk/laser-cutting-jig/>

Another of my blog articles, this one on configuring RD CAM for use with my jig: <http://dragonpowered.co.uk/configure-rd-cam-to-laser-cut-with-a-jig/>