Adjusting for Kerf

What is kerf and why should you be concerned about it?

You probably shouldn't be. For most people, the kerf created by the laser is **not** going to be something they will need to worry about. It's an amount of material **equal to the width of a human hair** that is removed by the laser when it cuts.

The beam on a laser is very small, generally in the neighborhood of 0.010 inches (0.25 millimeters), but if you are trying to create parts that snap-fit together perfectly without needing glue of any kind to hold the object together, that **is** enough of a difference to make the fit turn out to be slightly loose instead of snug.

Different materials will have a different kerf size. The thicker the material that you are trying to cut though, the wider the kerf is going to be. Also, some materials will melt unevenly, giving a larger kerf in foams, than in something hard and dense like wood.

There is no "one-size-fits-all" number for kerf. It's going to be different for each material that you cut. You can expect it to be similar for materials of similar density and thickness, but the only way to absolutely lock down kerf is to do TEST CUTS **on the material. *(I'm a huge believer in test cuts, particularly if you have expensive materials that you don't want to have to buy again.)* Once you have a good number for say….birch plywood, make a note of it. The next few times that you do test cuts on birch plywood, start with that number, and fine-tune it. If you try a different supplier for birch plywood, do a test cut. *(These are natural materials and they are* not *going to be consistent.)***

The explanatory diagram below shows what happens as the laser burns along a path. *(Note: It is **NOT** to scale!)*

The **vector path** is the black line in the center, and **that** is what the laser will follow. The yellow line is the fictitious width of the laser beam. As it travels along the path in the center, it nibbles away at the shape inside by an amount equal to **half of the kerf**. The other half of the beam will eat away at the area outside of the shape we created, which we don't care about, unless we left another part sitting flush against the first in our design.
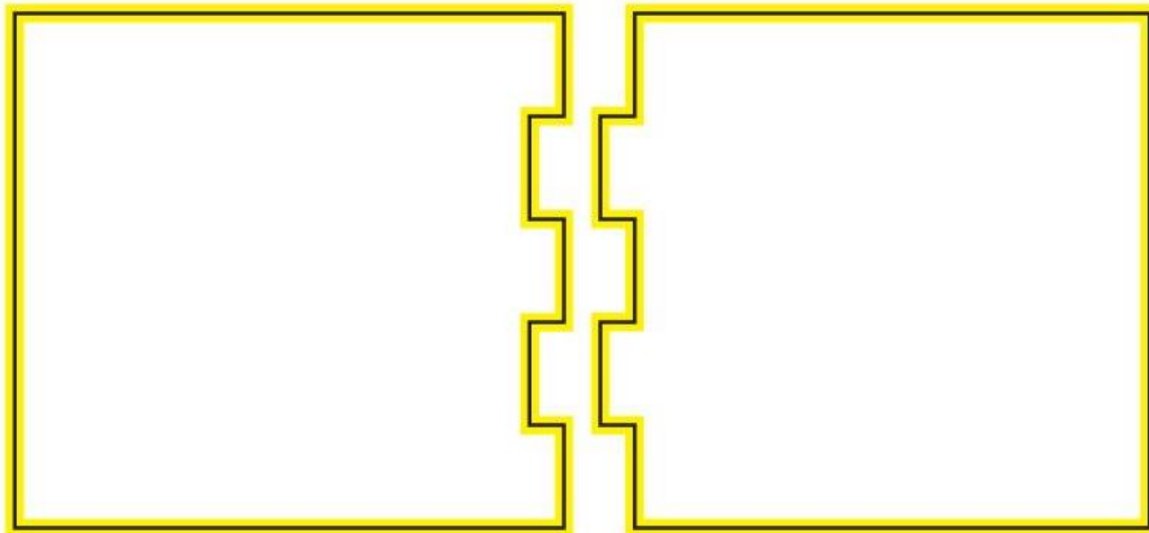

If we designed our parts to be exactly 100 millimeters wide, and they have to be that width in order to fit together properly, we will have to shift the design lines out further by **half the width of the kerf** in order for the end result to wind up at exactly 100 mm. That will cause the edge of the laser beam to just kiss along the originally designed line, instead of the center of the beam. Then the actual part will come out to be the correct size.

With our fake *(really really fat)* laser beam scenario, if we cut the shapes out without adjusting for the kerf first, the results (shown colored below) would be what we ended up with. The white areas were eaten by the laser.
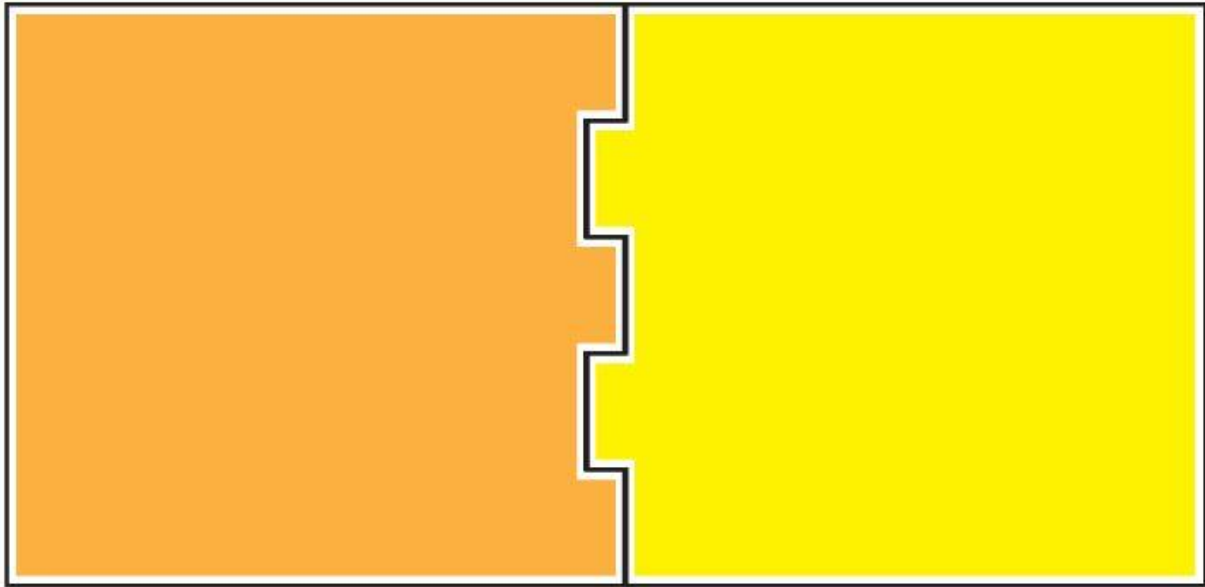
This is another illustration of the concept….by shifting the original black line that we wanted to end up with **out** by half a kerf width (the red line), when we cut along the red line, the edge of the laser beam (the pink beam) will just kiss along the original black line, and the size we originally wanted for the part is preserved. For interior cuts in a part, we shift the line using a **negative offset**, to make the laser cut in the waste area in the hole.
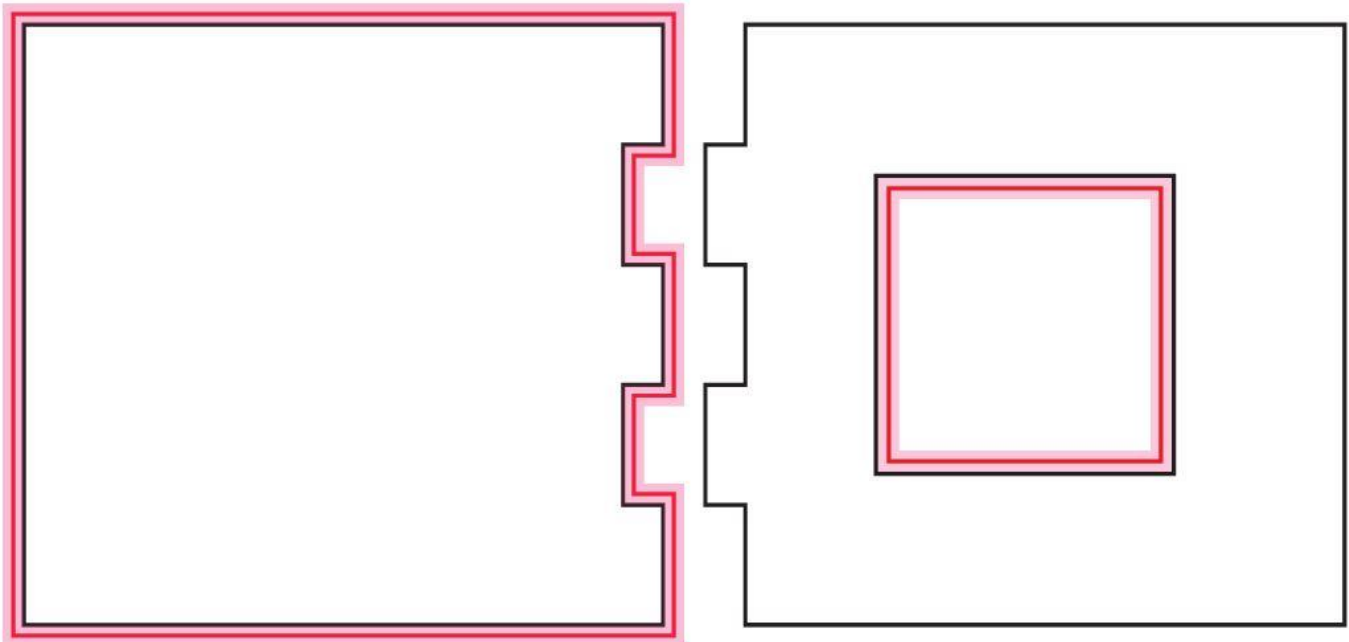
Cases where you might want to consider adjusting for the kerf would be inlay work, parts that need to end up being very specific sizes, miniature work, and anything designed by an engineer. *(Occupational hazard.)*

If you've decided that you still need to do it….the next page gives the steps for adjusting your design for kerf.

Adjusting for Kerf in Illustrator

1. Determine the Size of your Kerf

1. You will need a set of **Calipers** for this. If you don't have one, get one.
2. Create a small square (in inches or millimeters or whatever units you want to use) in Illustrator and save that file in **SVG** format with a label of **Test File**. (About an inch should do it. Or 25 mm.)
3. Import that file into the Glowforge interface and cut it out of a scrap piece of your material.
4. Take two measurements with the calipers: The size of the square, and the size of the hole.
5. **The difference between the two measurements, divided by 2, is your Kerf number.** You will enter **half** of that value into the offsets you create below.
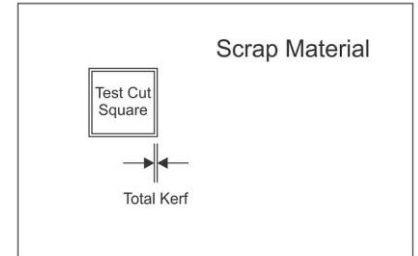
    (Note: The kerf changes at the top and the bottom of the material, depending on where the laser is focused in the material. The most accurate place to focus the laser for kerf measurements is at the midpoint of the material. Then the kerf at the top and the bottom are closest to being equal.)

2. Adjust your Design in Illustrator
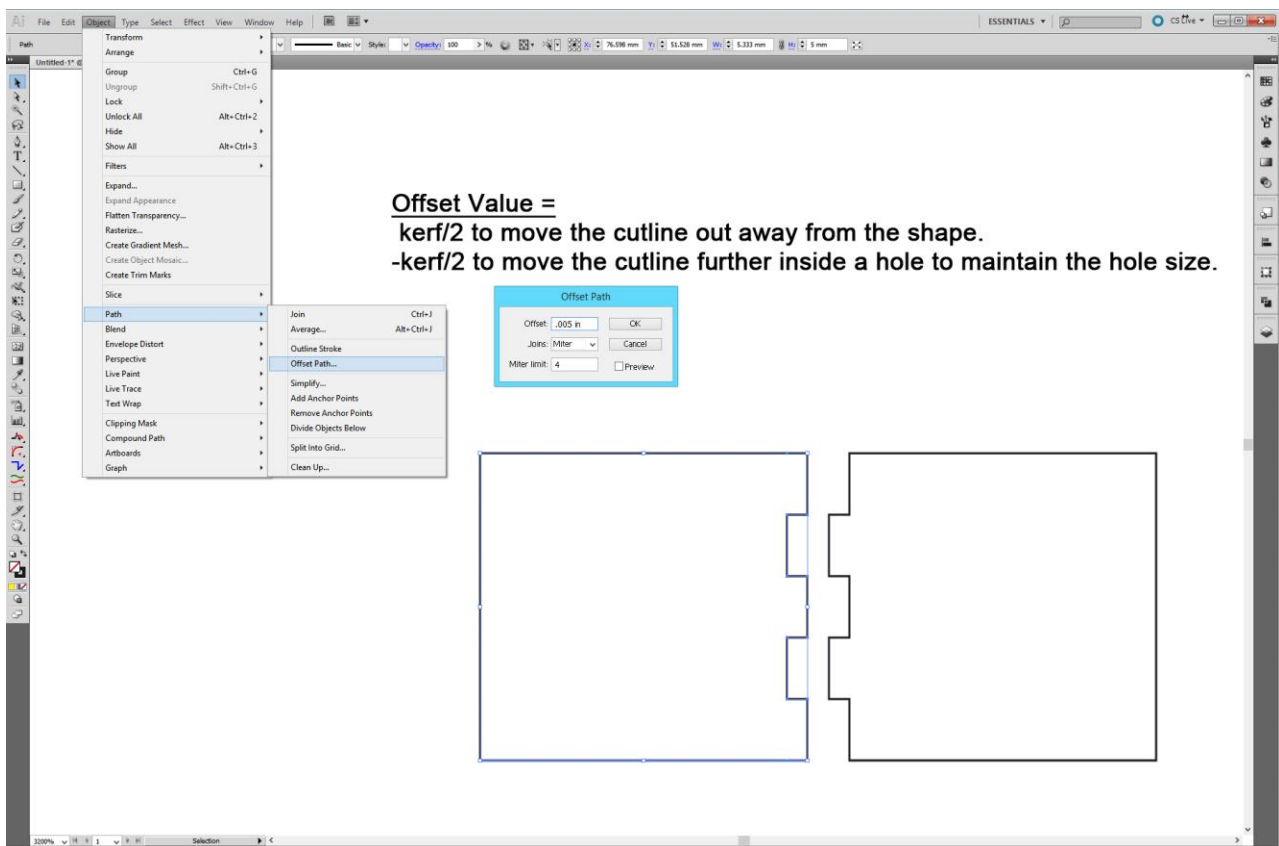
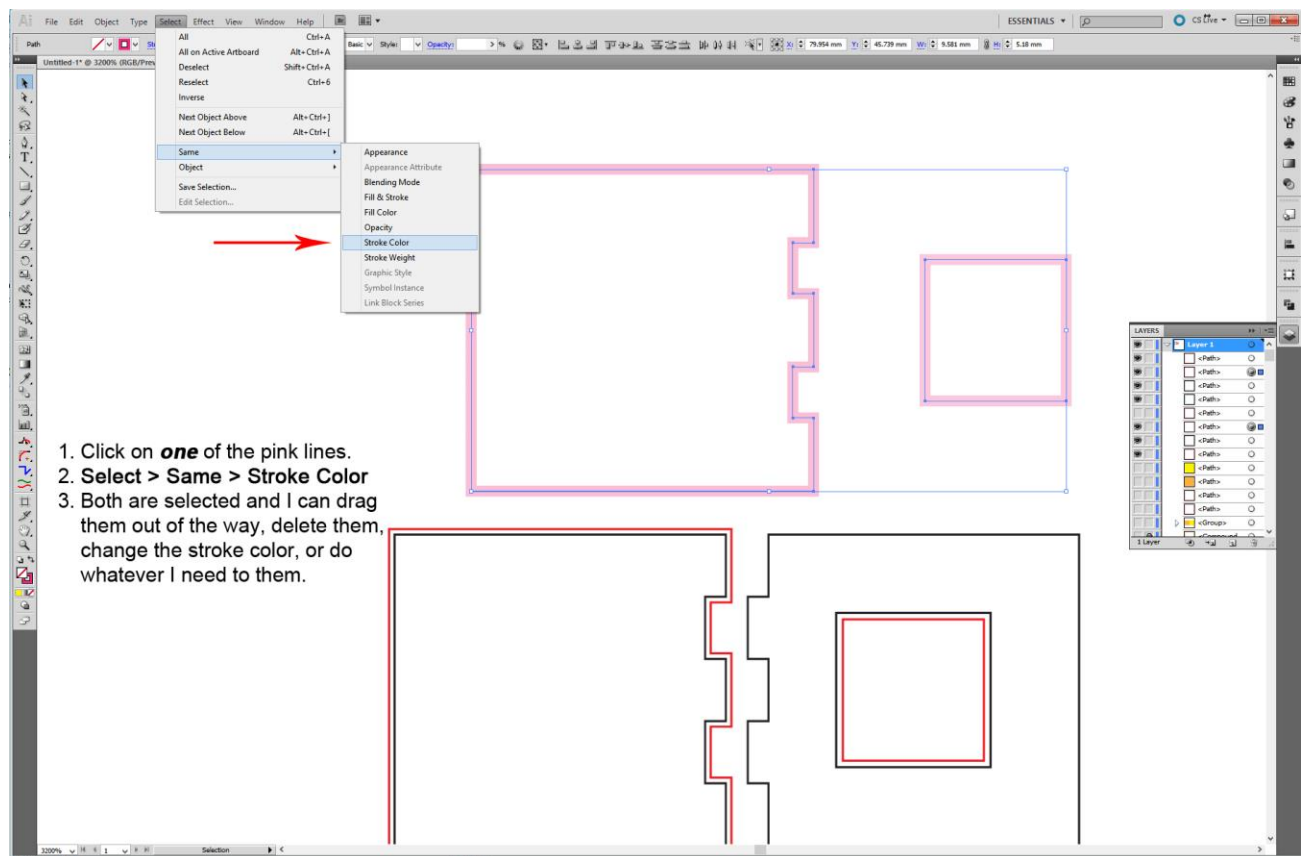
1. Select your shape path.
2. Go to **Object > Path > Offset Path**
3. Enter **½ of the kerf value** into the **Offset** slot. *(Positive number to move the line out, negative number to shrink the laser path for holes and cutouts inside of a surrounding shape.)* Press **OK**.

4. **Immediately** after entering the value and pressing **OK**, while the Offset is still selected, **change the color of the Offset path**. Make it a different color from the original path, so that you can select the correct one later. *(These lines are going to be unbelievably close together, and you will have to zoom way in to see them.)*
5. **Zoom in,** select & delete the **original (black)** path. Now save the **SVG** and the path is adjusted for kerf.

3. <u>Designer Tips for doing this on Complex Files</u>

1. If you've got a complex design with a lot of interior cuts, and a lot of external cuts that will need to have different orientations on the direction of the kerf adjustment….**start out** by designing your interior cuts with a different stroke color line than the exterior ones. Or, if you prefer, you can design them with a different stroke weight. Either of those characteristics can be used to select **all** of the occurrences of that stroke style at the same time by clicking on **ONE** of the strokes that you want to capture and then clicking on

   Select > Same > Stroke Color   or   **Select > Same > Stroke Weight**

1. Click on *one* of the pink lines.
2. **Select > Same > Stroke Color**
3. Both are selected and I can drag them out of the way, delete them, change the stroke color, or do whatever I need to them.

   So you can set **<u>all</u>** of the external kerf offsets with just a couple of clicks, and then set all of the internal offsets with just a couple more. Then you can delete all of the original lines with a couple more clicks. There is no need to adjust each path independently.

2. Save your file under a different name or version number if you think you will need to keep the originally designed file intact for some reason. I like to use **KA** for kerf adjusted, in the file name. It makes them easy to identify.

3. There are a few free simple box generator programs and apps that have built-in kerf adjustment.   Give them a look if you don't care to adjust your own.   Happy designing!

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