Photo Engraving Techniques

(twehr on www.LightObject.info)

2010-08-30

There seems to be no end to questions about the photo engraving process; mostly involving the best software and technique for scanning and converting an ordinary photo into the perfect 1-bit graphics file for engraving. It also seems that everyone who has had success at getting a good engraved result has their own answer to the question – **PhotoGrav**, **Gold Method Action Script** in **Photoshop**, **Corel Paint's Stuki** dithering, etc. Funny part is, they all seem to work; some easier or faster than others, but if you are getting the results you want, it doesn't really matter much what method you used to convert the image.

However, if you are NOT getting the results you what, it probably has less to do with image conversion techniques and an awful lot to do with your laser techniques. Let's take a look at why that is, and what you can do to optimize your results to really WOW your customer (and maybe even yourself).

The most common complaint about photo engraving results is the lack of detail in the final product compared to the original photo – usually, there appears to be too much contrast (too few shades of gray – loss of lower gray levels). Yet the converted image looks just fine on the screen. Why aren't those shades of gray showing up in the engraving? The answer is in the way that shades of gray are created in a 1-bit image (be it on the screen, on a black-ink-only printer, or your laser).

A 1-bit image is nothing more than a collection of black dots on a white background. In any give area of the image, the more black dots there are (the fewer white areas showing through), then the darker that portion of the image is. If it is 100% covered in black dots, it is 100% dark (black). If it is 50% covered, it is 50% gray, 10 % covered = 10% gray (nearly white). So really, you are just using varying amounts of black dots to create the illusion of various shades of gray. This sounds like a perfect system for use with lasers, which really only know on (black) and off (white). If it looks good when printed on paper, it should look good on your engraved output, right? In a perfect world, that would be the case. Unfortunately, my world isn't perfect, and I doubt that yours is either. So let's take an even closer look at what is going on.

The converted image file you have to work with is likely to be in the 250~300 dpi (dots per inch) neighborhood. That simply means that you can have up to 250 (we'll use 250 dpi for our example) non-overlapping dots in a 1-inch long, single row of dots. (It also means that there are 250 rows of dots in a 1-ingh high section of your image.) My laser has a 1,000 dpi resolution, so individually "printing" 250 dots in one inch should be a piece of cake – or is it?

Laser resolution and image dpi are not the same thing. On the laser, resolution gives an indication of the number of discrete steps the head can travel in any direction (x or y)

while traveling one inch of overall movement. That does NOT mean it can fire 1,000 individual black dots in that same space. In fact, it may not be able to properly fire the 250 times you would expect to represent the 250 dpi image you are trying to engrave. Here is why.

There are actually three limiting factors when it comes to turning a black image dot into a black spot on the engraving surface:

1. The speed with which the laser controller can send signals to the laser power supply.
2. The speed with which the laser power supply can receive on/off signals.
3. The speed with which the laser power supply can produce enough power to drive the laser tube to the desired strength level (25%, 50%, etc).

I use the DSP controller from LightObject.com. It is a great controller. If you are using something comparable, we'll assume that factor 1 above is not an issue. I also use the 40 watt laser power supply from LightObject.com. It is also good, and if yours is comparable, we'll assume that factor 2 is really not causing us a problem. But what about factor 3?

It took me many hours of testing to figure out that factor 3 contributes more to the quality of your photo engraving results than anything else. Here is the problem.

We need to turn the laser on and off up to 250 times while traveling a total of 1 inch. (**Note** – there is really a lot more going on than just turning the laser on and off, but for this discussion, we will omit discussion of the rest – we are currently only interested in the laser on/off cycle.) So your laser power supply must be able to bring the laser to the desired power level 250 times within the time it takes the head to move 1 inch. The faster the laser head is moving, the faster you have to bring the laser power up to the desired power.

Most of us like speed. There is nothing more boring that sitting and waiting for your laser to turn out your next great masterpiece. So let's say we are set to run 10 inches per second (254mm/sec). Not super fast, but reasonable. At 10 inches per second, you need to have your laser come up to desired power in .004 seconds (250 times per inch times 10 inches).

We all probably know that the faster the head is moving, the hotter (higher power) we need to make the same mark on any given material. Unfortunately, the hotter we need the laser, the longer it takes to come up to the set power. This means that, at 10 inches per second, your controller may be sending signals to turn OFF the laser before the laser power supply has had time to bring the laser power up to the level necessary to actually make a mark on the material. Guess what that produces in your final result – higher contrast (lower levels of gray – loss of the lighter grays). As we said earlier, that is the number one complaint when not seeing the results you want in your final product.

The solution, it painfully obvious – **slow down**. Showing down your head travel rate has the double benefit of providing more time to come up to power AND shorting the time necessary to come to power because we use lower power settings with slower speeds.

As I said earlier, it took me many hours of testing to determine that, with MY laser I need to be down in the 1.2 inch per minute (~30 mm/sec) at 12% power to really be able to get the **lower** end (lighter) shades of gray in a normal grayscale image.

Unfortunately, being able to get the full lower end causes yet another issue – loss of the higher (darker) end, so we still have a pretty "flat" or washed out looking final image. How do we increase contrast? We already know the easy way – **increase** speed. Sounds like a catch 22 scenario, doesn't it. It really is not. The lesson to learn in this –

Speed vs. Power Controls Contrast!

You just have to keep playing with it to get the results you want. You are still going to have some fine tuning to do with each photo you engrave. Over time, you will become more proficient at judging, from the look (quality) of the original (gray) image and the material you are engraving on, the settings you need. Whatever you do:

1. **Keep very detailed notes**, including reference samples of original images and results.
2. **Keep trying** till you get it.

Notes: There are at least 2 other ways you can affect the results:

- One way is to lower the dpi – fewer dpi (in the 1-bit image) will mean less times/inch that you need to turn on and off the laser power which means more time to do so which means you can have a faster travel. To keep you image from looking "grainy" however, I would not go below 200 dpi.

- There is yet another means of controlling contrast when using the DSP controller from LightObject.com – adjusting the Min Power vs. Max Power. For MOST engraving tasks, they should be the same. But, lowering the Min Power away from the Max Power, will also create some more contrast. (It is not intended to do so, but the side effect of it's real purpose.) But this should only be done AFTER you have gotten the level of low-end (light) colors you need in your engraved image. I plan to do some extensive testing with this method, as well, and will be sharing it with everyone here when I have something useful.

Hope this has been useful. If anyone has comments or questions, they can post them on the CO2 Laser Discussion section of the forum at www.LightObject.info.