

Guide to 'Bending' an LCD Screen.

v1.0 Stuart Brand (JamHamster) 08/12/2020

Disclaimer:

Feel free to skip the first two pages, it's mostly just waffle and if you just want the info, skip to Issues and Failure Points on page 3.

As it's 2020 and I'm taking some time out until the world gets better, I've been setting myself bizarre, random challenges and seeing how far I can get with them without having to worry about spending too much time on the project. I literally have no clue what I am doing and I have none of the relevant qualifications so use this information at your own risk. If you want to give it a try, it's well worth it but fair warning, it's quite tricky!

Introduction:

Emulation is great but it's a really clean experience, free of artifacts and geometrically perfect. It needs to be noisy and curvy to look 'proper' so I wondered if I could do something about it.

I started with a custom-made Acrylic lens and fitted it over a 3.5 inch LCD. It looked okay but not great. The contrast was way off, and the blacks looked 'grey'. You could also see that the image was behind the lens. In the words of Roy Walker, 'It's good but it's not right.'



I put the unit aside until I was washing a glass jug in the kitchen sink and noticed the way it refracted the light. It got me thinking about optics and how it could be applied to the project. My theory was that if the LCD and the lens were joined optically, this would lead to the image appearing on the outside of the lens 'somehow'.

I tried a fluid layer between the lens and the LCD and the results were encouraging. The image is patchy but it shows the difference joining the pieces makes. The depth of colour and contrast look great and the image is nicely curved. It was definitely an idea worth pursuing.



I eventually got it looking the way I wanted and developed a method to make it which I'm documenting here. It still needs a couple of cosmetic tweaks but I'm quite pleased with the result.



Issues and Failure Points:

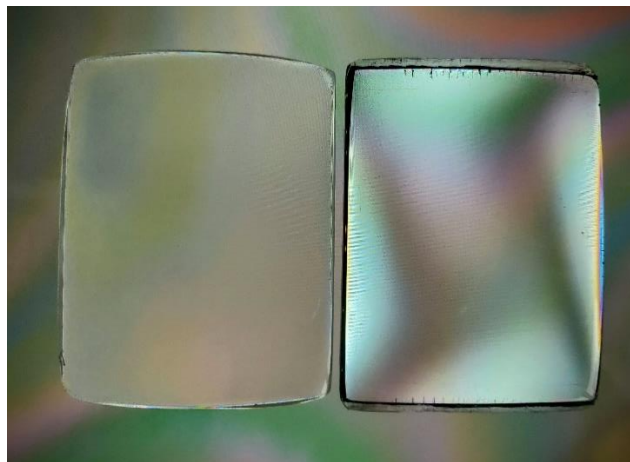
It took a number of attempts to get the right result and pretty much anything that could go wrong did go wrong so I have compiled a list of the major things to watch out for at each stage in case it helps:

Making the Acrylic lens

Acrylic is prone to cracking for a surprisingly high number of reasons but it is possible to mitigate the issues if you take the right approach. If you heat the piece unevenly, thermal expansion creates internal stresses in the material. These make the lens prone to cracking. Solvents can also cause cracking in the material where stresses are present which also doesn't help. The next section contains the most important things to watch for and should help you to avoid making the same mistakes I did (Which were plenty and manyfold!).

Using the right material:

Cold formed acrylic has variations in density which cause internal stresses. These stresses can cause the material to crack when machined. To verify that you aren't using cold formed plastic, use some polarised glasses and place the piece on an LCD screen (I used a Tablet). This will show stresses in the material. Avoid using this type of plastic.



Uneven Heating:

Do:

- Use sharp tools, fresh sandpaper.
- Take lots of gentle passes when machining/sanding.
- Regularly check the material for warmth every couple of minutes.
- Use WD-40/Coolant wherever possible when working.
- Wear proper respiratory gear.

Don't:

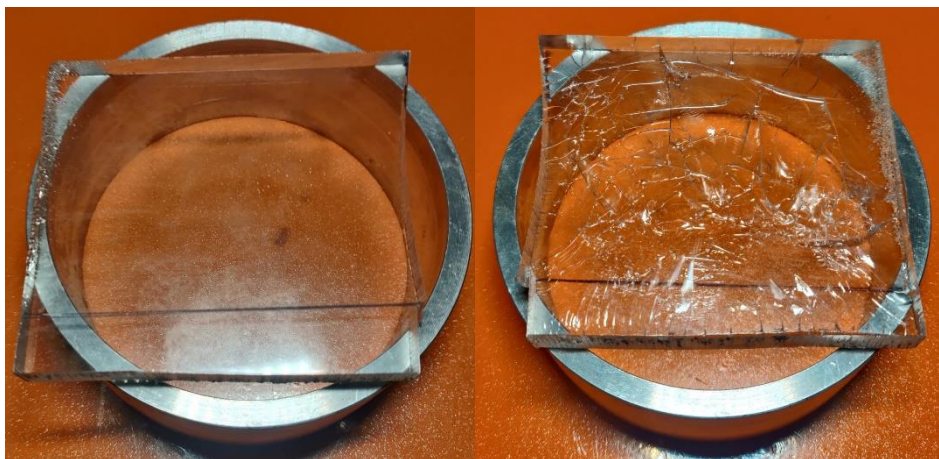
- Machine/Sand too aggressively. If the material is 'balling up' or you smell the acrylic then this is too hot.
- Don't rush it, acrylic is a tricky material and it only takes a moment to ruin your work.

Paint and Solvents:

Acrylic is shockingly sensitive to paints and solvents. A number of my attempts were ruined because I just didn't know how bad the issue was. I had a number of random failures in the material before I worked out what the issue was. This was the result of heat stress in combination with a single drop of Isopropyl Alcohol!!



To prove the issue, I roughly machined a piece of acrylic and sprayed it with Isopropyl Alcohol. The cracks formed almost immediately and in 5 minutes it was a total mess:



The only solvent I have found to be safe to use on acrylic is white spirit. There may be others but I know this works.

For masking paint, I used a matt black primer specifically for plastics. Once I switched to the correct paint I managed to eliminate my random failure issue and got a great result:



Bonding the screen:

Joining the screen to the LCD was the hardest part. I tried a number of adhesives and approaches before I found one that worked. The main issues I had were adhesive contamination of the backlight assembly, air pockets and lint.

Recommended Adhesive:

I found that LOCA TP-2500 was the best adhesive. It is relatively easy to use if you're careful and is cured using UV light. TP-2500 is not too thin and sets to an optically clear gel in a few minutes which can be removed with a piece of cotton thread if required. The LOCA I used has some seepage for 24-48 hours after being cured but more expensive LOCA may not have this issue.

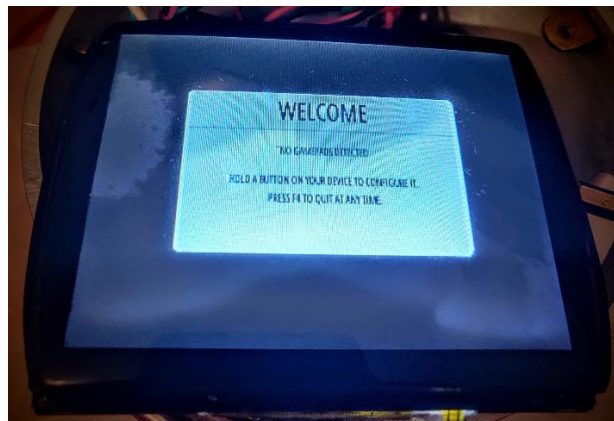


Backlight assembly contamination:

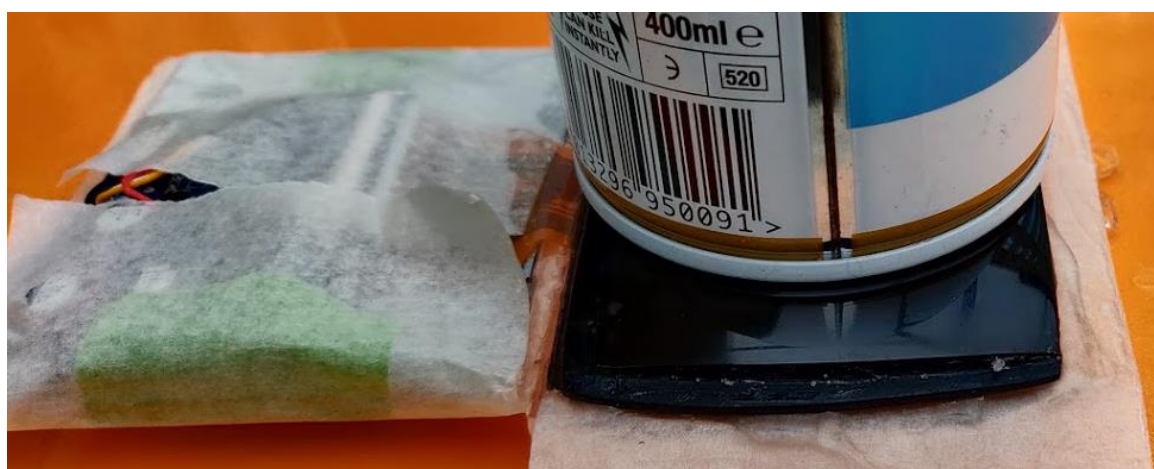
It is really easy to ruin a screen by contaminating the backlight assembly, the backlight is comprised of many layers of refractors, lenses and diffusers that even out the light behind the LCD. The units I used are not sealed and because of these layers, capillary action causes them to pull in any liquid contamination.



This will lead to a patchy image that I have yet to find a solution for so it is effectively ruined. You should take all steps to avoid this.



The most reliable method is to split off the backlight assembly from the LCD and then cover it up immediately to avoid contamination. You need to be *really* careful when doing this as the ribbon cables are quite weak and are easily broken. Re-assembling too soon also causes issues and the seepage from the adhesive can weep for 24-48 hours.



These are the most error prone parts of the process and the main thing is to take your time and be scrupulously careful!

Good luck!