## The main features of t-glase

**Strength** - Specifications on the strength of t-glase will be posted as soon as the data is returned from the test labs. We have started using a local test lab along with the lab's at a few universities to ac involves printing several "test bars" These are bars printed at 5" x .5" x .25". The setup for printing these is 1 perimeter and 100% solid layers.

**Temperature** - Optimum temperature is about 235c to 240C, but will print down to 230C and up to about 248C. (NOTE: An early misprint had t-glase printing at 212C and should have been 232C to NOTE: A feature of t-glase was to select a polymer that easily sticks to heated acrylic and glass print tables for the smoothest bottom surface possible. While t-glase meets this requirement, it results temperature. The effects of a low TG is that parts printed in t-glase, should not be exposed to high temperature use or applications. The measured TG of t-glase is 78C.

**FDA approved** – t-glase is specifically made of FDA approved polymers for direct food contact/containers. This includes cups and other liquid storage parts as well as utensils. We are working with th provide you with FDA related documentation so you may sell your printed parts that meet FDA requirements. These documents will be posted below when available.

**Environmental** - While t-glase is not biodegradable like PLA, it is a material that's considered 100% reclaimable. Thus the new "struders" that convert failed prints back to usable line work perfectly w "struder", you can actually mix in 12% of the total weight in discarded clear water bottles. Please keep in mind, that the polymer used in most water bottles, has a slightly higher melt temp and that ad increase print temp a few degrees.

**Clarity** – t-glase is considered colorless per industrial classifications. t-glase is considered "water clear" as it will not degrade to a color in multiple layters of applied thickness. t-glase's clarity suppor non-destructive evaluation of 3D Printed parts.

**Shrinkage** - Very low shrinkage makes printing large flat surfaces a breeze. And it easily prints to acrylic, glass, Kapton and other platforms.

**Bridging** - Those of us that have printed with acrylics and poly carbonates are always envious of their bridging capabilities due to glass temperature. And the new t-glase is very impressive at bridging

**Fumes** - Unlike some lines, there are no odors or fumes when 3D Printing with t-glase.

**Overview of the Optics and Light-Pipe features**
**of taulman3D's new t-glase 3D Printing material**
**The following information is to provide 3D Printer operators a general scope of the optical and esthetic capabilities of t-glase.**

**NOTE: The following is for the best "Optical Properties" only! If optical properties are not important, then print t-glase using your standard speed, nozzle and layer settings!**

engineering, it's a reference to how high quality plate glass seems to disappear when placed in water. When a clean piece of high quality glass is placed in water, the water negates the **flat** surfaces as a making the major surface invisible. However, the edges of the plate glass will still redirect or reflect light in a different direction, thus making them viewable even in water. This water-clear property i buy are displayed in "Blister-Pack" packaging. The material is based on PETT with processing that bring out it's reflective properties and enhances the visual presentation of the product. Over and ab with removing said product from the packaging!

So, if t-glase is water-clear, why isn't my printed part water-clear? The answer is, that they actually are water clear; however, because the part is made up of many layers of oval shaped threads, the en tends not to be transparent and white-ish. This holds true for pure optics as well. While a single plano lens may look water-clear, a box filled with 5000 plano lens looks, just like your part printed in t- white-ish. This is due to the edges, or any part of the surface that modifies the optical properties.

So, how can I 3D Print truly clear parts on my reprap? The answer is quite simply, you can't with a reparap style 3D Printer. Why? Because there are no optical flats within the print….or very few. You pipes as t-glase was specifically formulated to allow for light pipe transmissions. Light-pipes are discussed below, but only work along the thread axis, not against.

But I've seen parts that sort of look transparent, how is that done? While they look somewhat transparent, what you're seeing is a percentage of the light rays that are not reflected at angles outside polymers have a percentage of transmission and reflection. While ABS and some PLA's have a higher degree of transmission, PETT has a higher degree of reflection. This is why a part printed in t-glas mirrors at the transitions from x to y movement.

Ok, then.....how do I get clear looking parts..? This is rather easy, but you'll need to make a few changes to settings in your slicer. While this sounds simple, a lot of users are hesitant to do this once the running. However, there are only three changes needed to bring out t-glase's optical properties.

Specifically, you simply need to increase your layer thickness to a minimum of 70% but preferably 80% of your nozzle setting. This significantly widens the optical path thus allowing less internal refle However, note, I wrote "nozzle setting" rather than actual nozzle. Your nozzle size actually determines the smallest thread you should extrude. Not the largest. Even if you have a .5mm nozzle, you ca your slicer to .7, and it will calculate a greater amount of material to output that equates to a .7mm nozzle and increase thread spacing to accommodate this increase.

Here are the changes:

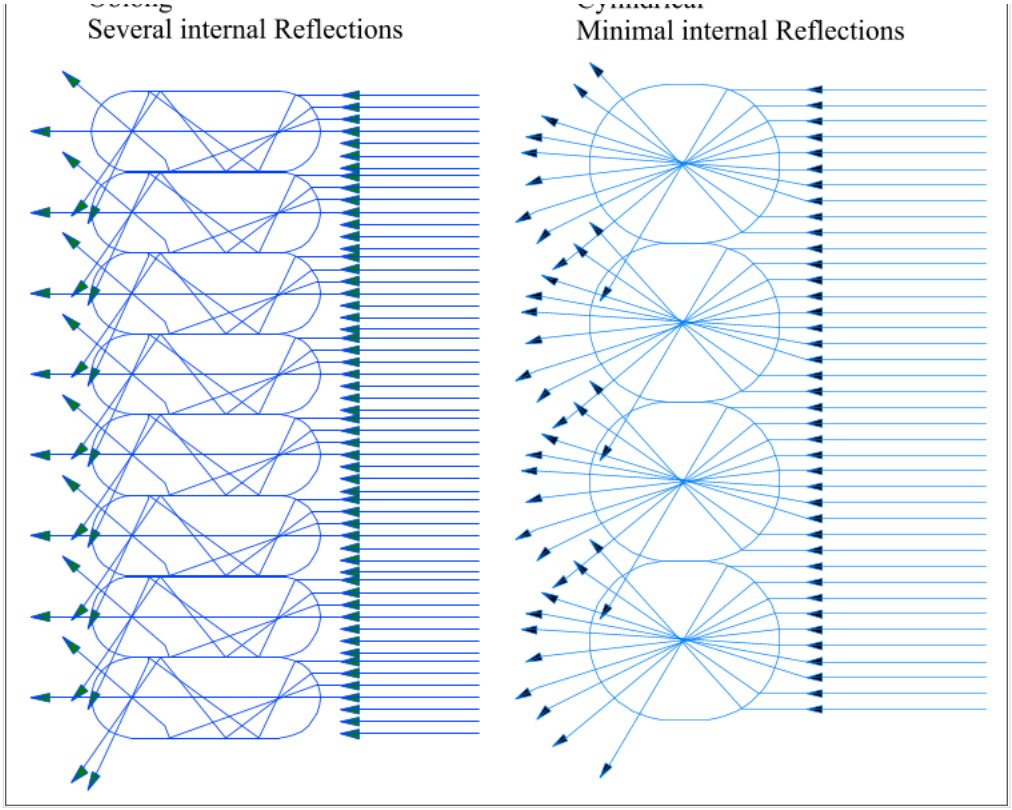
| | New settings | New settings | New settings | New settings | New settings |
|---|---|---|---|---|---|
| Actual Nozzle Size | .5mm | .6mm | .7mm | .82mm | 1mm |
| Nozzle Setting | .6mm | .7mm | .8mm | .84mm | 1mm |
| Layer | .5mm | .58mm | .68mm | .72mm | .82mm |
| Speed | 14mm/s | 12mm/s | 12mm/s | 12mm/s | 10mm/s |
| Temp | 212C | 212C | 212C | 212C | 210C |

1. Nozzle Size - If you don't have a larger nozzle, on the order of .7mm or larger, you can still change the nozzle setting in your slicer. The slicer will allow more material out, thus equating to a larger testers of t-glase found they could increase their .5mm nozzle up to .7mm.
NOTE: Nozzles smaller than .5mm will create a rather large amount of pressure on the extruding gears and components, and the line may begin to slip.

2. Layer thickness – As most of us are used to printing at .2mm to .25mm layers, the bonding from thread to thread with t-glase is such that if your part does not require vertical high resolution tran increase your layer thicness/height/size to 70% - 90% of the nozzle setting.

**3.** Print speed – Due to the 2 points above, you will be allowing more material to pass through the heater block, than you would with standard settings. Because it takes time to heat up a quantity of down the printer to allow for this difference. A good place to start is 25% - 30% of your usual speed. The assumptions here is that you are printing hollow items like vases and such that shouldn't take infill. **NOTE: Do not try printing at current speeds. We want you to be successful and reducing print speed is just as important as a larger nozzle.**

Figure 1 shows the path of light rays as a function of thread shape.




While t-glase was developed to allow reprap users the ability to print industrial strength parts, we also know that this optical feature is just as important to the artist, and jewelry designer. If you want t-glase and the majority of your designs are artistic or jewelry oriented, then we strongly urge you to get a larger nozzle.

***The optical and reflectivity of t-glase increases exponentially with nozzle size.***

If your printer vendor does not offer any larger nozzles, then here is what we do in our lab. We mostly use our own hotend and nozzles designs for our main industrial unit. However, we have a few sr widely known nozzles and hotends.

1. SeeMECNC – We use these on some of our units as well as those we set up for some industrial customers. We purchase three or more .7mm nozzles. We then simply drill the .7mm out to .82mm in the photos on our site are printed at .7mm and .82mm.

2. J-head – Again, we purchase three or more with .5mm nozzles. We then simply drill the .5mm out to .82mm and 1mm.

3. Ubis - Again, we purchase three or more .5mm nozzles. We then simply drill the .5mm out to .82mm and 1mm.

Drill bits – Harbor Frieght sells a low cost ($8.00) 20 pc set of carbide bits. Just use your micrometer to measure and select a size you wish to use. (The reason these are grab-bag is they are incorrectl sure to measure....twice)

http://www.harborfreight.com/20-piece-solid-carbide-micro-bit-grab-bag-44924.html

**Printed optical flats** – The closest you can print to something truly optically clear is to print a flat rectangular surface of one layer.

As a note. A large flat rectangular single layer surface is now being used by one of our customers to make lenticulated overlays. These are the images you see where you hold a photo one way and wh a different image. There are actually two images interleaved and printed at 60 – 150 DPI on a standard B&W inkjet printer. When the single layer of 1mm printed t-glase is pressed on the paper, the e

## Jewelry with t-glase

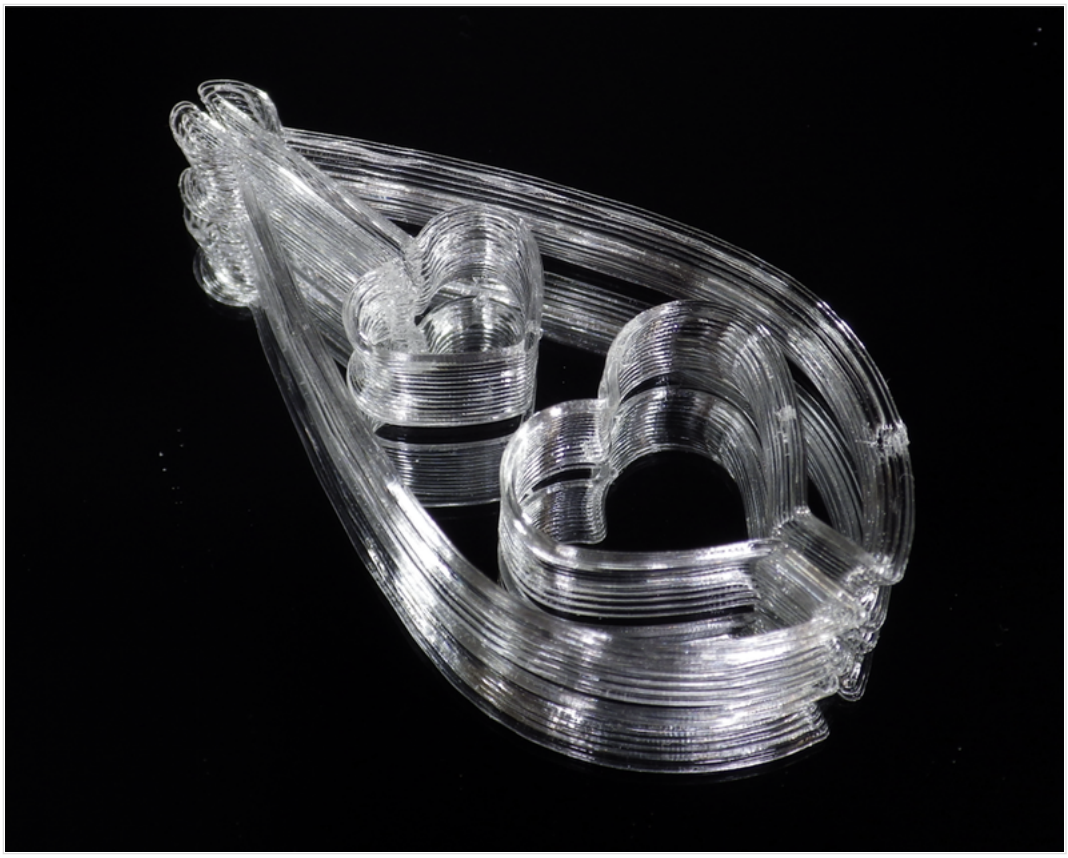
taulman3D has been working closely with two new on-line jewelry artists to develop the best nozzle sizes and printing speeds for directly 3D Printing jewelry using low cost 3D Printers. The n Printing of these jewelry pieces, is personalization, FDA approved materials, Cost and a glass like glint that transitions along the piece as it's observed at different angles . Or as referred to in jewelry c

nozzles. To add more of a 3D effect, the artist have learned to add three dimensional transitions in the extruded solids. An added benefit of using t-glase for these jewelry artists is the industrial strer are small, glass clear and intricate, however, they are not subject to breaking as glass itself would be. And in the case of earrings, the fact that t-glase is an FDA approved polymer with zero leaching is

Of course anyone with a 3D printer should be able to duplicate this process or even add to it with additional aesthetic features. The only requirement is a slightly larger or modified nozzle alor above. The obvious advantage, is that each user can create a totally unique piece of jewelry with little effort. And the pieces speak for themselves as noted in the photos below.

Bracelets by KAADEE

Bracelets by KAADEE



Pendent by KAADEE

Bracelets by KAADEE

## Using t-glase for Light-Pipes

**Problem =** You need to print light-pipes to have the LED on your PCB but have the light come out on the front panel of your new widget box/enclosure. How is that done?

When we developed the specific chemical processing used in t-glase we specified a % of reflectivity. Chemically, this is a function of controlling the crystalline nature of the polymer. This proprietary s optical properties and actually enhances the strength properties. This process gives t-glase the capability to transition light along a path.

This path, is defined as individual threads. Or along the "length" of a thread. You can think of it as light flowing through the length of a thread. Once this light hits any aberration, i.e. bend, bubble, etc. refracts and reflects outward in all directions.

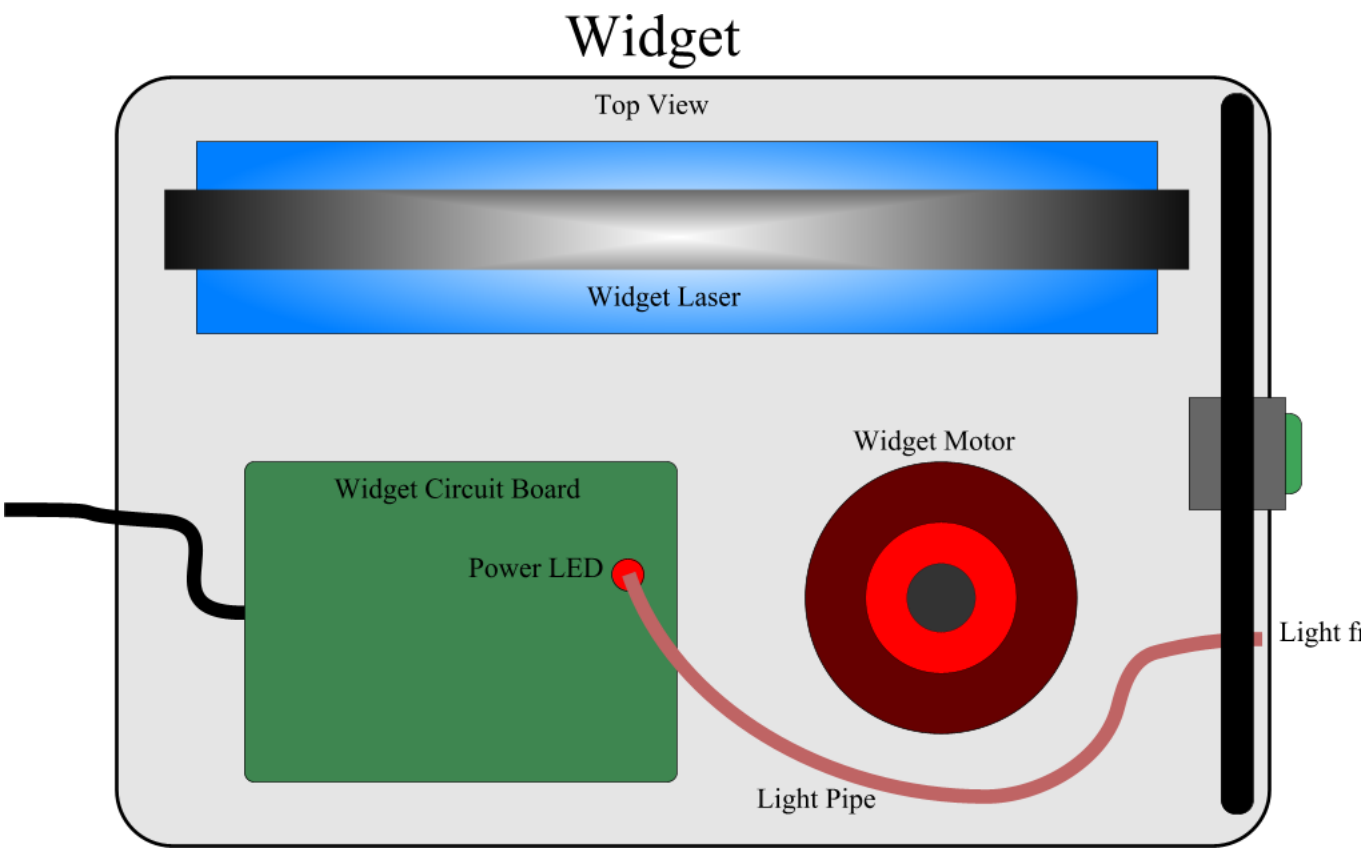
**Example:**

If you design a solid cylinder 60mm dia. and 4mm height. Yet 3d print it **at zero solids and zero fill for 4 perimeters.** You get a thick hollow band.

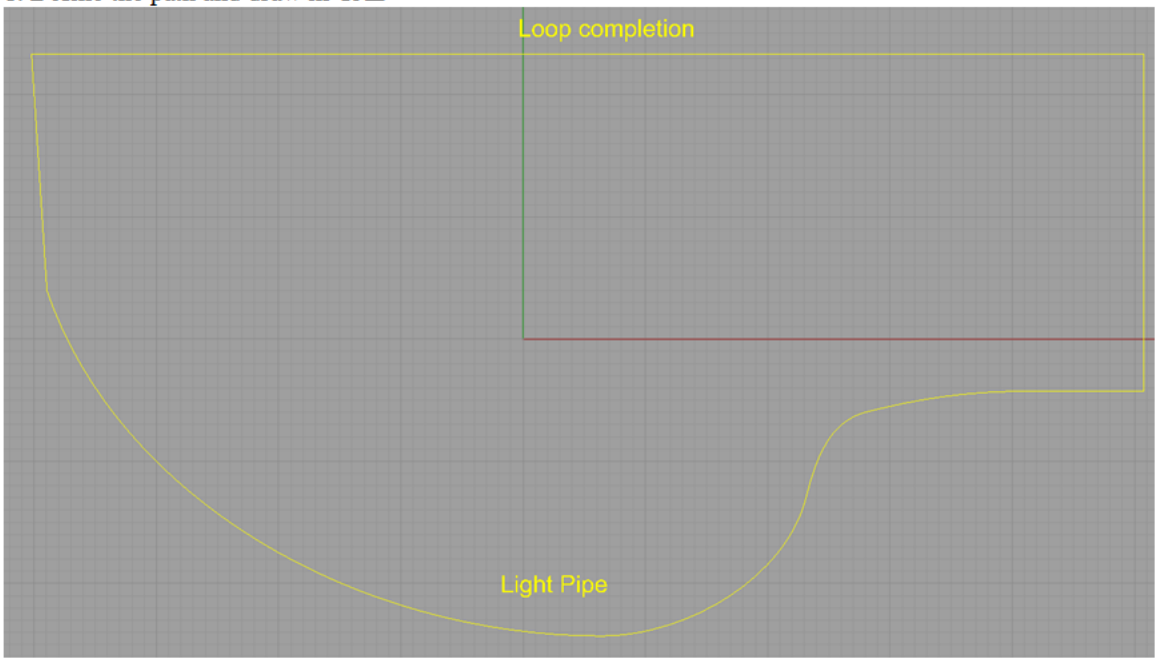
If you take a sharp blade, and cut the band, and then shine a light into one end, the band will act as a light-pipe and the other end will emit a bright light beam as if it was the light source. You have just c **Remember....You must cut a clean sharp and flat surface at the light input end.**

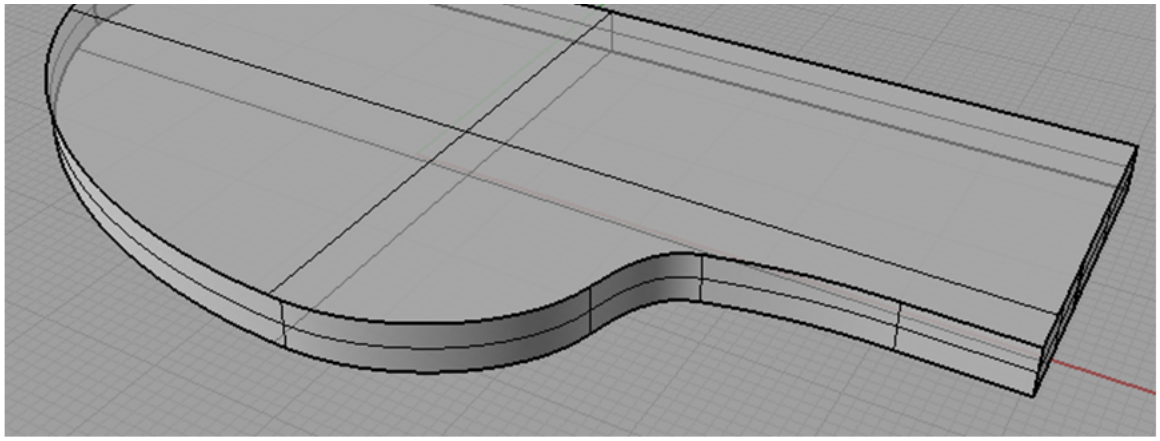
Great, so what are the variables..? The main variable is how smooth the external thread surface is and how sharp you make the bends during your design. Remember, any sharp transition will c light. So, the smoother the external thread surface, the better. The more you use soft bends (larger radius) in your design, the better.

So how do I make a ornament that lights along it's path?

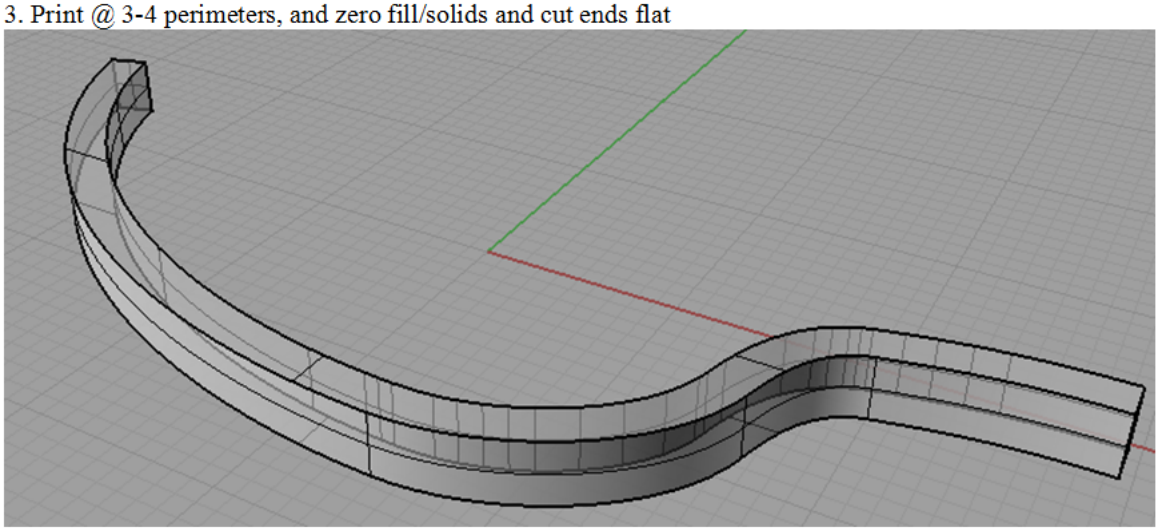



1. Define the path and draw in CAD

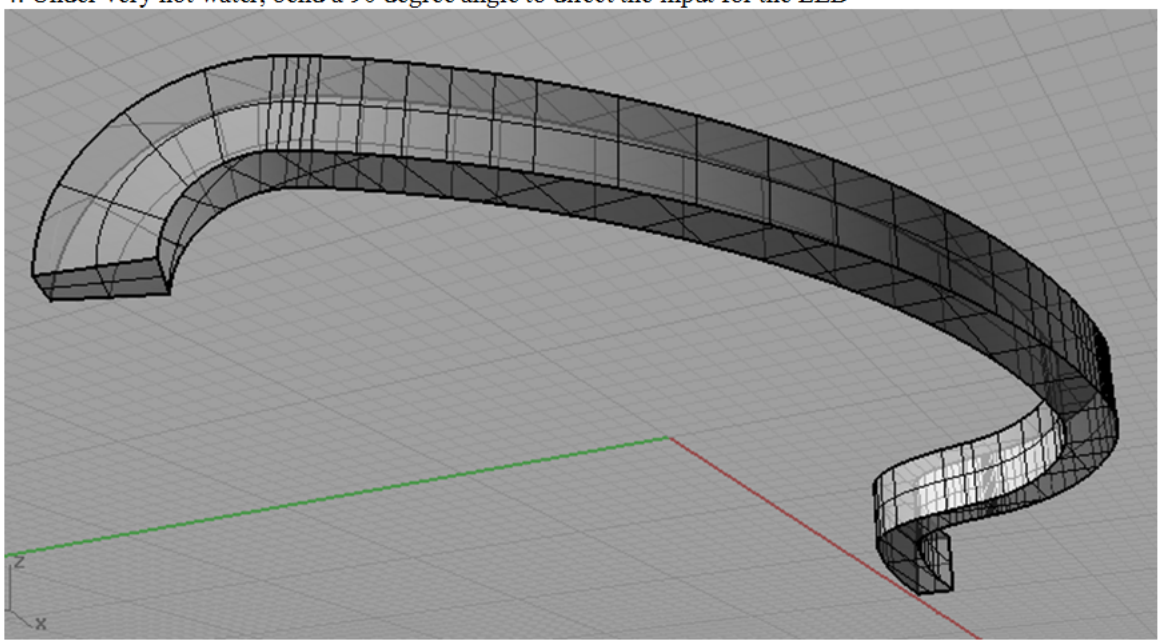


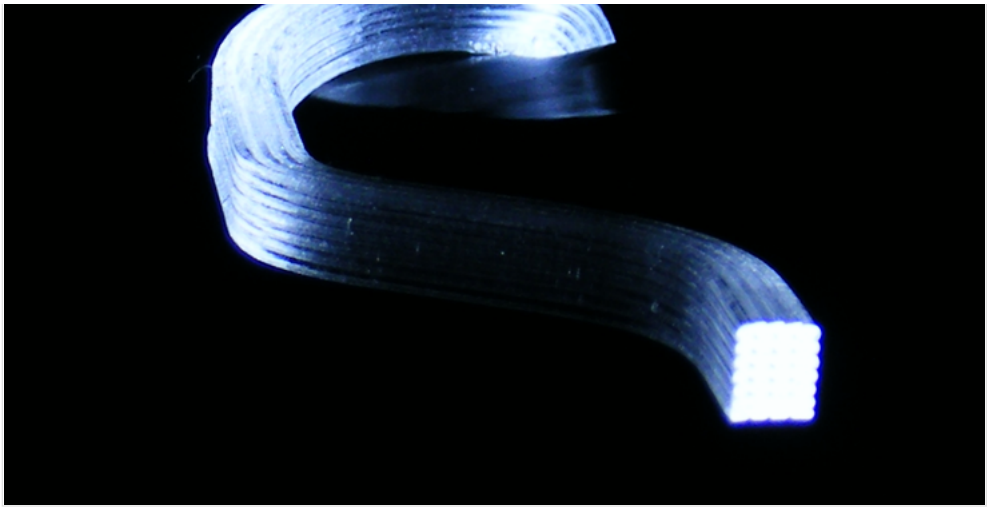


3. Print @ 3-4 perimeters, and zero fill/solids and cut ends flat



4. Under very hot water, bend a 90 degree angle to direct the input for the LED





The efficiency of the light pipe is a function of the polymer and it's specified reflective crystalline nature. While some materials can sort of perform in a similar fashion, they can not approach the effic other polymers will filter some wavelengths resulting in an undesired color.

Expect more tools from taulman3d.