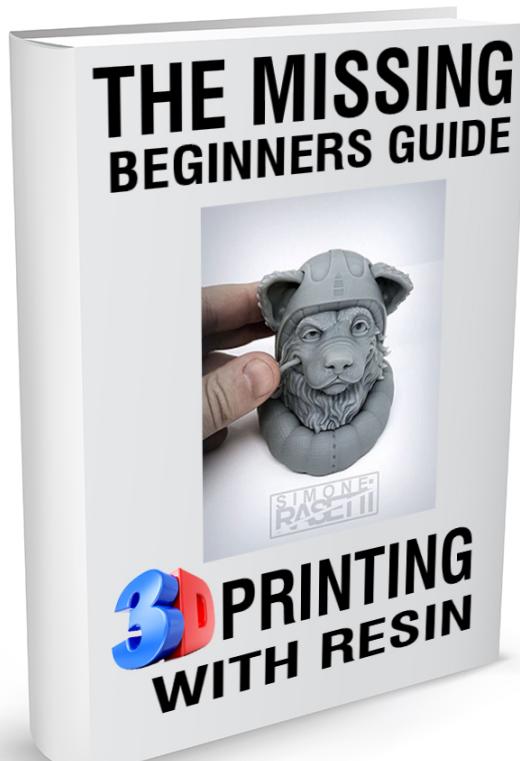




# 3D Printing with Resin

## The Missing Beginners Guide

Written by  
Charlie Anderson





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# 3D Printing with Resin

## The Missing Beginners Guide

### 1. An introduction - Who am I?

My name is Charlie Anderson, I spent 20 years working in the TV industry. For most of the time I worked in studio production as vision-switcher and director. A few years ago I decided a change was needed and joined my fathers business, Monocure Pty Ltd. **Monocure** is best described as a chemical research and development company, that sells the products it develops. I'm confident in saying that the original chemist at Monocure who is still working with us today, was the first to work with UV curing technology in Australia, more than 30 years ago. This technology has been used by the traditional printing industry for years, where it uses UV light to cure inks and coatings rather than relying on evaporation of water or solvents for the drying process. UV technology revolutionised the industry as it saves time & energy and gives a superior result.

### 2. Monocure 3D - Is it time for a new direction?

Soon after I started working at Monocure, I was asked by our National Sales Manager to return a phone call from a guy "interested in UV resin for 3D printing". He admitted he knew nothing about the subject and thought that I may have better understanding of the topic. At the time, I knew very little, but I accepted the challenge and made the call. As they say, the rest is history. For the next 12 months, I worked closely with our chemists, we imported a desktop SLA printer from the USA for testing and our chemists developed a UV curable resin that seemed to work well. I contacted others who I knew had SLA and DLP printers and had them test our resin too. Since then, many tweaks and adjustments have been made and we now have a resin that is high in quality, low cost and is very popular with our customers.

3D resins are a positive new direction for Monocure to add to its already extensive product range. All our resins are manufactured in our factory in beautiful Sydney, Australia. We buy quality imported raw materials from local suppliers. This ensures that we get batch-to-batch consistency. All our batches are quality checked by a qualified chemist and matched to a retained sample. This makes sure that the product our customers get is exactly the same the next time they get it.

As this is a new field for me, I have had to learn very quickly. It has been a pressure cooker course, but I have now been 3D printing since 2015. I had an unusual introduction as I didn't start with the traditional FDM 3D printing like most. I have since bought an FDM printer, and use it regularly to print usable parts around the house. My kids are loving printing stuff and sometimes even taking orders from their friends.



### 3. Preface - Why did I write this guide?

There is quite a lot of information about 3D printing on the internet. Everywhere you look there is an article about the latest technology or new uses for 3D printers. Professionals, both from large and small companies, artists, scientists, designers, engineers, architects and hobbyists choose this technology not only to try something new and different - they choose it because it is less expensive, low-waste, and a simplified manufacturing process. The possibility of using recyclable materials, simplicity and mobility, as well as environmental friendliness, and unlimited shapes and sizes of products. There are many different styles, brands and models, that can now be bought in supermarkets and office works.

There seems to be a lot of how-to videos, user guides and information on the FDM 3D Printers (Fused Deposition Modelling). This simply means that material is deposited in single layers that fuse together to create a 3D object. There has not as much information on the SLA/DLP printers. I think it is safe to assume the reason you have downloaded this guide is because you are interested in this technology. Maybe you are thinking about buying a resin 3D printer or you have already purchased one and are looking to understand the process better. We are very lucky these days to have the internet, with forums and social media groups where we can ask other users questions and expect nearly instant answers. This has changed the way we have adopted new technology and have made the idea of being a "pioneer" a much less daunting task. With others on hand that have had the experience having made the mistakes so you don't have to. They have done the experimenting and it really opens the door to so many other people, who in the past would have put it in the "too hard" basket!

I feel it is very important to give credit to all those people out there who are happy to share their experience and knowledge with others. I am not going to pretend that I have come up with all this information myself, in fact, this is drawn from over three years of making mistakes, following the social media groups & forums and asking for a lot of help along the way!

I feel that there was a need for a guide to assist people who might be getting into resin 3D printing. My aim is to keep it simple and to the point, to include as many tips and tricks I have learnt along the way. I want to try and make the process as easy as possible for a beginner or for someone who has come from FDM printing. Please feel free to skip ahead or jump around between topics. You may already know enough about a topic and don't want to waste your time reading it or you may not be at that stage of printing yet. I am essentially putting together the "missing" guide I needed when I started!





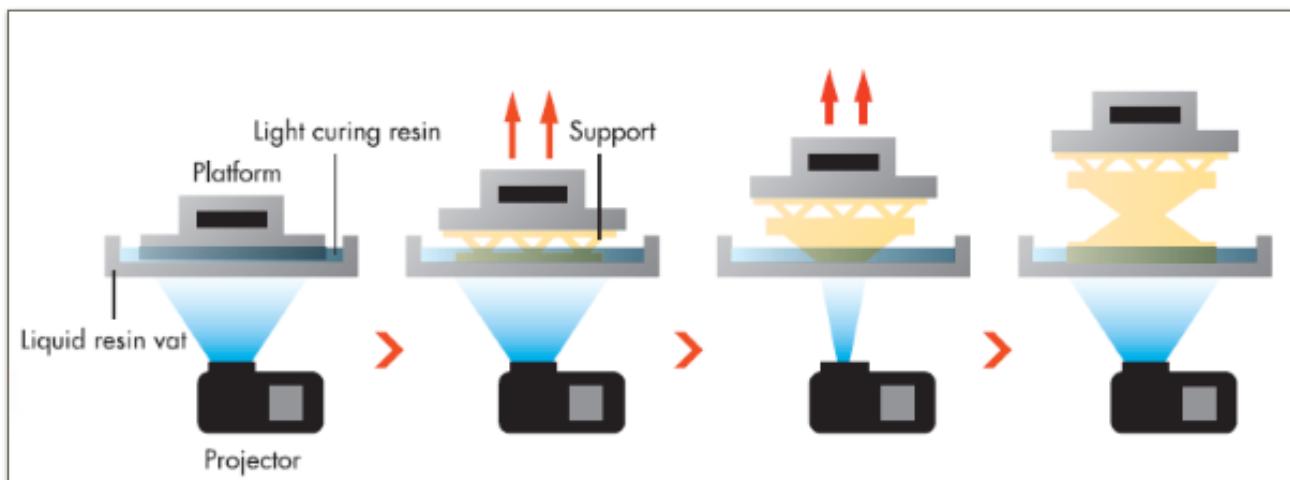
## 4. SLA & DLP Printing - How does it work?

The SLA (stereolithography) process works by “filling in” thin layers of an object using an UV (ultraviolet) laser focused on a vat of liquid photopolymer resin. The DLP (Digital Light Processing) system also uses a UV light source to cure the resin, but instead of a laser it uses a projector or a LED/LCD to cure each layer of the object being printed.

This technology is not new, it was said to be first developed by the Japanese in the 1970s and then later in 1984 a patent was filed by an American, Chuck Hall. Regardless of the exact method of production, almost all of the liquid-based technologies we've seen recently have been enabled by the expiration of Hull's patent. If you want an in-depth look at the history or more on the technical aspects, there are many articles if you search the subject on the internet. As for this guide, it's important to understand that the patent for this technology expired in 2014...this opened the door for the low cost, desktop SLA/DLP to be manufactured and sold.

One of the most well known names in 3D printing who were responsible for bringing SLA 3D printing to the desktop at an accessible price point. However, this new free market hasn't been without its bumps in the road. In 2012 they were sued for patent infringement after the company launched their wildly successful Kickstarter campaign and went on to raise nearly \$3 million for their desktop SLA 3D printer. In December of 2014, they settled and now pay an 8% royalty for every product sold.

Since they paved the way, there has been a large number of desktop SLA and DLP printers come on to the market.



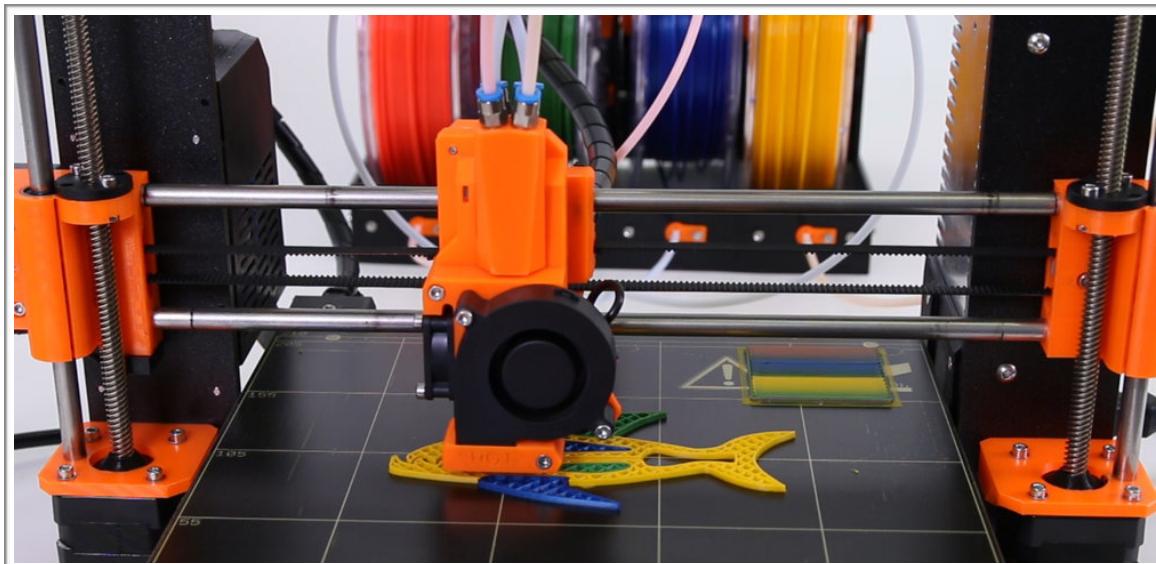
DLP Printing Diagram

## 5. I know how to FDM 3D print - Is it really that different?

There are many similarities between FDM and SLA/DLP, the main one being that you end up with a printed model at the end of the process (hopefully!) If you have been printing using FDM technology, you will probably have a good understanding of 3D space, slicing software, layer heights, positioning, supports, in-fill percentages, materials like ABS and PLA, bed and nozzle temperatures, gcode & STL files etc. You will also be aware of the



limitations of the technology. The main issue and cause of disappointment with the technology is the dreaded VISIBLE PRINT LINES! You will know that melted plastic going through a nozzle is restricted to a minimum layer height (this is measured in microns, more on this later). Yes, these lines can be sanded down or you can use acetone vapour baths to "dissolve" the lines on ABS. This is one of the main reasons that people want to try an SLA or DLP machine as most of them will print at 25 microns (bare in mind that even at 50 microns print layers are hard to see with the naked eye). Saying that, the FDM printers most certainly have their advantages. They are usually quicker to print than resin printers and can use materials that can be extremely tough and durable. They are good to print useable parts that require high strength and or flexibility. There are many different material options of filaments available, including a large variety of colours, flexible, dissolvable, carbon fibre added, and even glow in the dark! Here is a link to a [good list](#) I found if you are interested.



FDM 3D Printer

The most common mistake I see on the groups and forums, even with the most experienced FDM printers, is the positioning on the model on the build plate. The thinking here from printing with FDM to SLA/DLP technology needs to be changed. Most 3D resin printers print from the bottom up, meaning that they use a clear vat that the resin sits in and it is cured by a UV laser or projector from the underside of the vat. So compared to FDM, where they are all printed from the top down, this is in reverse. Unfortunately, its not just as simple as your model being printed upside down. Its position on the build plate is very important due to the relationship of the objects cured layer and the ability to be released from the bottom of the resin vat. It's essential to avoid large flat surfaces as these can cause a suction effect on the bottom of the vat which will "pull" on the model and remove it from the build plate. I believe, this is the main reason for print failures on bottom up SLA and DLP printers. There is nothing worse than starting a 12 hour print to find it sitting in the bottom of the vat and nothing on the build plate! Some printers overcome some of this suction effect, by allowing the vat to tilt, while others use a flexible film called a FEP that helps with the release. I will get more in-depth about this later in the guide.



## 6. I'm new to 3D printing. Is it ok to dive straight into resin printing?

As I mentioned earlier, I had no 3D printing experience whatsoever before I got my first SLA printer! Coming from FDM, or another type of printing can be helpful and make the transition easier, but it is certainly not essential. The aim of this guide is to steer you in the right direction and have you 3D printing with resin in no time! I will touch on some of the basic concepts in more detail and will also explore the more complex technical aspects, hopefully without getting confusing or caught up with technical jargon. As this is a beginners guide, I think it's important that you know for example what G-code is (The language 3D printers use to know what to do!) but it's not necessary for me to teach you individual G-code commands! If you are prepared to learn from your mistakes and failures, be happy to take advice from others with more experience, then you are ready to dive in head first and enjoy the satisfaction and delight that you get from a perfectly printed 3D object!

## 7. The Resin - What is it & how does it work?

At Monocure we pride ourselves on producing a high quality resins that work with a large number of SLA and DLP printers. We are constantly developing our resins and reacting to the demands of our customers as quickly as we can. The resin is made up of a tough epoxy base, monomers, photo-initiators and some magic ingredients which makes it special! It is considered non dangerous, non flammable and has low odour. I recommend you insist on a SDS (safety data sheet) on any resin you purchase - all of ours are available for download on our [website](#). The SDS will let you know how to properly handle the resin, its base raw materials and important safety information in case of an accident or spill. I have seen some resins that are considered corrosive and flammable, I would steer clear of these as they must contain some nasty materials which could be damaging to your printer, but more importantly to you, or a loved one. All photopolymer resins work by cross-linking (turning from a liquid state to a solid) when exposed to a certain range of UV light. Our resin will cure between 225 nanometers and 405nm. Other resin will cure at a lower range and some might at a higher range. This is usually determined by the type of photo-initiator used. The difference between a water based or solvent based and a UV cured product is the amount of solids that remain once cured. As nothing needs to evaporate to allow most UV products to cure like solvent or water based products, they are left with 100% solids, thus not causing any shrinking or cracking over time. Think of this like painting a wall, you take your brush, dip it into a water based paint and apply it to a wall. It dries because the moisture that makes it a liquid evaporates into the atmosphere. This is why it will dry more quickly on a hot day. If you left the lid off that tin off paint and put it outside, eventually all the water would evaporate and the solid component would remain. This is how the solid content of a product is measured ie. what percentage of the product remains after the liquid component has gone. Solid content in a paint, adhesive or resin is the good stuff, what makes it hard and durable. Generally speaking a water based product, such as a paint would only contain about 30-40% solids. A solvent based product can have up to 60%. This is why enamel paint is considered tougher and more suitable for high traffic areas such as doorways and skirting boards. A UV product that has 100% solids means that there is no evaporation of liquid, but a chemical reaction, like a 2 part polyurethane, but instead of the hardener setting off the reaction the UV light does.



The Resin continued...

**MONOCURE3D**  
Advanced 3D Printer Products



When it comes to odour, it seems that not only are most resins different, but also peoples senses are also different! Let me explain, I have had 2 people tell me that our resin has a very strong smell...2 out of hundreds of customers. I don't think it has an odour at all, unless you put your nose in the neck of the bottle and sniff! I have my D7 set up in my open office right on my desk. It does test prints with the cover off most days, I am yet to have anyone, including visitors who have never been to our site before and say "what's that smell?" This fact, makes me believe that our resin does not have a strong odour and going on what customers have told me in comparison to some of the other resins out there. I think enamel house paint has a much stronger smell than our resin.

As you can probably tell, I am not a chemist! The explanation I have given you is from what I have learnt over the past few years from our chemists. Please forgive me for not getting too technical, but there is plenty of information on the internet covering this in great detail. I didn't believe it was necessary to have one of my chemists write this section as most of you would have found it too heavy for a beginners guide! If you are technically minded and would like a detailed description, please contact me and I would be happy to put you in touch with one of our chemists for more information.





## 8. Getting started - What do I really need?

Like any new hobby, it is easy to go overboard on accessories and waste hard earned cash on things you simply don't need and won't use when preparing for resin printing. I will recommend you get the basics before you start, and then as you get more experienced with more prints under your belt, you will work out what works for you and what will make your 3D printing experience easier and more fun.

### THE BASICS

1. **A work space** - Choose an area that can be shut off from little people and pets! It's also important that you have some ventilation (a window is fine). Make sure you keep the natural sunlight from ever hitting uncured resin and be aware that some electric lights, especially fluros can emit UV light which may cause the resin to cure. Best to test these by pouring a small amount of resin into clear plastic cup and intentionally holding it under the light source and seeing if the resin forms a skin on the surface.
2. **IPA wash-up bath** - This can be as simple as a small container with IPA (Isopropyl alcohol) which can be purchased from your local hardware store. Buying it in small quantities can be quite costly, but unless you work in a chemical manufacturing company you will probably have no choice! A cheap ultrasonic cleaner can be a very useful bit of equipment and I recommend getting one of these for helping with the cleaning process. These can be filled with IPA or a resin cleaning solution.
3. **Safety gear** - This should include, rubber gloves (disposable are fine), eye protection (dropping a printed object into an IPA bath and having it splash back into your eye is very painful! This is from experience, so now I always wear glasses when cleaning up!) Skin protection so you don't get resin on your skin. More on how to deal with spills and skin contact a bit later.
4. **Tongs** - great for grabbing prints from alcohol baths without getting your fingers wet!
5. **Strainer or slotted spoon** - another good way to remove prints from the bath.
6. **Metal paint scraper** - Essential for removing prints from the build plate.
7. **Plastic scraper** - Good for removing resin from the build plate and checking the bottom of the vat when filled with resin.
8. **Paper towel** - trust me, you will use lots of this! Buy in bulk to save money.
9. **Soft paint brushes (a few sizes)** - Perfect for removing uncured resin while in the alcohol bath.



10. **UV safe waste container (totally opaque, usually black in colour)** - needed for used resin, this can be strained and added back into the bottle using the next time.
11. **Funnel** - Very handy for getting the strained resin back into the bottle.
12. **A foil tray with cake cooling rack** - This is needed as a place to put your resin covered items, such as build plates and vats to keep the mess contained. When it gets too messy, just throw out the tray and start again.
13. **A post UV curing station** - the sun can be used, but it's important that you understand that the sun has a very broad range of UV and can cause the cured prints to turn yellow very quickly (No longer than a few minutes a side to avoid this!) It is recommended that you buy a UV curing box or make one. There are lots of clever designs on-line that are low in cost and easy to make. Some people start with a UV nail polish box which are very cheap on stores like eBay. The level of power of the UV source (usually measured in Watts) will determine how long the post curing will take. Just make sure the UV wave length is compatible with the resin you are using.
14. **A working SLA or DLP 3D printer** - I thought I would state the obvious just in case!! Seriously, I will talk about a few different printer options in the next section if you have not made that decision yet.

## 9. Choosing a Printer - Which one is right for me?

There are many different makes and models of SLA and DLP 3D Printers on the market today. Sometime's it makes it harder to make a decision when there is more choice (think of standing in front of the egg section at a supermarket...I remember when the choice was between 1/2 dozen or 1 dozen eggs!) Saying that, having more choice means that you can get a printer that is better suited to your wants and needs. There is no better research tool when looking for technical information and other users experience than the internet. Forums, Facebook Groups and Google will be your best point of contact when trying to make the decision. Lets go through some of the things that you should be thinking about before you part with your hard earned money.

### CHOOSING A 3D PRINTER

1. **SLA or DLP 3D printer** - SLA use a laser and tilting mirrors to "fill in" the layers while a DLP uses a projector or a LED source to cure a layer slice at a time. SLA is said to have better detailed prints and can tend to be more forgiving with certain complex structures. The SLA usually does not suffer from "dead spots" where the UV might not be as intense in certain areas of the build plate. While a DLP uses a projected image for each layer slice, they are usually faster, especially if you are wanting to print multiple items at a time on the build plate. In fact, if you are printing one small item, if you were to load the build plate with multiples of the same thing, it would take the same time to print.



This is important to remember if you are wanting to mass produce objects rather than print one item at a time. Make sure you do your own research as this is probably the biggest decision you will make when choosing a printer.

2. **Orientation** - Some DLP printers project the image from the top, this is called a "top down" 3D printer. These printers require special resin that will not be effected by oxygen inhibition. This is where the oxygen (between the UV source and the resin) effects the curing speed of the material. The build plate sinks down as the model is printed and the curing of the resin happens on the surface. While the more common method, "bottom up" shoots the UV from the underneath a clear resin vat and the model is printed upside down as the build plate raises up. Both have advantages and disadvantages, I will leave it up to your own research to find out more about both these methods and work out which one suits your needs more.
3. **Cost** - Set a budget, is this printer for fun or for work. How long will it take before you see a return on investment? This will also help you narrow down your search pretty quickly. I recommend you aim for a price range say \$500AUD - \$1000AUD for example. Don't think that the more you spend the better quality prints you get, this is just not true. Some of the prints I have seen printed in a \$500AUD DLP printer compared to a \$5000AUD SLA printer are hard to tell apart. Shop around, there are always heaps of 2nd hand printers on-line and good deals from resellers trying to move old stock.
4. **Build size** - What is the size of the items that you want to print. If you are planning on doing jewellery then a big build plate and large resin vat is not important. If you are wanting to print large scale models, then this is definitely a consideration.
5. **Speed** - Don't get bogged down on speed! Resin printing is not fast, you need to be patient and understand that even a small rook can take a couple of hours, this depends on what layer height is chosen and how long the layers are cured for (DLP). Manufacturers will try and wow you with speed specifications, but it is usually smoke and mirrors. I wouldn't even take this into consideration when choosing a SLA or DLP printer.
6. **Materials** - This is an important one! Look at the cost of materials for the printer you are looking at and the availability. Free plug here for **Monocure 3D!** Jokes aside, it's no good getting the best printer if you can't afford the resin! Some printer manufacturers only want you to use their own resins and don't offer settings for 3rd party resins. They are now even building printers that take expensive cartridges! I don't recommend you go down this path, unless you are prepared to pay for their resin. Not all resin is equal, quality can vary and results can be very different. Resin cost can range from \$60AUD - \$300AUD per litre and some special dental and medical resins can get up to and over the \$600AUD per litre mark.
7. **Other factors** - you need to take into consideration when choosing the right printer is the software supplied, warranty, technical support and if spare parts are readily available. Forums, Facebook groups and other social media groups can make setting up and trouble shooting problems much easier. I would go as far as saying, if



you can't find a good group that has many active users, don't even consider that printer. Having the help of other more experienced users can make your 3D printing experience one of fun compared to one of despair!

## 10. My new 3D Printer - How do I set this thing up?

All SLA and DLP printers are fundamentally the same, they use a UV light source in the way of a laser, projector or LEDs and an LCD screen. We know that this UV light forms layers by curing the photopolymer reactive resin a layer at a time until the completed model is produced. As you read above there are a number of different technologies on the market and more being developed and released regularly as this technology becomes more affordable. As far as set up is concerned, I can give an overview, but can not be too detailed here as all printers are different so I recommend you refer to the user guide that came with your printer. These are usually in the form of an on-line guide from the manufacturer or video sharing sites like YouTube and social media groups can also be helpful resources when setting up your new printer.

### THE MAIN PARTS OF A DESKTOP "BOTTOM-UP" SLA/DLP PRINTER

1. **Printer body** - The main part of the printer which includes the UV light source, lifting/lowering mechanism and the cable connections.
2. **Build Plate** - This is usually detachable from the main part of the printer and is what the item will adhere to. Most build plates are made from aluminium to ensure that they don't suffer from corrosion and it is a good surface for the UV resin to stick to. If your build plate is painted, I recommend you sand off the paint to reveal the bare aluminium as this gives much better adhesion for the cured resin to stick to.
3. **Resin Vat** - Where the resin is poured before printing and the build plate lowers into. These need to have some way of releasing the printed object from the bottom of the vat. This can either be a PDMS (Polydimethylsiloxane) layer which is usually Sylgard 2 part silicon, the same silicon that is commonly used in solar panels, or FEP (Fluorinated ethylene propylene) Teflon release film. This is a flexible film that comes in different thicknesses. Both these technologies have the same ultimate effect, but some of the printers that use the PDMS type vat also include a tilting mechanism to help with the release. Please see subject below on failures to understand more about why the prints sometimes stick to the bottom of the vat instead of on the build plate.
4. **The LED, LCD, Projector or Laser** - The very clever part what emits the UV light to cure the resin.



Wanhao D7 (DLP)



Build Plate



Resin Vat



## SETTING UP YOUR 3D PRINTER

1. Here is a general list of things to remember when setting up your new 3D resin printer. Most of these instructions are in relation to the "bottom up" type printer rather than the "top down" printers. My experience with the top-down type is limited, but I believe that there are many more bottom up printers around and a much more popular technology for the small desktop SLA or DLP printers. If you have a top-down printer and would like some more information please contact me and I'll put you in touch with a friend of mine who makes a 3D printer that operates like this.
2. **Find a good place to set up** - (please refer to section above named "Getting Started" for more information) It's very important that your printer is on a flat, level surface away from any UV light source, these include some electric lights (especially fluorescent) and windows where natural sunlight can enter. Windows can be covered with a UV filtering material, these are transparent films that are usually orange or red in colour, that can be purchased on-line.
3. **Connect to a stable power source** - and a cabled internet connection if this is required for the printer you have purchased.
4. **Choose the right computer for the printer** - Some DLP printers require a HDMI connection from a computer as it will act as a second screen. Make sure the computer graphics card is compatible and can support the resolution demands of the printer. Many people are using a Raspberry Pi (Mini computer) for this role, as they are inexpensive and mean that you wont need to tie up a PC or laptop while printing. (Remember some prints can take 24+ hours)
5. **Install the slicing software** - This is how you will get your 3D file into the printer. Some printers have in-built memory and files can be loaded directly into the printer using an SD card or USB stick drive. Others require a tethered connection with a UBS cable from a laptop computer or Raspberry Pi. Some printer manufactures will supply purpose built software that is very comprehensive and is easy to use (this type of software is usually associated with the higher priced printers!)
6. **Connect all the required cables** - follow manufactures guide
7. **Homing the printer** - This is getting the build plate to start at exactly the right spot in the bottom of the vat. Getting the homing right is essential to getting your prints to adhere to the build plate. If the plate is too high then the laser or projected UV light will not be able to cure the resin through to the build plate so the model will not stick to it. Making the build plate too low in the homing procedure will mean that there is not enough resin between the bottom of the vat and the setting up the homing of your printer will vary depending on the make and model, so I suggest you follow the recommended method outlined by the manufacturer.



8. **Choose a model to print** - I know you probably have something in mind that you want to try and can't wait to print! Take a deep breath and remember there is plenty of time for big complicated models later! Remember to take small steps when starting something new. Keeping it simple will help you make sure your printer is set up correctly and give you confidence one print at a time. I have seen so many frustrated people posting on forums and groups trying to print really difficult things first up and getting annoyed with the whole process. Unfortunately they usually blame the resin, and post pictures all over the place of these huge messed up prints only to work out that the printer wasn't homed properly or the computer settings were not correct! I recommend you print this **flat round disc**. It is only 2mm thick and 50mm wide and is designed to sit flat in the middle of the build plate. This should only take approximately 15 minutes to print (depending on your resin, printer and settings). Printing this first will outline some fundamental things about your settings, printer and resin, more on this later....



9. **Positioning it on the build plate** - Hopefully you have followed my advice and downloaded the very exciting flat round disc (yawn). It's time to open up your slicing software and position it on the build plate. I suggest you just put it flat in the middle of the plate, with no supports or rafts. At this point it might be necessary to slice the model (this is where the computer will figure out the slices and prepare it for the printer.) Now export the file in the format as recommended by the printer manufacturer.

10. **Load the model file into the printer** - This is done by either using a hard wired connection to a computer (usually a USB cable) or through a network using an ethernet connection or WiFi or it can be loaded using a SD card or USB memory drive.



Some printers may offer only one or two of these connection options, while others may work with all. Whatever method you choose, make sure you understand what is required. For example, if you use a hard wired connection, does the computer need to remain connected for the entire print? Have you changed the sleep settings on your laptop or PC so it won't fall asleep and stop the print. In the case of a DLP that uses the HDMI connection, it is important that the screen is not set to sleep. If you are

connecting to a network, check all the network settings and make sure the printer and computer are on the same one. Or maybe you are using a USB drive or SD card? Make sure they are formatted in the correct format for the printer to read.

11. **The Printer Settings** - If the printer is running from a PC, Laptop or Raspberry Pi then the settings will need to be done on the computer itself. If the printer can print directly from an SD card, then it is possible that some settings are done in the slicing software and some can be changed in the printers own firmware. These setting will



need to be obtained from the printers manufacturers guide, the resin manufacturer or other users who have used both your printer and resin combination together.

**12. Testing the UV light** - It's a good idea at this point to make sure the UV light source is working correctly. Most printers have a testing mode, or I recommend starting a print without the resin so you can see the light working properly and you don't have anything else on the screen. By this I mean parts of the desktop or anything else other than the intended image.

**13. Choosing the resin** - It's important to understand that 3D printers are usually designed around a resin, this makes it hard for 3rd party resins to work in all printers. Make sure you have the correct resin selected for your printer. If resin came with your printer then it's a pretty safe bet that it should work with your printer. This can be a good place to start! Otherwise, if you know that a 3rd party resin works very well with your printer (Like our **Monocure 3D Rapid** does with the Anycubic Photon, Phrozen Shuffle, Wanhao Duplicators, - sorry I couldn't help myself!) Then it's ok to use that resin too. Please don't start with a fancy flexible or casting resin, stick with a clear or semi-transparent colour, as these will give you the best chance of getting a successful print first up.



A promotional image for Monocure 3D Model Dental Resin. On the left, a circular graphic features a red 'NEW' triangle pointing towards a blue circle containing the text 'DENTAL MODEL RESIN' and a 3D model of a dental arch. In the center, five bottles of Monocure 3D Dental Rapid Model Resin are displayed in a row, each labeled with a different color: Beige, Grey, Tan, White, and Clear. To the right of the bottles are several 3D-printed dental models, including a full set of teeth and various orthodontic components. A yellow oval on the right side contains the text 'introductory OFFER'. Below the main image is a dark blue banner with white text that reads 'Monocure 3D Model Dental Resin now Available. Introductory SALE!'.

**14. Resin Profiles** - These need to be set up depending on your printer and the resin you are using. I recommend you find this information from the printer or resin manufacturer or other users on-line in forums or groups. Trial and error can make this process long and frustrating. Free free to contact me as I'm happy to help if I can or point you in the direction of where you might be able to get help.

**15. Pouring the resin into the vat** - This should be done with the build plate lifted up from the floor of the vat to allow the resin to flow across the bottom of the vat. Make sure you give the bottle of resin a good shake and open it away from any UV light. Fill the vat as to the manufactures recommendations, some vats have level markings on the inside so you know not to over-fill the vat. If you do over-fill it, when the build plate assembly lowers into the vat filled with resin it can overflow due to displacement (Think of what happens to the water level in a bath when you hop in!) Some bubbles may be present on the surface of the resin since it has just been shaken to mix it. These will disperse after a few minutes time, but a light blow with a hair

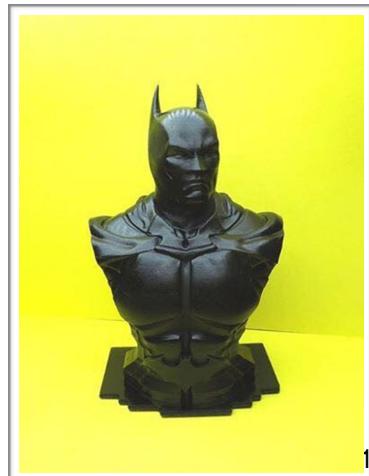


dryer will heat the air in the bubbles causing them to pop and speed up the process if necessary.

**16. It's time to start the print** - With the vat now full of resin, your file is loaded and you have tested the UV light, lets get this party started! If all done correctly, when commanding the printer to start, it should engage the motor drive on the Z axis (up & down) and lower the build plate into the resin filled vat. Now it's time to practice that thing called patience! Not much will happen for a while as most SLA and DLP printers will start with a series of "burn in layers". As the term suggests, it is burning in the layers of the resin onto the build plate. These are the first few layers that are printed to help with the resin adhesion to the build plate. During the next 10-15 minutes, the printer should move up and down as the layers are printed and the resin is refreshed for each printed slice.

**17. How did we do?** - When the print is finished, the build plate should rise up so you can see the underside of the build plate. If your print was successful you will see the round disc sitting flat on the build plate as you set it up on the slicing software covered in uncured resin. If this is what you see, punch the air and give yourself a pat on the back, congratulations you have successfully printed your first 3D resin print! If you do not see this picture, and you have nothing on the build plate or it has not printed as expected, don't worry, it's very common and can be fixed by looking at a number of factors which I will go through in detail later in this guide.

**18. Lets remove the object from the build plate** - Now we need to remove the printed part from the build plate. The first thing I normally do is put on a pair of latex gloves, I like the thin medical type ones. I then use a soft hand scraper (made from plastic so it can not damage the print) and push the uncured resin that is sitting on top of the build plate and as much as you can on the underside, back into the vat. If you do this carefully, it should all just end up dripping into the vat. Now remove the build plate and place it carefully onto a tray. I use a disposable foil tray with a cake drying rack so the resin can drip off the build plate and not have to sit in it. Find your metal scraper and carefully slide it under the edge of the print and try and push and slide it off. Once you have the scrapper in a good position, it should just come away from the plate. If you are having trouble getting the scrapper under the part, then turn the plate around and try it from the other side. I find that there is usually a weak spot that will lift more easily than the rest.





**19. Time to clean up this print** - The object that you have printed is now separated from the build plate, but still covered in uncured resin. I have a small ultrasonic cleaner that is filled with IPA (Isopropyl Alcohol) If you don't have an ultrasonic cleaner, I recommend you use a small open top container filled with IPA and a soft paint brush to remove the uncured resin. Dipping it in and out of the IPA and brushing in one direction until you can not see or feel any more resin covering the surface of the model. Don't feel the need to wash it in water as this can cause clear resins to become cloudy as the water can be absorbed into the slightly uncured surface layers. Pat the surface dry with a lint free cloth or just allow the IPA to evaporate off.

**20. Remove the supports** - If you have just printed the disc, then you wont have any supports to remove, but if your model has supports, this is a good time to remove supports as the resin is still slightly soft before it gets post cured. Some people recommend small nail scissors or side cutters for this job, be careful if snapping them off by hand, as it can be very disappointing to break part of your model that just took 16 hours to print! Best to use a tool and remember that sanding can always be done once the part is post cured to remove any support nibs or bases.

**21. Post Curing** - With the model now clean, it needs post curing. This process is necessary as all resins will not be fully cured straight off the printer. The reason for this is simple, if each layer was fully cured, then the next layer would not be able to bond with the previous layer. Just like pouring wet cement on top of fully cured dried concrete, you would have no hope of it sticking. I know this is a rough comparison, but I'm sure you get the idea. So we need to finish the cure by putting the object under a UV light source at a similar wavelength range to your printer (or check the resin you are using as they should have a working range) for example, Monocure 3D resin will cure with a UV light between 225 and 420nm.

As mentioned already, the sun can be used for post curing, but it is not recommended as it has a broad range of the uv spectrum that can cause prints to go yellow. Some people recommend placing the printed parts in a clear glass vessel filled with water. This does help filter some of the harmful rays, but the water can



make the model cloudy, especially if you are printing with clear resin.

The reason for this is the uncured resin that is still on the surface is not water soluble so it can make it have a cloudy appearance. I recommend a UV light box, home made or bought, either will do the job. The time left under the lights will be dependant on the power of the UV light. But in a lower power LED system, post curing can take up to 30mins. Unless you are lucky enough like me to work in a UV chemical factory that has 300W UV curing tunnels with conveyor belts! With this much power, post curing can be done in a few seconds. You will be able to tell when the part is completely post cured as it will no longer have any surface tack (this is the uncured resin), the parts will feel more rigid and harder.



22. **Finishing** - You may need to use some fine grit sand paper to clean up any support nibs or unwanted cured resin on your completed part. Unlike FDM printing where you can see the build lines that need sanding down, printing at 50 microns, this should not be an issue. You can use a primer, or paint directly onto the resin surface. I would recommend a enamel paint, similar to the ones used in traditional model making work well.

23. **Cleaning up** - I alway think its a good idea to remove unused resin from the vat between prints. It can go lumpy, if exposed to light or screw threads can get jammed up. The newer thin FEP materials don't seem to suffer from going "cloudy" like the PDMS silicon that many of printers use as a release layer in their vats. A word of warning for bottom up printer owners, NEVER REMOVE YOUR VAT WHILE YOUR BUILD PLATE IS STILL IN POSITION. Resin dripping from your plate onto your LCD screen or Mirrors can be disastrous! To easily remove the resin from the vat, use a open UV safe jar and pour the resin into it. If you can position the vat so it can sit on top of the open jar and let it drain into it. This technique should nearly drain all the resin out of the vat, any residue resin can be wiped out with paper towel dipped in IPA or the whole vat can be submerged in IPA and allowed to soak for a few minutes before being washed with running tap water and wiped out. The build plate and other resin covered tools can be cleaned up in a similar way.

24. **Getting rid of old resin** - I find the best way to dispose of unwanted resin is to tip it into a foil tray and leave it in the sun! It will eventually go hard and you can simply just throw the foil tray with the cured resin in the bin.

25. **How to deal with resin spills** - If you have a resin spill, use plenty of rags and paper towel to clean it up. Depending on the surface you have spilt it on, IPA will work well to finish the job. Please do a test patch first to make sure the IPA is not going to discolour or damage the surface. If you are concerned with using IPA, you could use an orange oil product as this also does a good job in cleaning up the resin.





## 24. Trouble Shooting, what went wrong?

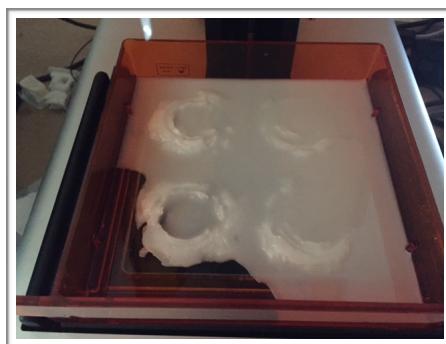
**i) Stuck to the bottom of the vat** - This can occur because the homing of the build plate was not done correctly or you did not have long enough for the "burn in layers" to help the resin stick to the build plate.

**ii) Nothing anywhere** - If you can't see any cured resin on the build plate or stuck on the bottom of the vat then something is obviously wrong! Check your UV light is working correctly, this can be done by running the print without the resin or vat and see what is happening during the print. Big flat areas can cause the model to create suction between it and the bottom of the vat. This causes it to be pulled off the build plate. You may need to reposition your model on an angle so it avoids this issue.

**iii) It printed, but it does not look formed properly?** This can be a result of under or over curing of the resin. If it is under cured, then you will need to increase the layer times or if it is over cured you may need to decrease your layer times. This is obviously only possible with a DLP printer, so if you are experiencing this with a SLA (uses a laser diode to cure the resin) they only way is to try a different resin setting see if it is possible to adjust the laser strength to compensate.



Over-cured resin



Resin stuck on the vat

**iv) It's a big over cured mess!** This can be caused by extraneous things appearing on the screen in the case of a DLP or with an SLA the wrong resin setting or incompatible resin may have been used.

**v) Why are the edges of the base lifting off the build plate?** Basically the resin adhesion to the build plate is not good enough. You can fix this by increasing burn in layer times and or amount, or changing the shape of the raft. If you have to print with a raft, I find it much better to use rounded edges as they are less prone to lifting (not sure why!) You may need to look at repositioning the model on the build plate.

**vi) Why did I only get a part my print?** This can happen if the model has a weak spot and it snaps off at that point. The rest of your model will be stuck to the bottom of your vat. Make sure you properly clean out the vat before attempting to print again. Use a soft plastic scraper or your fingernail to gently lift the edge of the hard resin from the bottom of the vat.



## 11. Top 10 Resin Printing Tips for Beginners



1. Choose your new printer wisely - Research as much as you can using the internet and communicating with others who have already done the hard yards for you!
2. Prepare your work area so it is 3D resin printing ready and keep it neat and tidy!
3. Join the community! Try and find a good online forum or a social media group that has the same printer as yours. Set up your printer according to manufacturers instructions and listen to others who have already paved the way.
4. Remember KISS (Keep it simple stupid) Don't be too ambitious to start with! Print something simple! Choose a well known SLA/DLP friendly model like this [Monocure 3D rook](#). No supports needed for this one, it can be positioned flat on the build plate. This will help build your confidence and get you printing your own complex designs quickly.
5. Learn how to properly position your models on the build plate. Understand that this is very different from FDM printing as most parts work best between 30 & 45 degrees with lots of support posts.
6. Get a good post curing station, either homemade or store bought, but a good source for artificial UV light, not the sun.
7. Get and learn a good 3D design program. I use 123D by Autodesk, its free to download and there is lots of online help and YouTube tutorials to get you started. Once you can use this type of program, you are only really limited by your imagination!
8. Choose the best resin for your printer. The stock resin that came with your printer should work, but it's not always the best resin for your needs. You may want to do casting so you need a resin that wont expand in a kiln and will burn out with as little residue as possible. Or you may want a flexible resin so your printed parts have rubbery, bendy feel to them. Our resin is made with a tough epoxy base, that makes it very hard and rigid. This makes it perfect for producing parts and models that need to be more durable.
9. Learn how to best clean up your 3D printed parts and post cure them.
10. Have fun and enjoy! It's really satisfying when you design your own model using a 3D program, send it to the printer and then have it 3D print just as you would have expected. With success you need to experience a few failures along the way! Remember, it's not a fail if you have learnt something that will make you better next time you try!



## 12. That's a Wrap!

I hope you have gained some knowledge from this beginners guide to 3D resin printing. Please feel free to [contact me](#) if you have any questions or need help in anyway. I welcome any feedback regarding this guide, if you feel there is anything I missed or areas that need more information, please contact me with your suggestions on how I can improve it.

Please consider our Monocure 3D Resin as I'm confident that you will be very happy with the results! Here is a link to our [photo gallery](#) where you will see some of the incredible models that have been printed by our talented customers with our resin.

Remember to keep on 3D Printing!

Cheers,

Charlie



## 13. Disclaimer

This disclaimer governs the use of this guide. By using this guide, you accept this disclaimer in full.

This guide has been written for the purpose of assisting people who are new to 3D printing with resin.

You must not rely on the information in the guide as an alternative to the manufacturers instructions or advice from an appropriately qualified professional.

If you have any specific questions about any matter you should consult an appropriately qualified professional.

Without prejudice to the generality of the foregoing paragraph, we do not represent, warrant, undertake or guarantee that the use of guidance in the report will lead to any particular outcome or result.

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