

# 3D Printing

FDM and SLA 3D Printing in the 3D Workshop.

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# Ultimaker FDM 3D Printers (plastic)

Information on 3D Printing with the Ultimakers in the 3D Workshop.

# What are the Ultimaker 3D Printers?

In the 3D Workshop there are six Ultimaker 3D Printers for student use.



Ultimaker is a brand of 3D Printer which uses a technique known as [\*\*Fused Deposition Modelling\*\*](#) (FDM) or [\*\*Fused Filament Fabrication\*\*](#) (FFF). This technique uses a string of thermoplastic material (filament) which is pushed through a heated nozzle. The printer lays down melted material at a precise location, which then cools and solidifies, building the print layer-by-layer.

In order to print, you will need a 3D model in the .stl file format. Free models are available online - [\*\*Thingiverse\*\*](#) is a particularly good source. It is also possible to [\*\*3D scan\*\*](#) existing objects. 3D modelling support is available at [\*\*The Digital Space\*\*](#). Once you have your .stl you will need to run it through a program called [\*\*Cura\*\*](#). This is a free software. See our cura guides for [\*\*set up\*\*](#) and [\*\*use\*\*](#).

Here are some video links of the Ultimaker printers in action:

[\*\*How does 3D printing work?\*\*](#)

[\*\*Printing time-lapse Video on the Ultimaker 2\*\*](#)

[\*\*Ultimaker 3D printing with PVA water soluble support on the Ultimaker 3\*\*](#)

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# Which printer should I use?

The 3D workshop has 2 different models of Ultimaker 3D Printers:

- Ultimaker 3
- Ultimaker S5

The **Ultimaker 3** and **Ultimaker S5** have 2 print heads. One head prints PLA plastic. The other head prints support material. The support material supports any overhanging areas while the hot plastic solidifies. This stops any drooping e.g. you would want support under the chin of a person if printing a bust. After printing, the support material can be broken off by hand or with pliers. Some sanding may be needed. For very complex geometries, technicians may instead recommend a dissolvable support material.

The maximum print size of the Ultimaker 3 is **169 x 170 x 198mm**.

The **Ultimaker S5** is the larger of the two printer models. The maximum print size of this machine is **308 x 218 x 298mm**. The larger print size means longer print times - often over 24 hours.. The longer a print runs the more likely it is to fail. Any print over 48 hours has a higher chance of either failing. Set up your file in **Cura** to find out the print time before booking your printer. For prints of over 24 hours, book on a Friday so that you have the printer over the weekend.

Only book the **Ultimaker S5** if you need it for large prints.

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# How do I book the Ultimaker Printers?

<https://indd.adobe.com/view/b16754d2-de69-4aba-a37d-bd2cafe0164c>

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# What materials are available for the Ultimaker 3D Printers?

 We have a range of filaments and colours you can print with. We primarily print with PLA (Polylactic Acid) a fully biodegradable thermoplastic polymer consisting of renewable raw materials. Colours currently available are

- Black
- White
- Silver
- Pearl White
- Magenta
- Red
- Green
- Blue
- Orange
- Yellow

There are also some specialist materials available such as Flexible Plastic, Clear, Wood and ABS. Please contact the workshop to discuss these materials.

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# How much does it cost and how can I pay?

We charge a small fee to cover the cost of materials. PLA costs 43p per meter of material used. Cura can determine the price of the print for you. See how to [set up Cura for the first time](#)

The cost of the print depends on the level of detail and the size of the model. Generally speaking a bust model, 80mm tall with a good level of detail would cost between £1.50 and £2.00.

A technician will email you once your print is completed with a payment link to the [Estore](#). You will need to pay before collection and show your payment confirmation email to technicians. Simply add the amount sent in your email into 'Amount', then 'Add to Basket' and 'Proceed to Checkout'. It will ask you to Register if it's your first time using the EStore (you can always checkout as a guest if you are having problems).

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# Setting up Cura and Preparing Files for Printing

## Setting up Cura and Preparing Files for Printing

### Ultimaker 3 and S5

Download and follow the [Guide: Setting up Files in Cura for Ultimaker FDM plastic 3D Printers](#) and follow all the steps. If you find anything confusing, come into the 3D Workshop and see a technician in the 3D Print room.

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# Using the 3D Printers

## Printing

### **Ultimaker 3 and 3 Extended: How to Print**

You will do this supported by a technician in the workshop. The video is just here if you are interested in seeing the process beforehand.

<https://www.youtube.com/embed/6dV7Q4fHe68>

## Changing Filament

### **Ultimaker 3 and 3 Extended: How to change filament**

<https://www.youtube.com/embed/oFI8vGPQaXM>

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# Ultimaker Useful Resources

The guides below cover a range of print/design considerations in detail.

## **Designing for FDM 3D Printing**

**3D Verkstan** have produced a useful guide on **designing for 3d printing** which is worth reading to get the most out of the Ultimaker 3D printers.

## **Getting Better Prints**

There is also a useful guide on **how to get better prints**.

## **Print Finishing**

There's lots of useful information on the **Ultimaker website**.

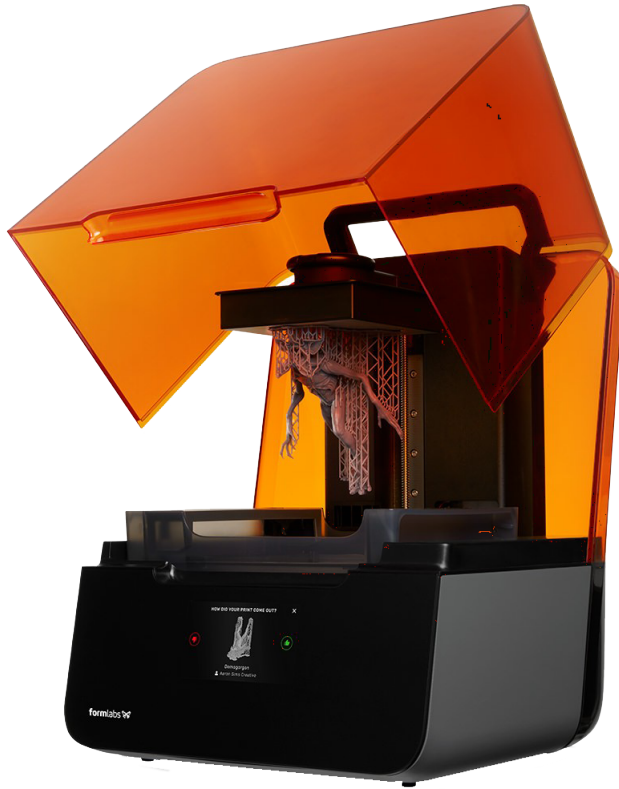
**Make** have created a guide on **finishing and post-processing 3D printed objects** which covers friction-welding, rivetting, sanding and painting.

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# Formlabs SLA 3D Printers (resin)

Information on 3D Printing with the Form Printer in the 3D Workshop.

# What are the Form Printers?



The Form 3 and 3L are desktop stereolithographic 3D printers which makes three dimensional solid objects from a digital file. Prints from the Form's are much more detailed and have a higher quality finish than prints from the Ultimaker printers. They are also more expensive.

Stereolithography (SLA) is a form of 3D printing which uses a UV reactive liquid resin which is selectively exposed to UV light to solidify only the areas that are needed for that layer.

After printing the model are post processed. This involves washing them in a bath of Isopropyl Alcohol to remove excess uncured resin and then exposing the model to UV light in an enclosed box to fully cure the surface. Post processing usually takes 1 hour. You can then cut away any supports that were needed during printing.

The Form is more expensive then the Ultimaker printers so a prototype should first be printed using one of the [Ultimaker](#) machines to test model integrity.

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# Which printer should I use?

The 3D workshop has 2 different models of Form printers.

- Form 3
- Form 3L

The difference between the machines is the maximum print size and the materials they can print.

The **Form 3** can print all materials available. The printing area has a maximum size of **145mm x 145mm x 185mm**.

The **Form 3L** can print in **clear resin only**. The printing area has a maximum size of **335mm x 200mm x 300mm**.

The 3L should only be used for large prints or if the Form 3 is already booked.

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# How do I book the Form Printers?

<https://indd.adobe.com/view/93c1de5e-1c9a-46fb-8bb7-b5433aa7a173>

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# What materials are available for the Form Printers?

The Form prints in hard resin. We have a limited number for colour choices for the Form. You can print in:

- Clear
- White
- Black

You can also print using an elastic resin. This can be used for small molds or parts that need flexibility. The elastic resin is a cloudy see through finish. The elastic resin is more prone to failure during printing and cannot print delicate objects in the same way the hard resins can.

We try to keep all of these options in stock however it is subject to availability. Check with a technician before booking your slot to guarantee we have the material you want.

Prints in hard resin from the Form printers can be spray painted with standard spray paints and hand painted with acrylic based paints.

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# How much does it cost and how can I pay?

We charge a small fee to cover the cost of materials. Clear, black and white resin costs 16p per ml. Elastic resin costs a small amount more - ask technicians. **PreForm**, the software you will download can determine the price of the print for you. See how to [Prepare your file in PreForm](#)

The cost of the print depends the size of the model. Generally speaking a bust model, 80mm tall in clear, black or white resin would cost around £14. The easiest way to print on the Form printers is to print models solid and this means prices increase dramatically as size increases. You can save money on larger prints by hollowing models out but this needs some extra preparation for printing so speak to a technician.

A technician will email you once your print is complete. Before collection you will need to pay for the print via the [Estore](#). Simply add to total amount and pay as you usually do.

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# File Preparation (Preform)

## Setting up and Exporting files in PreForm

### Form 3 and Form 3L

Preform can be downloaded for free [here](#)

Download and follow the [Guide: Setting up Files in PreForm for Formlabs SLA resin printer](#). If you find anything confusing, come into the 3D Workshop and see a technician in the 3D Print room.

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# Wasp Printer (clay)



The Wasp Delta 3D printer is an experimental printer. You should expect to spend a significant amount of time printing. Unlike the other printers in the workshop you must stay with the machine while it is printing. This is because you need to adjust the settings during printing or it will fail. The Wasp is quicker than other printers and a medium sized print will usually take about 1 hour 30 minutes. You can pause the machine at any time.

**Bookings are for one week at a time. You can use the printer anytime during our opening hours during that week.**

Maximum print size is 180mm x 180mm x 350mm

You should have your model ready before your booking. For clay printing the model needs to be a fully closed watertight model, with a top and a bottom - whether the top and bottom are printed will be dictated by you during set up. The clay printer does not print any support material so the model cannot have any sharp overhanging pieces. The model will be prepared for printing in Ultimaker Cura - you will be shown through this during your booked session and given a preset Cura file for you to drag and drop your models into.

Before printing you will need to prepare your clay. It involves mixing water into the clay until you have the right consistency - a Technician will guide you in this. Once you have the right consistency you must scrape the clay against a board to remove any air pockets and then load it into the print cartridge. The print cartridge store the clay in an airtight environment which allows you to leave the prepared clay in the printer overnight, or for up to 3 days. This means you don't need to prepare clay everyday.

We have a small selection of clay stocked in the workshop, usually Paper Porcelain and Terracotta but sometimes other types are available. If using our clay you will pay by the weight of clay used at the end of your printing week. You will only pay for sucessful prints that you want to be fired, any other waste will get recycled. If you wish to use a different type of clay you may have to buy it yourself externally - please consult with a technician first to make sure it will work with the printer.

If you want to print large quantities you will need to buy your own. If you are buying your own clay - Clay with fine grog or crank is better for 3D Printing. Grog and Crank both add texture to the clay which stabilises it while printing. Ensure the it is fine and not coarse, coarse will not extrude through the nozzle.

After the print is complete it will need to dry out for around 1 week. After this inital drying period it is ready for a bisque fire. After the bisque fire the pieces can be glazed and fired again to complete them. The Kiln is in the screen print department and when your prints are fired will depend on the firing schedule and what else is ready to be fired. The entire process will usually take at least a month so ensure you allow plenty of time for your pottery project.

You will have to disassemble the cartridge and print head and clean them thoroughly if you want to change between different types of clay, and at the end of the project. This whole process takes about 40 minutes.

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# Mimaki Inkjet 3D Printer (full colour)



The Mimaki is a high resolution full colour printer which produces highly detailed colour 3d prints. It is the most costly printer in the 3D workshop due to the materials involved and level of detail, so its ideal use is for the production of end-of-project outcomes, final pieces, or exhibition work. The intended use is not for batch production of models or for creating products for sale. The Mimaki print bed is not large and students should not expect to print models exceeding 12cm in height.

## **How do I book the Mimaki?**

The Mimaki full colour printer bookings are consultation based – a technician will look at your model with you and decide if its ready to print. Student models on the Mimaki are batch printed, meaning that multiple student files will be collected and then printed together to save time. This means that your print will not start on the same day as your consultation. Your print will usually be ready within a week from the date of your consultation – please allow time for this in your production and understand that printing is not instant.

In the case that your model needed a considerable amount of work to be print-ready, a technician may advise you to work more on your model and then book a second consultation slot when the model is finished. All consultation slots are booked on the Orb. You are able to come to the workshop or email a technician any time if you have some informal questions about the printer, or want to look at the samples we have in the workshop.

If you cannot see the Mimaki on the ORB, come and chat with a technician in the workshop.

### **What material does the Mimaki print with**

The Mimaki prints with resin. The core of most models will be made of solid white resin, with a full colour shell deposited around the outside of the model only. The mimaki also has the ability to print in clear resin. Clear resin comes out slightly yellow tinted, but can have a minimal amount of violet added to counteract this. Any colour tint can be added to the clear resin, however this will affect the visibility. Clear resin can be polished to be totally transparent, however this will only work on models with forms that are simple enough to be polished and buffed. The printer can print in both full colour solid and transparent at the same time. Models that require both clear and solid colour parts require a bit of additional setting up, which we will go through during your booked consultation time as we prepare the model for printing.



### **What file type do I need for printing on the Mimaki?**

The Mimaki works best with .obj files. These files can be exported out of any software, and usually come accompanied by a .mtl file which contains the colour data. Some .mtl files need a .jpg file to read the colour from. Please bring all three with you to your consultation booking. It is also ideal if you bring a laptop with our original working files on your software of choice. For files with both solid colour parts and transparent parts, you will need one exported .obj containing the solid colour components, and one .obj containing just the clear components. We will set the clear components to print clear on the Mimaki software. It is ideal if these are exported from the same file so that they import in the right position.

### **How much does it cost?**

The Mimaki is the most expensive printer in the workshop and as such should be used primarily for printing outcomes and final pieces. A model of about 7cm in height could cost anywhere between £10 - £25, depending on how dense it is. A technician will be able to provide a cost during your consultation, and we can adjust the size of the print according to your budget.



any questions should be emailed to [3dworkshop.lcc@arts.ac.uk](mailto:3dworkshop.lcc@arts.ac.uk).

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