

## Ormerod 3D printer review

**Dr Jonathan Hare, The Creative Science Centre, [www.creative-science.org.uk](http://www.creative-science.org.uk)**

The Ormerod Rep Rap 3D printer is supplied as a kit which I had to assemble, set-up and calibrate. As I travel a lot with my work, I built the printer over a few sessions when I was at home. Adding up the time it probably took me about 10-12 hours to assemble the printer and then a bit longer than this to properly set it up and overcome the odd technical problem and drive the software etc.

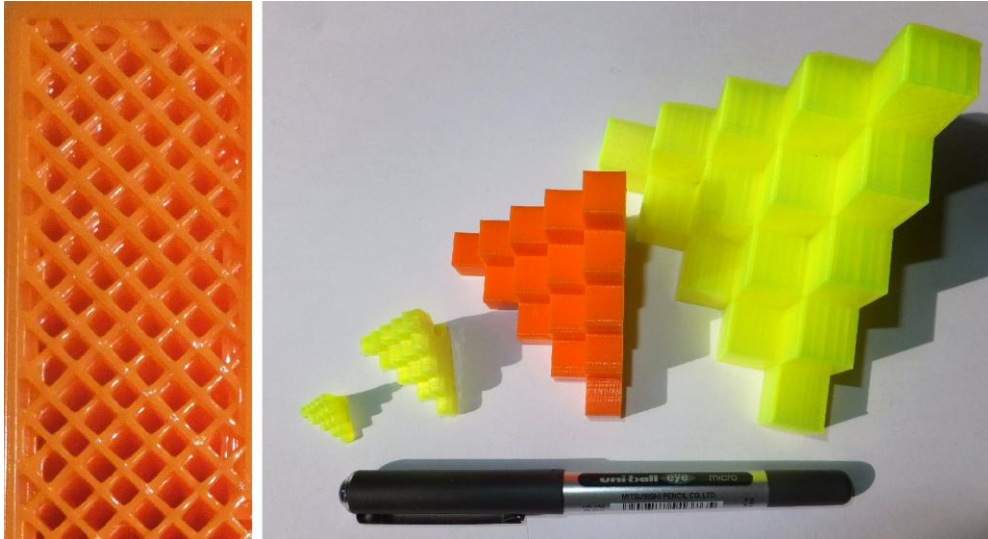


**Why purchase a kit when I can buy one ready-made?** - The advantage of buying a ready-made 3D printer is that you can immediately plug it in and print things out. With the kit there is the considerable investment in time and effort required to build and calibrate the printer. However it's a lot cheaper and (importantly) by assembling it you get to understand each part of the printer. If things go wrong you will probably be much better prepared to fix it yourself or at least you will know the right question to ask at the help-line or the on-line forum.

**Construction, testing and calibration** -There are extensive instructions on the Rep Rap web site for assembling the printer which are constantly being reviewed and improved. These instructions obviously cannot include every mistake or misunderstanding that someone could make assembling a complex device like a 3D printer. So I studied the web pages as much as possible (including the diagrams and pictures that link from the web pages), looked at the forum and if all else failed, contacted the Rep Rap technical staff (who were very helpful). I had a few minor problems which we sorted out. The most serious issue was with the nozzle assembly – the bit that heats the plastic to print the object. I had to make up a small spacer to ensure the printing head was slightly lower than the rest of the moving parts to ensure reliable printing.

There is quite a lot of precise and technical setting-up and calibration required in the hardware and the software to get the printer to work properly. The website constantly advises you to up-date the firmware; and it's worth it. However this requires some experience using windows, DOS and a good understanding of your computer's file structure. There are a lot of new things that have to be absorbed, understood and played around with until you understand the correct procedure to install and set everything up – it's worth it though.

**Drawing packages** - I have tried various 3D drawing packages including Sketchup and Tinkercad. My favourite is OpenScad which allows you to create complex objects using code that can be easily adjusted and modified. These can be saved as a .stl format and then the Slic3r program (recommended by Rep Rap) can be used to convert this to a .g file that can be printed. The .g files can be loaded directly onto the memory card. A simple mouse-click (via the Ormerod web interface) starts the printing process. It sounds a bit complicated but is actually straightforward when you have done it a few times.

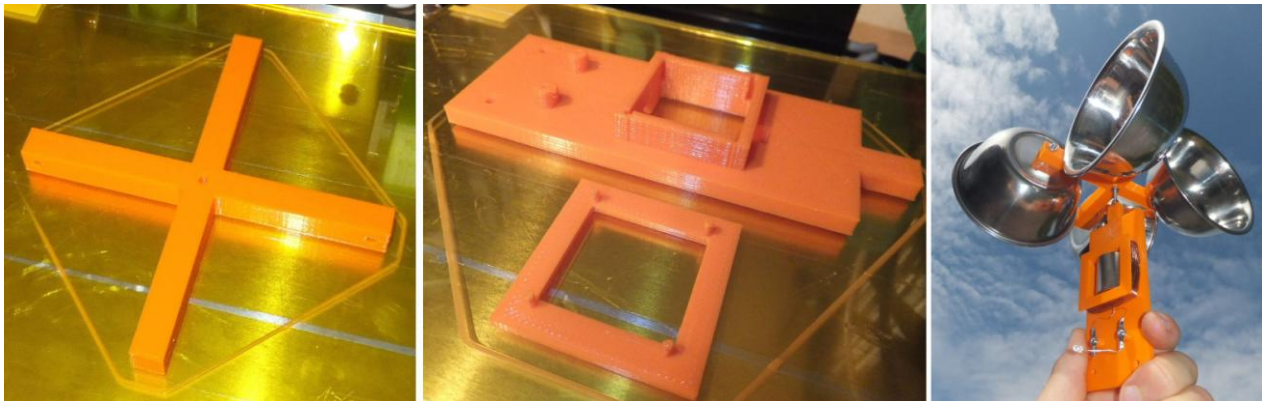


**Quality of print-** I was really impressed with the quality, strength and stiffness of the plastic prints produced by my Ormerod. Depending on the intricacies of the print you do sometimes get a few extraneous flecks of filament on the surface but these can easily be removed by hand or knife. The printer usually creates a smooth outer layer, while the inside is built-up of a cross-hatch lattice work (i.e. it's not solid, see photo above). These tiny square and triangular intersections create a very rigid, but light structure.

To investigate how this internal structure effects the final weight and strength of a printed object, I downloaded a pyramid shaped object ([www.thingiverse.com/thing:24238](http://www.thingiverse.com/thing:24238)) and used Slic3r to scale the edge size by 50%, 100%, 200% and 300%. Because of this internal lattice the printed objects are lighter than they look. The largest pyramid (300%, shown right) is ( $3^3$ ) 27 times the volume of the original file (100%, second left) but when printed it turns out to be about 15 times rather than 27 times heavier. The exact figures will no doubt vary depending on the software settings and nozzle diameter used. The low densities mean the prints use up less filament than I expected yet the prints are light and strong.



**4 cup wind generator** – shown above is a simple 4-cup wind-generator (anemometer) I made from Perspex using a router, band saw, set of drills, files and other tools. The cross piece that holds the cups is tricky for a beginner to make by hand. It's not easy with hand tools to make sure the shaft channel is straight and true, so I decided make a 3D printed version to compare.



The 3D printer easily tackles this sort of job, you can create complex shapes and 'cut-outs' (e.g. to house the magnet, magnet nuts and make a coil former for the wire) that takes time and patience by hand. The 3D printed plastic is probably less fragile than Perspex. The parts shown in the photos took about 3 hours to print. Of course if you want to modify something – to try a different magnet etc. - you simply change the 3D file and print out a slightly different version, which is a lot easier than starting again by hand.

The printer not only helps my research but also my teaching. For example if I wanted to make up 20 of the Perspex structures for a science workshop it may take me a lot of time to prepare them with standard tools. If it was a workshop for 50 people I would probably think about doing another activity. Using the 3D printer however I can simply print-off a many as I like, leaving the printer to do the work while I go off and do other things with my time. Without a 3D printer getting all the parts together for the workshop may take a couple of days of prep, with the printer just a few hours!

**Summary** - Although it took me longer to build, calibrate and set-up the printer than I had first imagined, the whole processes has given me a practical hands-on introduction and experience to 3D printing. I am really enjoying exploring what it can do. If you are interested in getting into the wonderful world of 3D printing - especially if you really want to use it for useful applications - I would really recommend the Ormerod Rep Rap printer.

**Thanks** - My thanks to Ian from the Rep Rap technical staff and Tracey Taylor from RS components for supplying me with the Ormerod 3D printer kit.

For a much more detailed description of my experiences building the Ormerod and also for science based 3D projects, please see my Creative Science Centre web site at: [www.creative-science.org.uk/3D.html](http://www.creative-science.org.uk/3D.html)

.....

**JPH 6<sup>th</sup> August 2014**