

# Dyson Centre 3D Printing with the Ideawerk Machines



# Overview

- Ideawerk Machines and Familiarisation
- Materials
- Obtaining Things (STL Files) to Print Online (Thingiverse)
- ...Or Getting an STL File from Your CAD Package
- Checking for Error Free STL File ([viewstl.com](http://viewstl.com))
- Processing Your STL File For the 3D Printer (gives WTK File)
- Printing you WTK on the 3D Printer
- Charging for Materials Used
- Health and Safety (Burns, Entrapment, Gassing and Fires!)

# Machines and Familiarisation

# Machines Available

- Dyson Centre has 5 IdeaWerk (RS machines) available plus spares:

## IdeaWerk™ Plus Desktop 3D Printer Model : WT280A



Maximum  
component  
size:  
150mm x  
150mm x  
140mm high.

- Also some Ultimaker machines available, though these have many more settings, and can make larger parts, though this can take a lot longer.

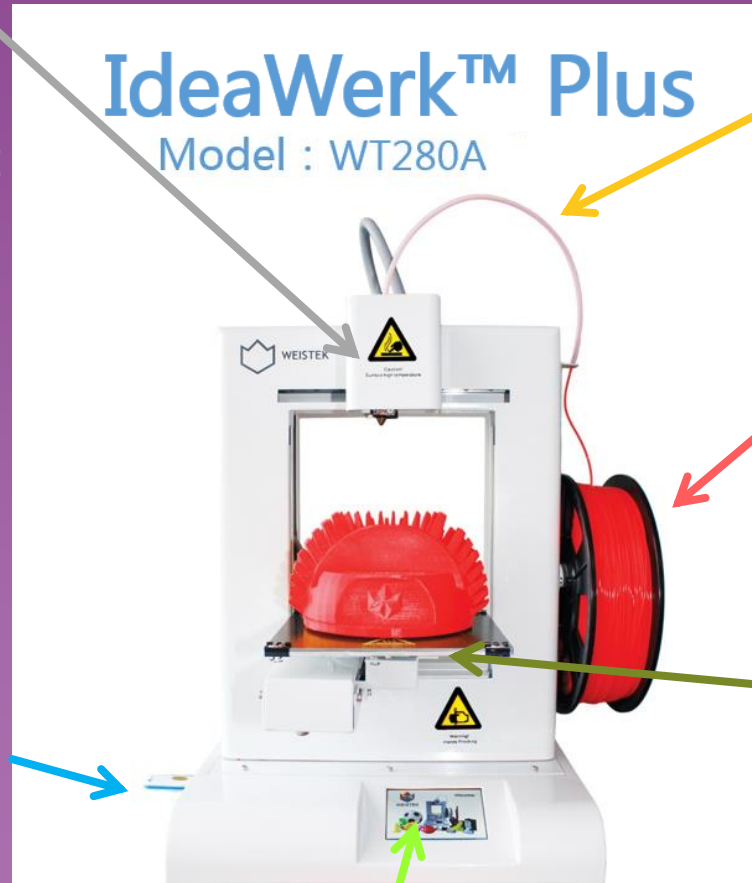
# Machine Familiarisation

## Extruder head

- Moves side-to-side
- Mechanism to draw filament in.
- Then heats filament above melting point.
- Small nozzle out of which molten plastic forced.

USB stick for file transferring to printer

On-off switch on rear



**IdeaWerk™ Plus**  
Model : WT280A

Filament is drawn through low friction tube

Reel of 1.75mm diam. filament (different colours/types available)

## Platform

- Moves front-and-back and up-and-down.
- Can be heated (necessary for some jobs).
- Thin removable sheet (bed) is clipped to platform – this is what is printed into.

Touch screen for operating printer

# Machine Familiarisation

Extruder can have temperature set to anywhere between 190 and 280 degC



Platform can have temperature set to anywhere between room temperature and 100 deg C

- Ability to set both temps. governs ability to print different materials.
- The extruder must be able to melt the material to be printed.
- Bed heating is to prevent shrinking on cooling and warping off the bed.
- Caution also has to be given to any dangerous gases which might be given off on heating a material – don't assume it is safe!!!

# Materials Available

# Materials Available: PLA

- Noting previous slide (about machine capabilities)
- We have available:
  - PLA (polyester called polylactic acid or polylactide)
    - It is derived from renewable sources such as corn starch.
    - It is biodegradable and recyclable
    - Extruder temperature 220 deg C
    - Bed temperature 70 deg C for anything of significant size
    - Currently stocking natural (off white), red, blue, yellow, black
    - We could order-in white, clear, grey, green, purple for around £25 per kg (for reasonable quality filament).
    - Also (for up to twice the cost) fluorescent colours, gold colour, translucent filament, thermochromatic and photochromatic colours wood colours, filaments with sparkly inclusions.
  - "PLA is an organic material, often made from corn starch or sugar cane, making it quite safe to use as far as fumes are concerned. Currently there is very limited official information available about the effects of PLA on our health."  
Taken from <http://3dprintheq.com/desktop-3d-printer-safety/>







SKY BLUE

€35.95



ULTRA MARINE BLUE

€35.95



BLUE GREY

€35.95



BLUISH WHITE

€35.95

0.75kg spools



LILA

€35.95



MAGENTA

€35.95



FLUORESCENT PINK

€35.95



TRAFFIC RED

€35.95



WARM RED

€35.95



DUTCH ORANGE

€35.95



OLYMPIC GOLD

€35.95



SIGNAL YELLOW

€35.95

0.75kg spools



FLUORESCENT GREEN

€35.95



INTENSE GREEN

€35.95



LEAF GREEN

€35.95



MINT TURQOISE

€35.95

[HOME](#)[PLA / PHA](#)[CO-POLYESTERS](#)[SPECIALS](#)[SAMPLES](#)[VALUE PACK](#)[PELLETS](#)[PRINTERS](#)**RED TRANSPARENT**

€35.95

**ORANGE TRANSLUCENT**

€35.95

**YELLOW TRANSPARENT**

€35.95

**GREEN TRANSPARENT**

€35.95

0.75kg spools

**NATUREL**

€35.95

**PALE GOLD**

€35.95

**GREENISH BEIGE**

€35.95

**OLIVE GREEN**

€35.95

[HOME](#)[PLA / PHA](#)[CO-POLYESTERS](#)[SPECIALS](#)[SAMPLES](#)[VALUE PACK](#)[PELLETS](#)[PRINTERS](#)**STANDARD BLACK**

€35.95

**STANDARD WHITE**

€35.95

**SHINING SILVER**

€35.95

**CHOCOLATE BROWN**

€35.95

0.75kg spools

**LIGHT BROWN**

€35.95

**Violet Transparent**

€35.95

# Materials Available: ABS

No Longer Used and  
Stocked by Dyson Centre

- We also have available:
  - ABS (acrylonitrile butadiene styrene)
    - It is made from fossil fuels!
    - "A few studies have shown ABS fumes to be toxic to rats and mice and there is a fair chance that ABS fumes are more harmful than PLA fumes, mostly due to higher levels of emissions and higher toxicity." "Recent studies have shown that ABS emits around 10 times as many UFPs (Ultra Fine Particles) as PLA when heated, again making ABS more likely to affect our health than PLA."  
Taken from <http://3dprintheq.com/desktop-3d-printer-safety/>
    - It is recyclable
    - Some biodegradable versions now coming on market, but not normally!
    - Extruder temperature 240 deg C
    - Bed temperature 100 deg C (or higher if possible) always!
    - Currently stocking gold only.
    - A range of colours are available.
    - Technically stronger than PLA, however doesn't bond to itself as well: resulting 3D printed parts are about same strength as PLA.
    - A little bit more temperature resistance than PLA.



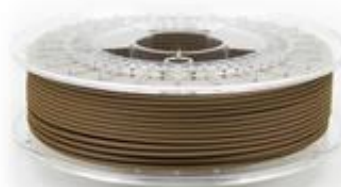


# Materials Available: Others

- Many other options available:
  - Metal laden filaments
  - Wood laden filament (sometimes referred to as wood)
  - Flexible filaments
  - HIPS (High Impact Polystyrene) which is dissolvable...might be useful for making a mould which can later be dissolved away.
  - PC (polycarbonate)
  - PA (polyamide)
  - PVA (poly vinyl alcohol) which is water soluble...useful for moulds?
  - Nylon
- Need to consider:
  - Availability (in 1.75mm diameter filament) / cost
  - Safety of fumes
  - How well our printers work with them
  - If the printer may be harmed by using them (e.g. acidic compounds given off on heating), wear caused by carbon fibre laden filaments

[HOME](#) [PLA / PHA](#) [CO-POLYESTERS](#) **SPECIALS** [SAMPLES](#) [VALUE PACK](#) [PELLETS](#) [PRINTERS](#)**XT-CF20**

€49.95

**CORKFILL**

€39.95

**BRASSFILL**

€59.95

**BRONZEFILL**

€49.95

0.75kg spools

**COPPERFILL**

€49.95

**WOODFILL**

€39.95

**BAMBOOFILL**

€39.95

**GLOWFILL**

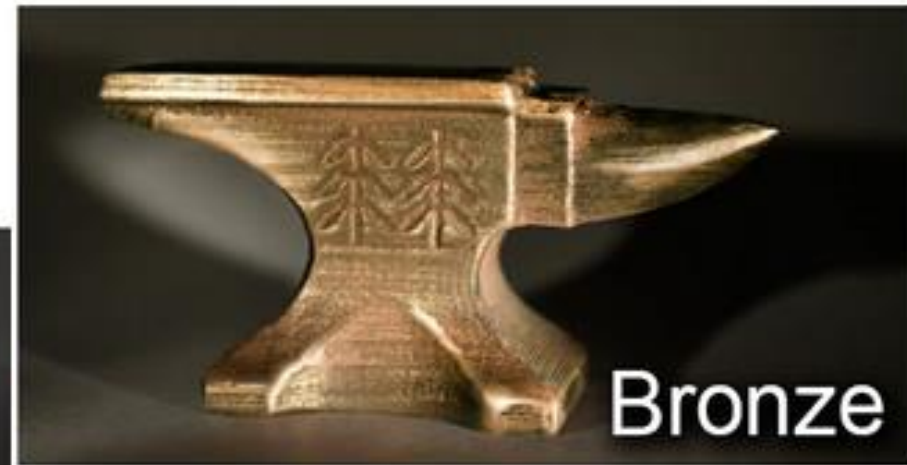
€39.95

[View All Tags](#)

KG

e to order, each item  
d-time.

...after polishing the printed metal-filled-PLA:

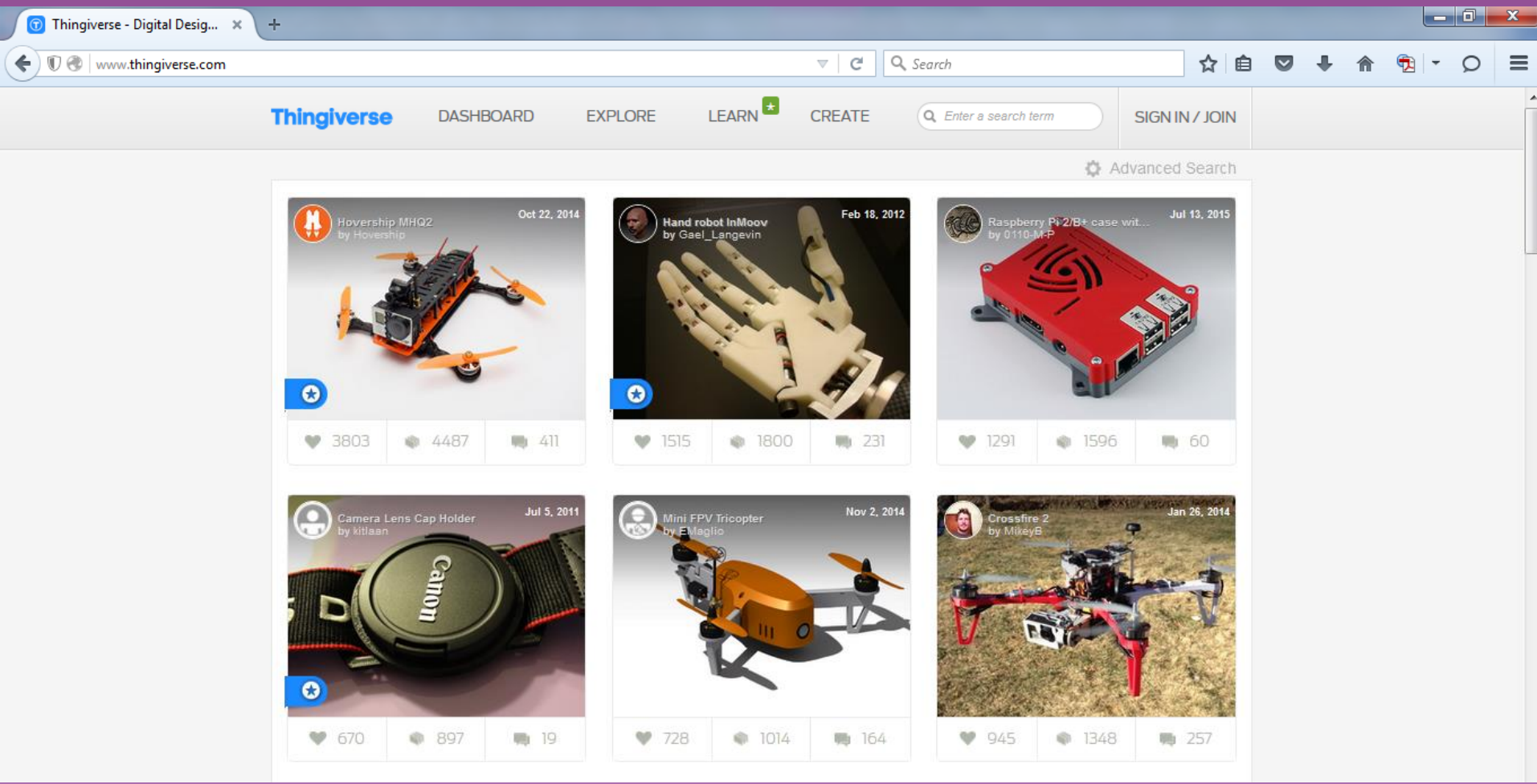




# Obtaining Things (STL Files) to Print Online ...Or Obtaining STL Files from CAD Packages

# Obtaining Things (STL Files) to Print

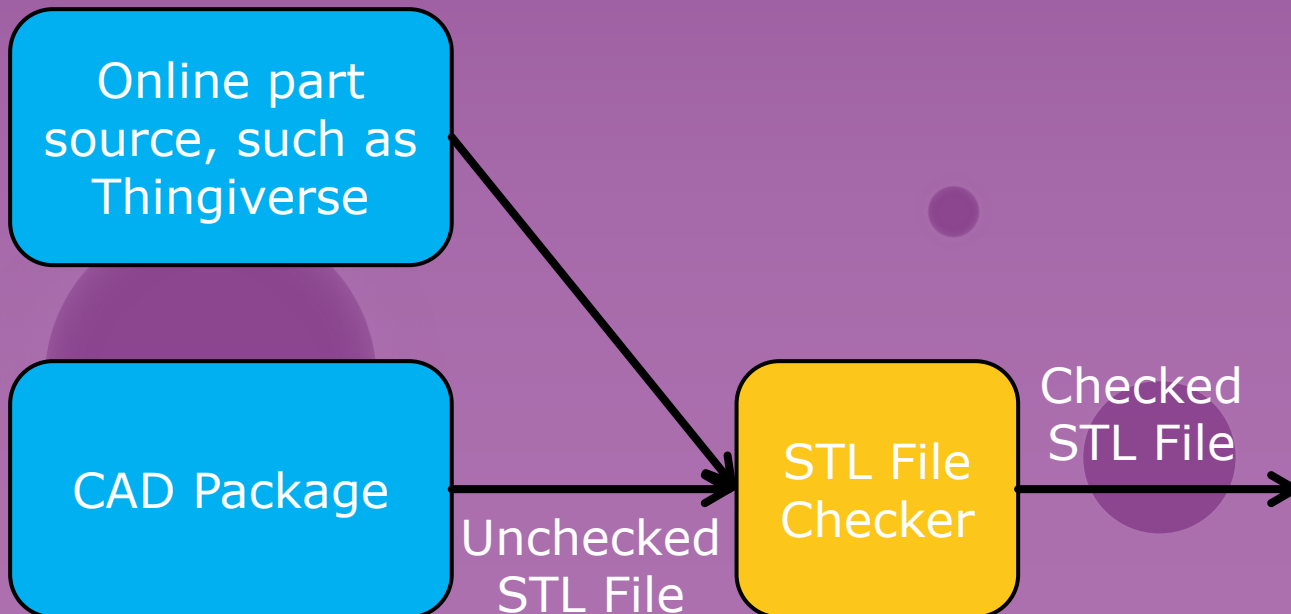
- Either create something to print using favourite 3D drawing package
- Or find something online you'd like to print and download its STL file:
  - Sites such as Thingiverse (a universe of things!) makes this very quick/easy:



# STL Files: Issues and From CAD

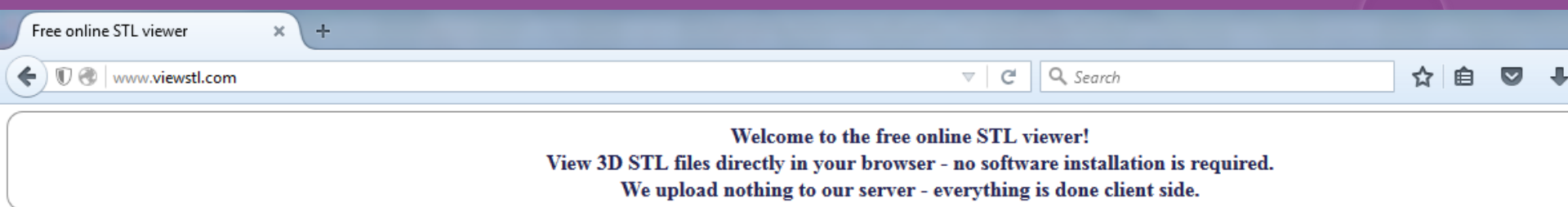
- If using Thingiverse or similar, the file type for download is an STL file.
    - STL: Standard Triangle/Tessellation Language
  - If drawing in your favourite 3D drawing package, such as:
    - [formerly Google's] Sketchup
    - IronCAD
    - Creo (Pro-Engineer)
    - McNeel Rhino
    - Solidworks
    - Solid Edge
    - AutoDesk Inventor
    - UGS NX
    - Catia
- ...see [www.dysoncentre.eng.cam.ac.uk/stl](http://www.dysoncentre.eng.cam.ac.uk/stl) for help outputting STL files.  
Note that molten plastic has to be supported, so consider adding supports in your model – we'll return to this later on!
- Important: STL file generation very sensitive to settings
    - Need to check the STL file provides closed (watertight) surfaces.
    - Still the case with Thingiverse STL files, or if file has been 3D printed before.  
(Because different printer software processes STL files in differently)

# Checking Your STL File For Errors



# Checking Your STL File For Errors

- A quick check of STL files can be done with a viewer
  - E.g. go to [www.viewstl.com](http://www.viewstl.com) and drag/drop (or upload) your (<35MB) STL file.




\* New - embed Viewstl.com in your own website!

**ecg enclosure v2.stl**  
Version 2 of file!

## Model info

Size ( mm ) 157 x 153 x 29  
Volume (mm<sup>3</sup>) 136,625  
File units ☒ mm ☐ in

## Options

Display ☒ Flat Shading ☐ Smooth Shading ☐ Wireframe  
Color   
Auto-rotation ☒ Yes ☐ No

# Checking Your STL File For Errors

- A quick check of STL files can be done with a viewer
  - E.g. go to [www.viewstl.com](http://www.viewstl.com) and drag/drop (or upload) your (<35MB) STL file.

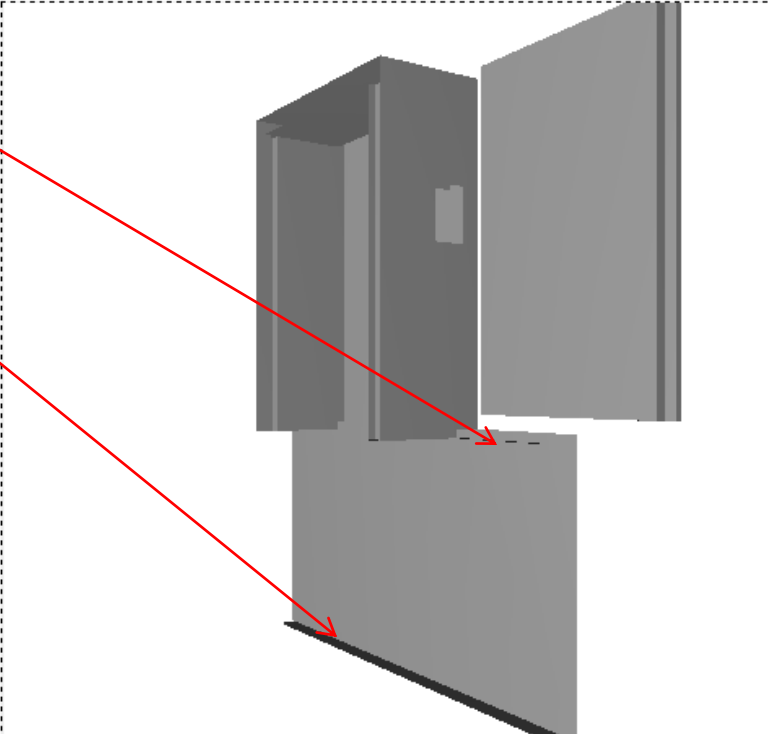
Free online STL viewer

www.viewstl.com

Welcome to the free online STL viewer!  
View 3D STL files directly in your browser - no software installation is required.  
We upload nothing to our server - everything is done client side.

\* New - embed Viewstl.com in your own website!

Maybe something odd going on here and here



The image shows a 3D model of a mechanical part, possibly a bracket or enclosure, rendered in a light gray color. Two red arrows originate from the text 'Maybe something odd going on here and here' and point to specific areas of the model: one points to a small gap or misalignment at the top of a vertical section, and the other points to a sharp, thin protrusion or gap at the bottom of the same section.

**ecg enclosure v2.stl**  
Version 2 of file!

**Model info**

|                           |   |
|---------------------------|---|
| Size ( mm )               | 157 x 153 x 29  |
| Volume (mm <sup>3</sup> ) | 136,625   |
| File units                | <input checked="" type="radio"/> mm<br><input type="radio"/> in |

**Options**

**Display** ☒ Flat Shading  
☐ Smooth Shading  
☐ Wireframe

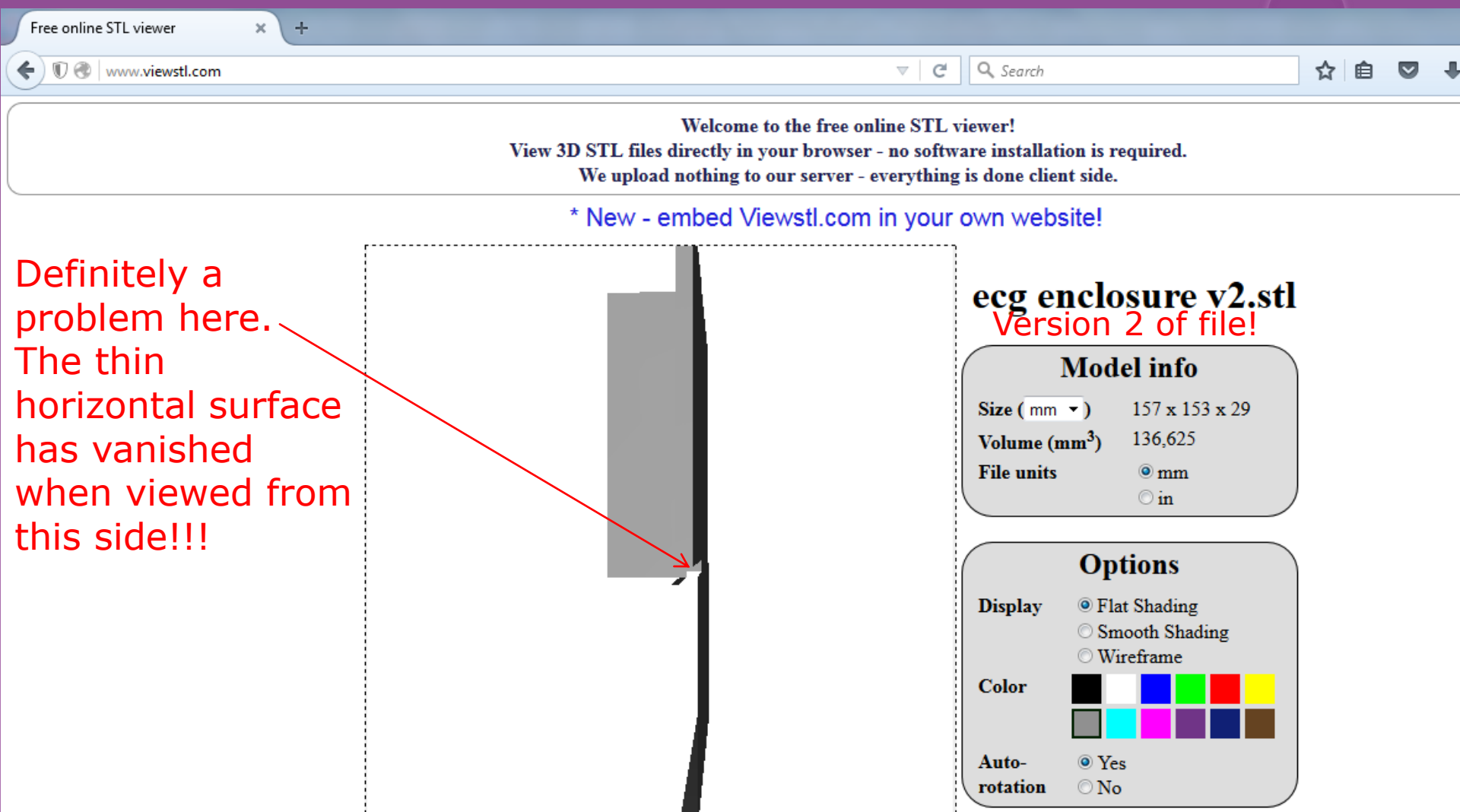
**Color**

|  |                             |                               |                              |                                 |                              |
|--|-----------------------------|-------------------------------|------------------------------|---------------------------------|------------------------------|
| <input checked="" type="radio"/> Black | <input type="radio"/> White | <input type="radio"/> Blue    | <input type="radio"/> Green  | <input type="radio"/> Red       | <input type="radio"/> Yellow |
| <input type="radio"/> Gray             | <input type="radio"/> Cyan  | <input type="radio"/> Magenta | <input type="radio"/> Purple | <input type="radio"/> Dark Blue | <input type="radio"/> Brown  |

**Auto-rotation** ☒ Yes  
☐ No

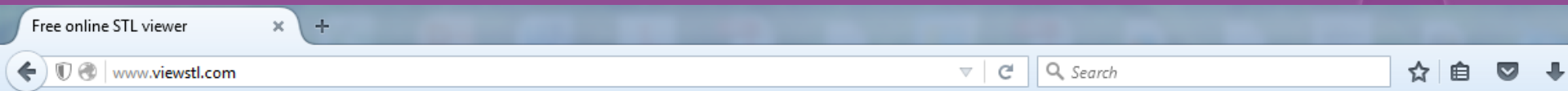
# Checking Your STL File For Errors

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# Checking Your STL File For Errors

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  - E.g. go to [www.viewstl.com](http://www.viewstl.com) and drag/drop (or upload) your (<35MB) STL file.



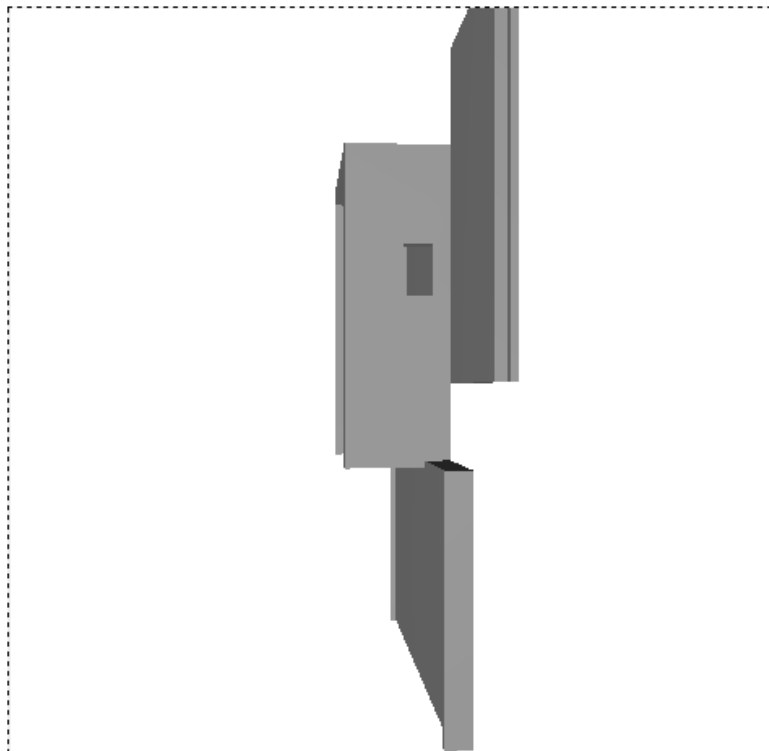
Welcome to the free online STL viewer!  
View 3D STL files directly in your browser - no software installation is required.  
We upload nothing to our server - everything is done client side.

\* New - embed Viewstl.com in your own website!

This user then re-exported their STL file using different settings, and the problem seems fixed in this view.

Note: it takes seconds to check in this way.

The file won't print properly with 'issues' so tends to waste a few hours of printing time.




**ecg enclosure v3.stl**  
Version 3 of file!

## Model info

Size ( mm ▾ ) 174 x 170 x 29  
Volume (mm<sup>3</sup>) 114,956  
File units ☒ mm ☐ in

## Options

Display ☒ Flat Shading ☐ Smooth Shading ☐ Wireframe  
Color   
Auto-rotation ☒ Yes ☐ No



# Checking Your STL File For Errors

- A quick check of STL files can be done with a viewer
  - E.g. go to [www.viewstl.com](http://www.viewstl.com) and drag/drop (or upload) your (<35MB) STL file.

Free online STL viewer

www.viewstl.com

Welcome to the free online STL viewer!  
View 3D STL files directly in your browser - no software installation is required.  
We upload nothing to our server - everything is done client side.

\* New - embed Viewstl.com in your own website!

Also important to keep an eye on the size of your model: the IdeaWerk machine can print at most 150mm x 150mm x 140mm high. Note that you can print long thin parts diagonally if that helps. In this case, we could scale down the size of the part (see later on using DoreWare-P). Note that excessive scaling down can reduce part thicknesses beyond what is practically printable/durable.

**ecg enclosure v3.stl**  
Version 3 of file!

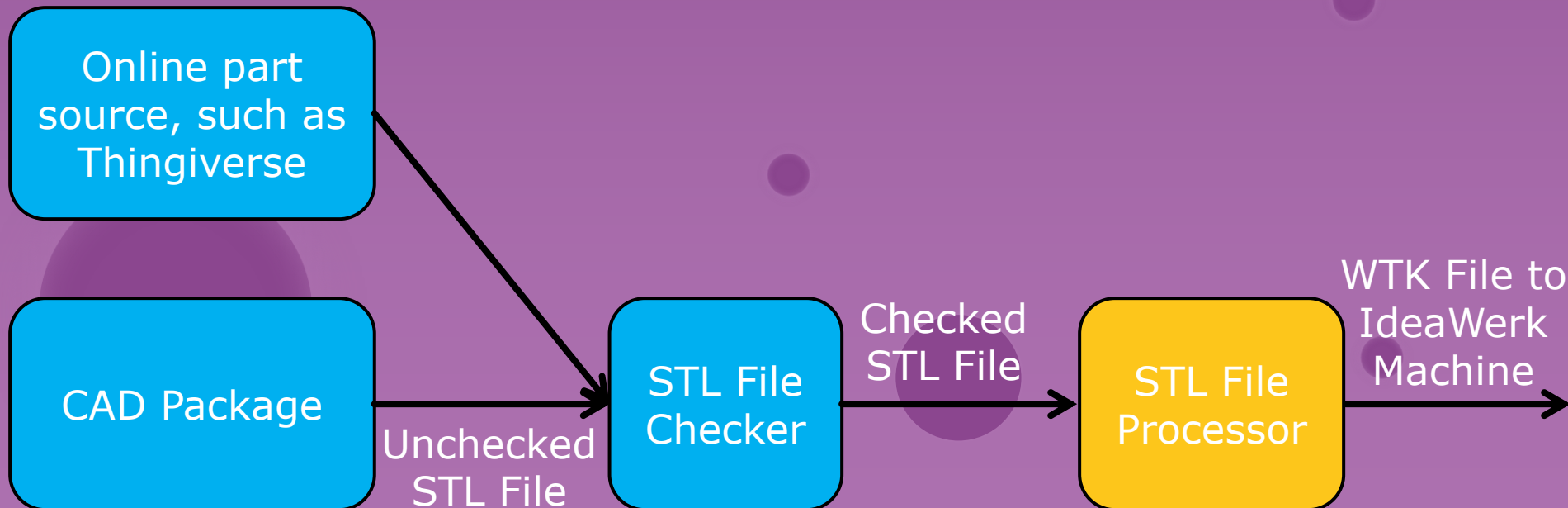
**Model info**

|                           |   |
|---------------------------|---|
| Size ( mm )               | 174 x 170 x 29  |
| Volume (mm <sup>3</sup> ) | 114,956   |
| File units                | <input checked="" type="radio"/> mm<br><input type="radio"/> in |

**Options**

|               |   |
|---------------|---|
| Display       | <input checked="" type="radio"/> Flat Shading<br><input type="radio"/> Smooth Shading<br><input type="radio"/> Wireframe  |
| Color         | <input type="radio"/> Black <input type="radio"/> White <input type="radio"/> Blue <input type="radio"/> Green <input type="radio"/> Red <input type="radio"/> Yellow<br><input type="radio"/> Grey <input type="radio"/> Cyan <input type="radio"/> Magenta <input type="radio"/> Purple <input type="radio"/> Dark Blue <input type="radio"/> Brown |
| Auto-rotation | <input checked="" type="radio"/> Yes<br><input type="radio"/> No  |

# Processing Your STL File For the 3D Printer

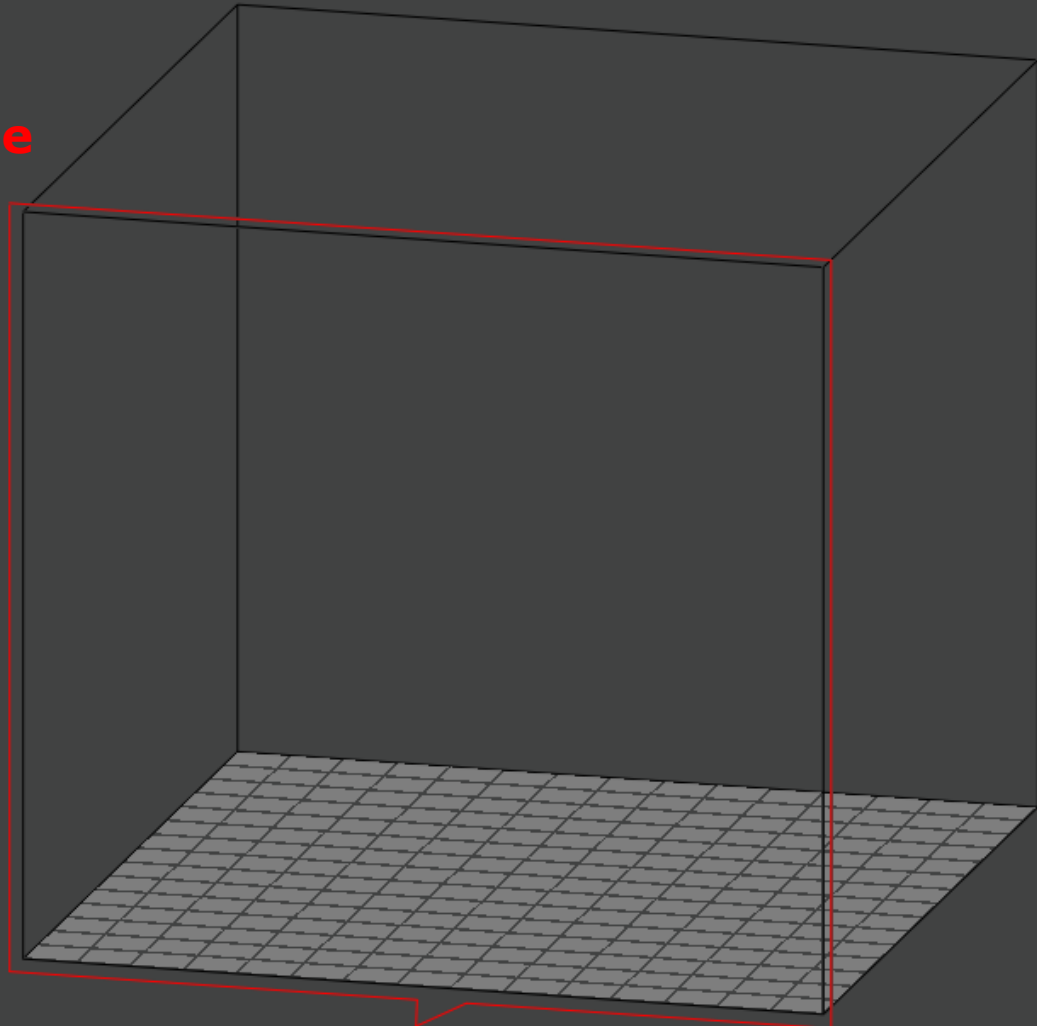


# Processing STL Files

- To process the STL file into a WTK file which can be fed into the IdeaWerk machine, we use a package called DoreWare-P.
- You can install this on your own PC at your own risk from:  
[www.dysoncentre.eng.cam.ac.uk/3dp](http://www.dysoncentre.eng.cam.ac.uk/3dp)  
or it is installed on the machine/s indicated near the 3D printers.
- The software takes the arrangement of triangles in 3D space, which represent your surface/s and turns them into instructions for making 2D layers.
- Instructions for such machines (including CNC milling machines) is known as G-code, which is instructions such as move X by so many millimetres, or move in an arc in the XY plane, centred on this point, etc.
- DoreWare-P modifies the G-code slightly into a WTK file format. Other 3D printers have other file formats (such as .makerbot, etc).



**Use this button to  
import your STL file**





**Manipulate the object (you may need to click on your object first to make symbols appear) using...**

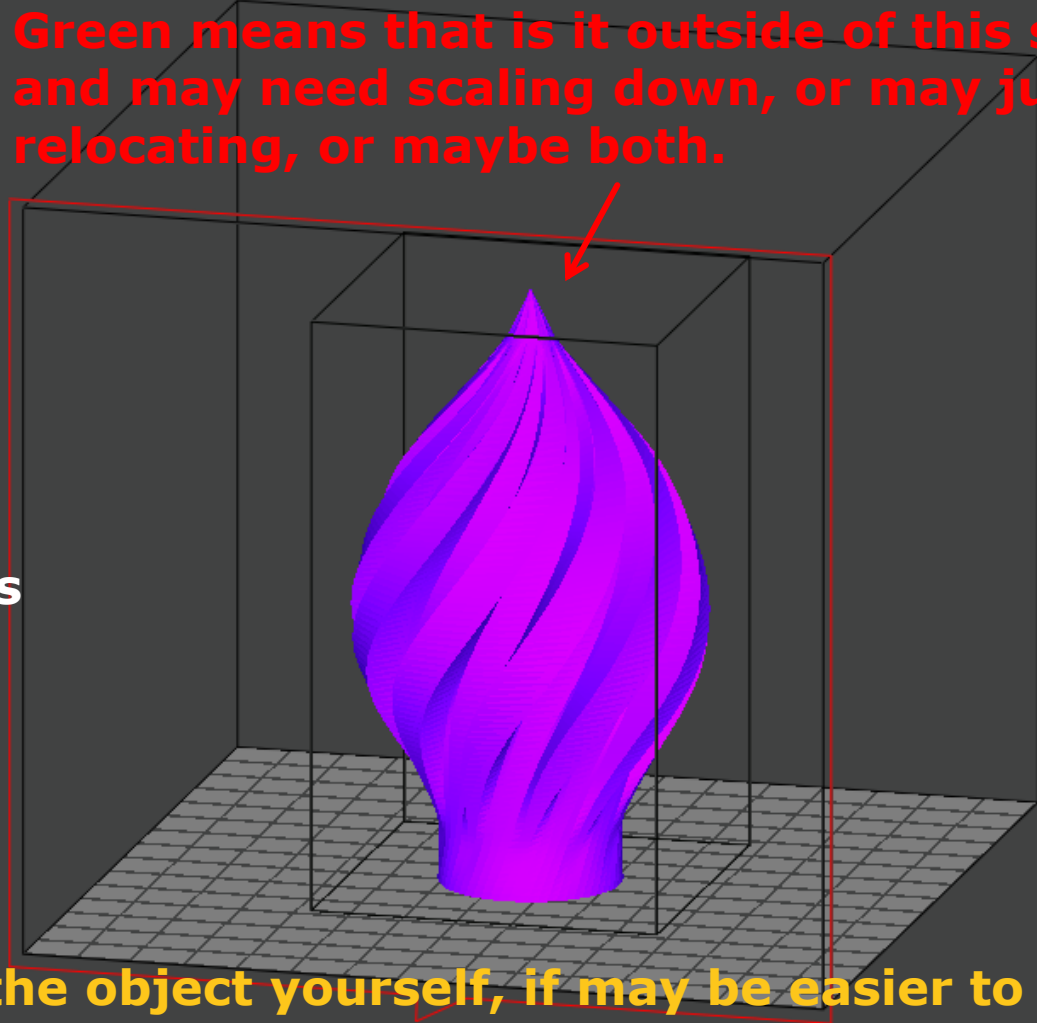


**←x, y, z translations**

**←x, y, z rotations**

**←scaling – all axes simultaneously**

**Purple means it will fit within what the IdeaWerk machine can print.  
Green means that is it outside of this space and may need scaling down, or may just need relocating, or maybe both.**



**...or if you made the object yourself, it may be easier to do more specialist 'tweaks' in the original drawing package.**



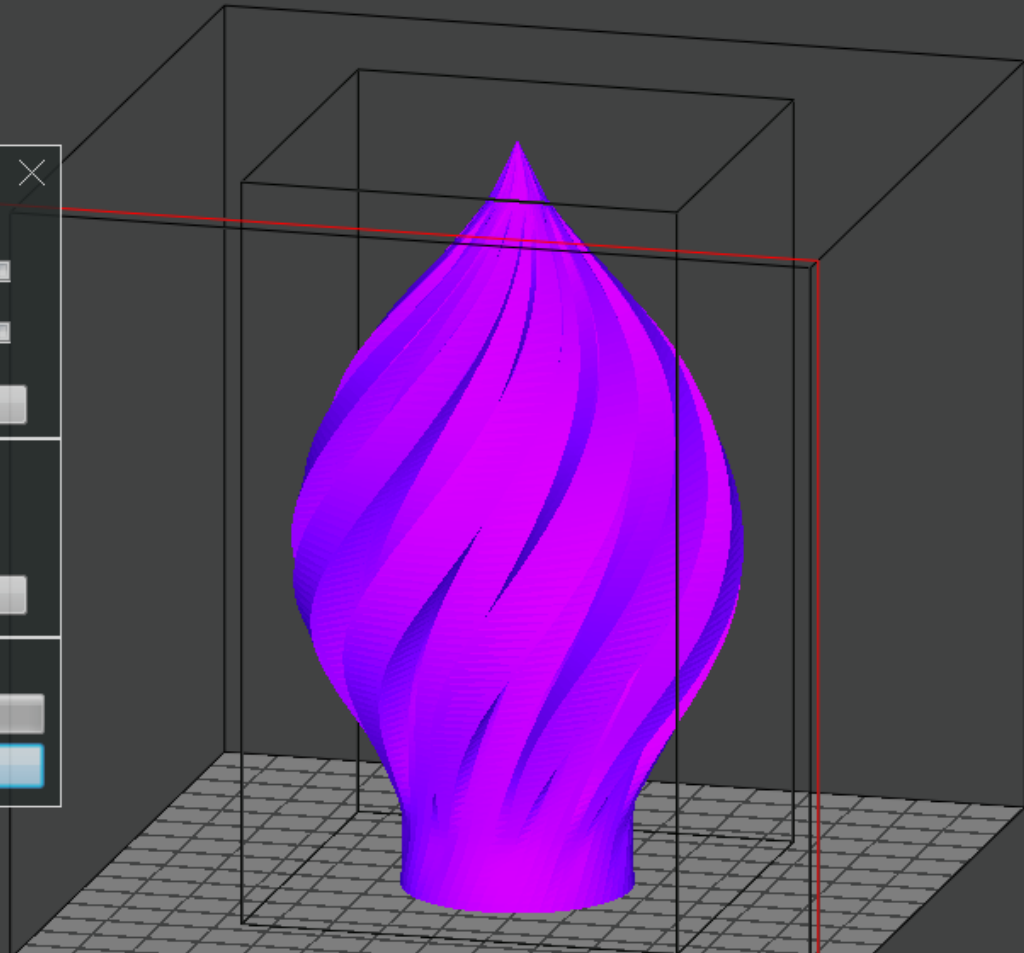


Fill Density: Medium(30%)  
Layer Height: 0.2  
Shells: Normal  
Print Speed: Standard

Raft: ☒  
Exterior Support: ☐  
Full Support: ☐  
Reset

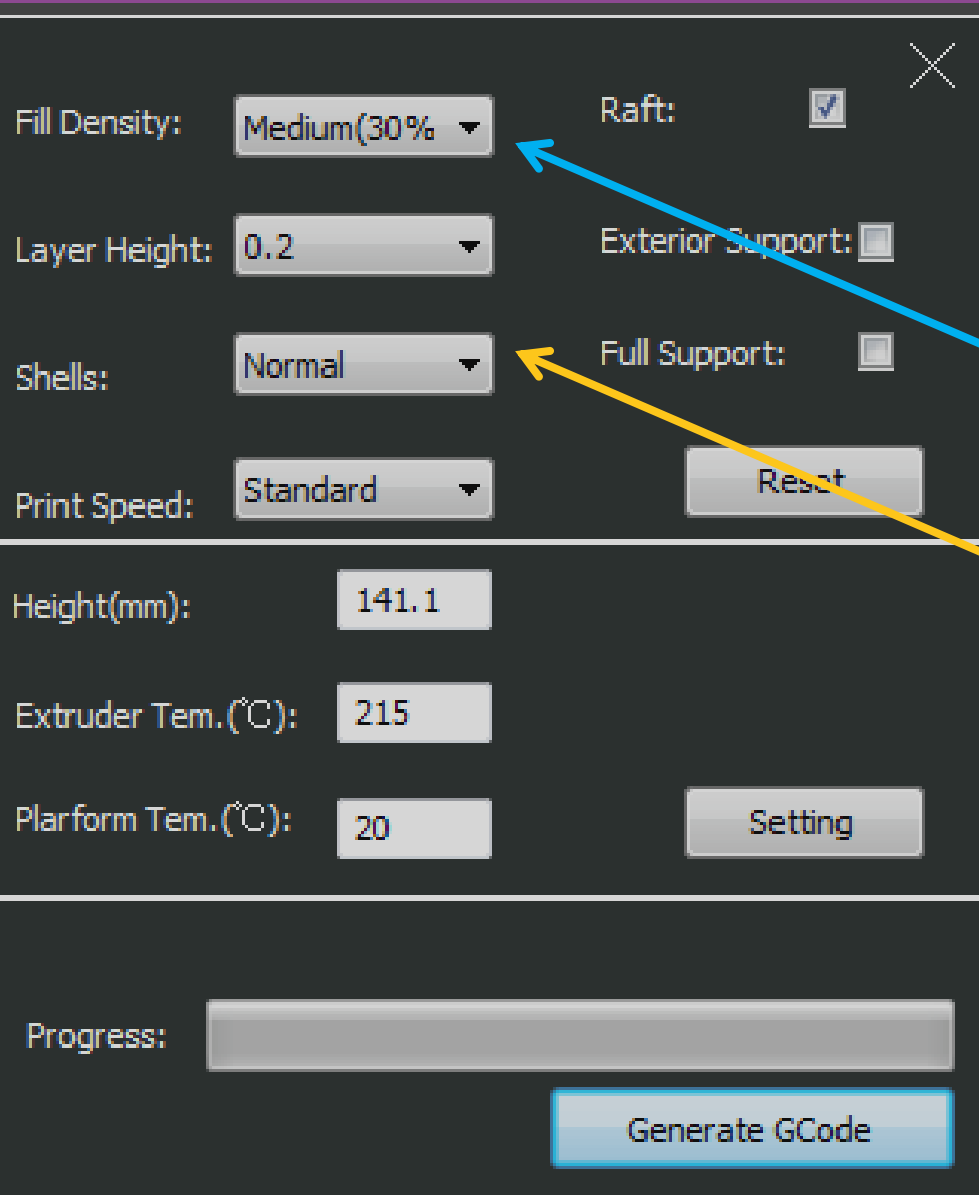
Height(mm): 141.1  
Extruder Tem.(°C): 215  
Platform Tem.(°C): 20  
Setting

Progress:   
Generate GCode



When you're ready to start producing G-code for your item, click on G and the above option interface will open.

# Producing G-Code in DoreWare-P



The screenshot shows the DoreWare-P software interface with the following settings:

- Fill Density: Medium(30%)
- Layer Height: 0.2
- Shells: Normal
- Print Speed: Standard
- Raft: ☒
- Exterior Support: ☐
- Full Support: ☐
- Reset button
- Height(mm): 141.1
- Extruder Tem.(°C): 215
- Platform Tem.(°C): 20
- Setting button
- Progress:
- Generate GCode button

Two arrows point to the 'Fill Density' and 'Shells' settings: a blue arrow points to 'Fill Density' and a yellow arrow points to 'Shells'.

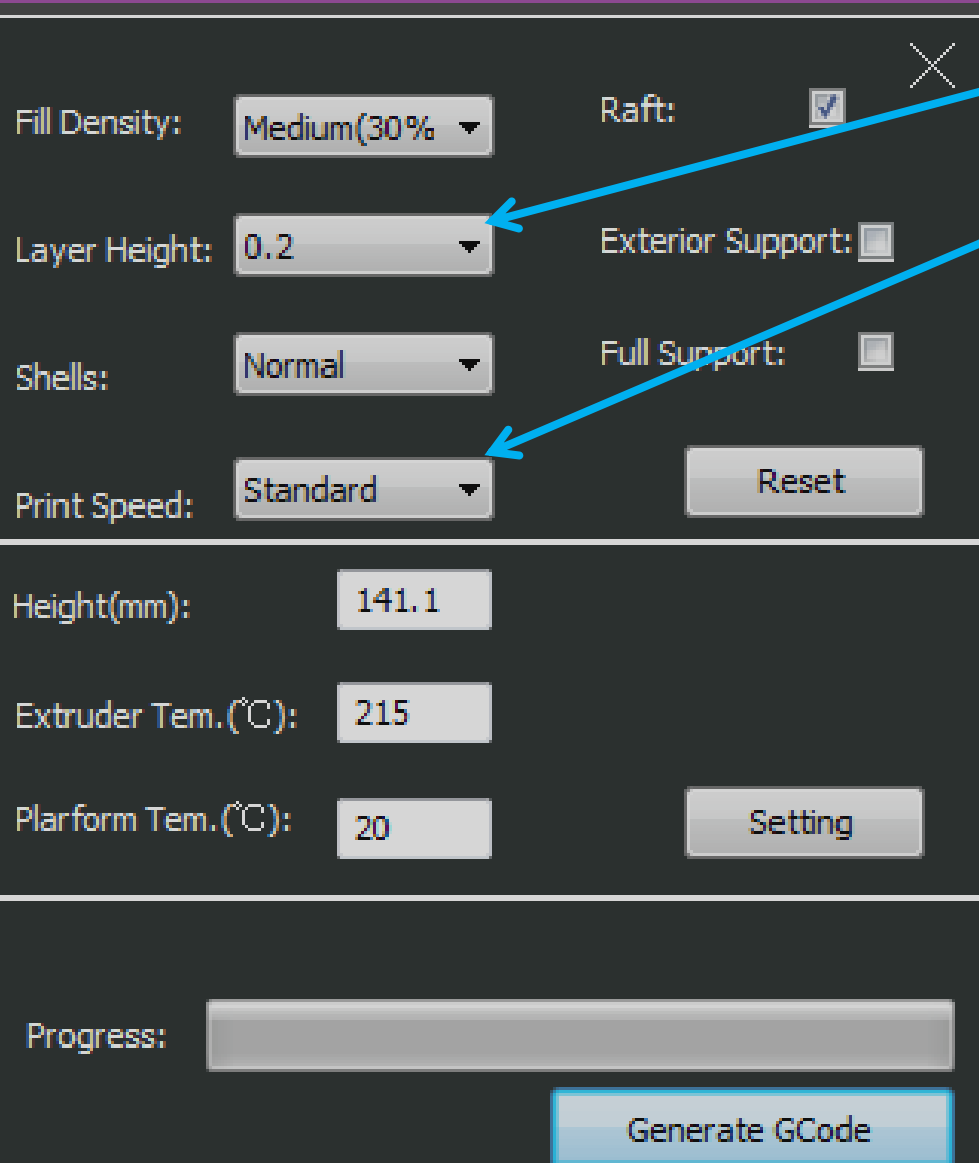
3D printed objects are rarely solid – they consist of a honeycomb centre and a solid shell.

“Fill density” allows you to vary the amount of material in the honeycomb.

“Shells” enables you to vary the thickness of the solid shell.

What to pick will vary a little depending on what you want the part for, but the default setting for both is not a bad start point.

# Producing G-Code in DoreWare-P



The screenshot shows the DoreWare-P software interface with the following settings:

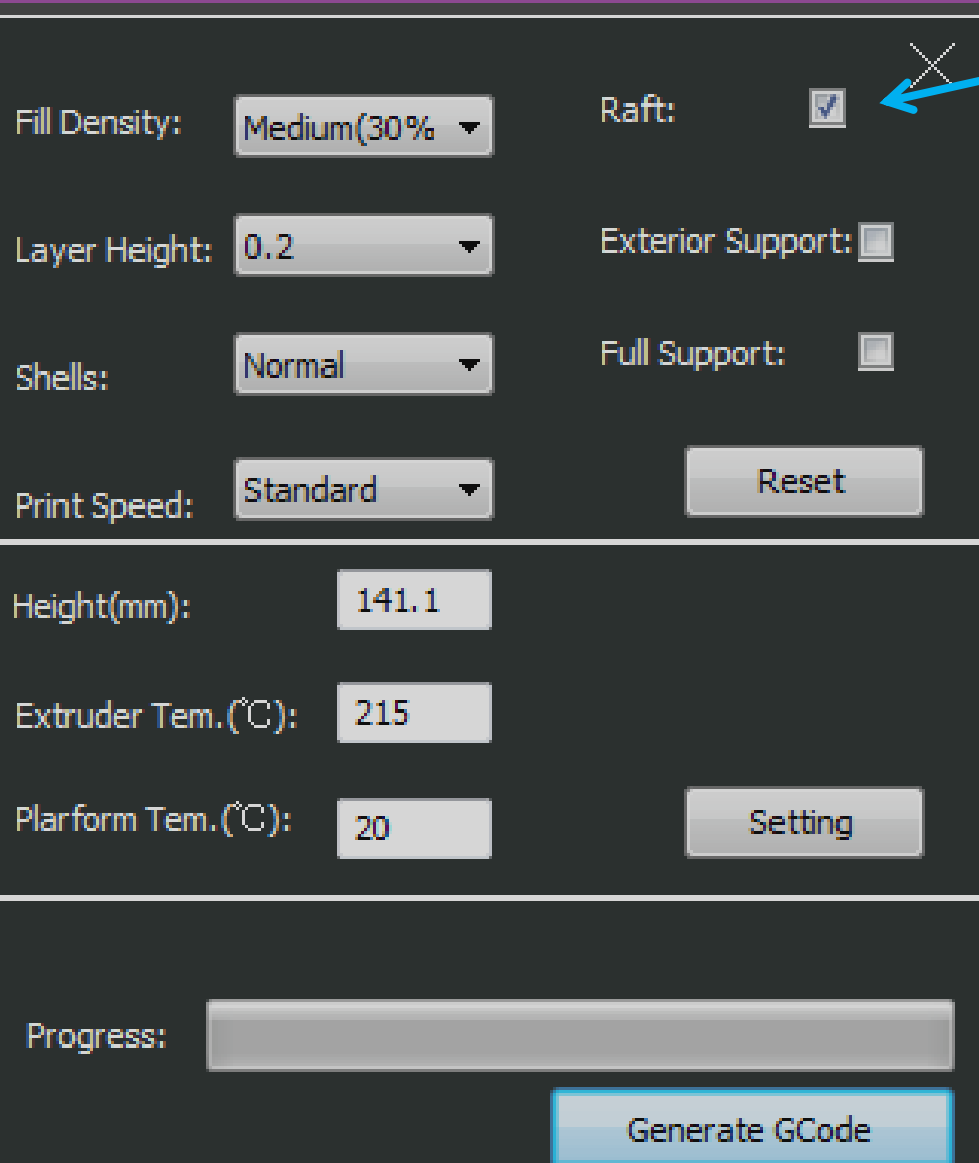
- Fill Density: Medium(30%)
- Layer Height: 0.2
- Shells: Normal
- Print Speed: Standard
- Raft: ☒
- Exterior Support: ☐
- Full Support: ☐
- Reset button
- Height(mm): 141.1
- Extruder Tem.(°C): 215
- Platform Tem.(°C): 20
- Setting button
- Progress:
- Generate GCode button

How thick a layer (in mm) the printer tries to lay down at once, and how fast it is traversing will have an effect in print quality.

0.2mm and standard print speed seem to produce good results, as do faster and thicker settings for crude items.



# Producing G-Code in DoreWare-P



The screenshot shows the DoreWare-P software interface with the following settings:

- Fill Density: Medium(30%)
- Layer Height: 0.2
- Shells: Normal
- Print Speed: Standard
- Raft: ☒ (indicated by a red arrow and a red X)
- Exterior Support: ☐
- Full Support: ☐
- Reset button
- Height(mm): 141.1
- Extruder Tem.(°C): 215
- Platform Tem.(°C): 20
- Setting button
- Progress:
- Generate GCode button

Raft produces a layer under your item, which helps it to stay stuck to the print bed, whilst the item is being printed.

It will easily peel away from your item, and we do not recommend you untick this option!

The raft also helps to compensate for any misalignment and/or irregularity in the bed.

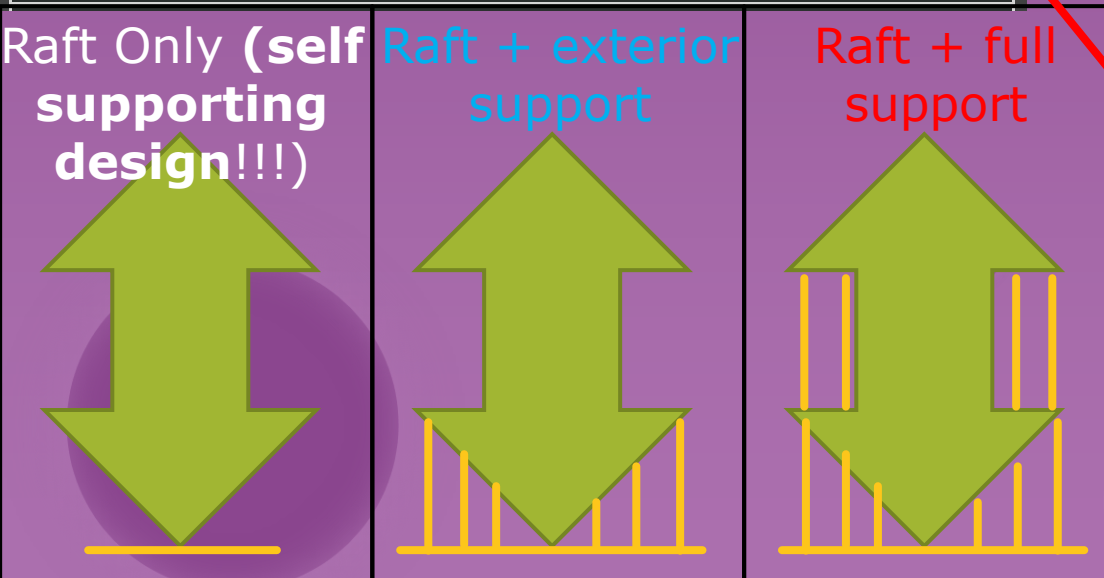
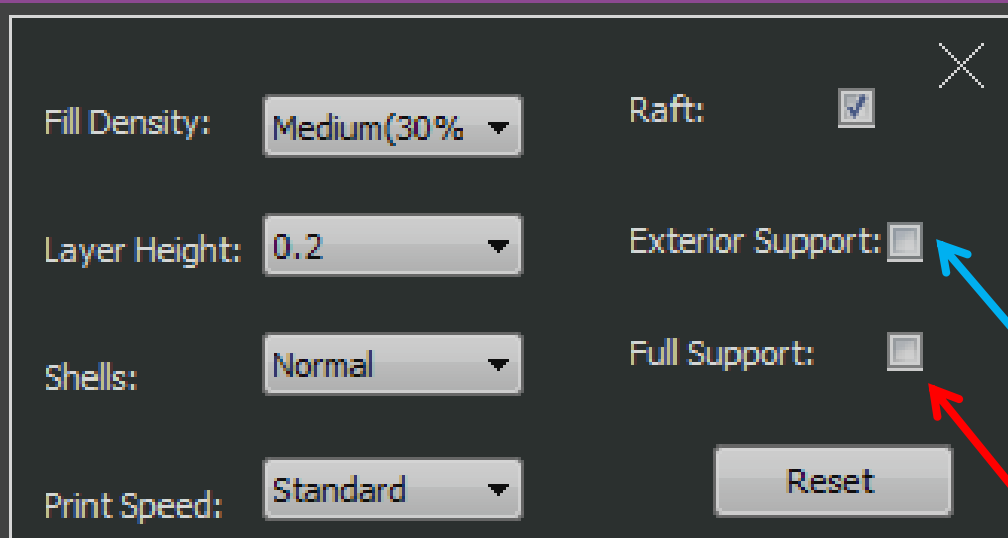
# Producing G-Code in DoreWare-P

“Support” refers to temporary (break away) vertical columns which the printer prints under your item, to help the printer print runs of material which would otherwise constitute it trying to lay down molten plastic in mid air, which wouldn't work.

Our two options here are

- Exterior support (i.e. underneath it, between it and the bed/raft).
- Full support (where all overhangs further up are also supported).

(Note you can't tick exterior and full support, as exterior support is a subset of full support.)



Trying to print green item. Support shown orange.

# Producing G-Code in DoreWare-P

Fill Density: Medium(30% ▼) Raft: ☒

Layer Height: 0.2 ▼ Exterior Support: ☐

Shells: Normal ▼ Full Support: ☐

Print Speed: Standard ▼

---

Height(mm): 141.1

Extruder Tem.(°C): 215

Platform Tem.(°C): 20

---

Progress:

Setting the [maximum?] height of the model doesn't seem to have much point, unless you have a modified machine.

For PLA printing set the extruder temperature to 220 deg C.

For PLA printing: set the platform temperature to 70 deg C if your item is more than about 4cm in diameter, otherwise you could leave it at 20 deg C.

This avoids shrinkage causing larger items to warp off the bed during printing.

Note we will also enter the same temperatures into the machine to avoid an issue with the way in which it operates.

# Producing G-Code in DoreWare-P

Click to generate the G-code.

Note that this is computationally fairly complex.

Time taken may vary from a few minutes for something simple...

...to about half an hour for the example item shown six slides ago, with no support...

...to a few hours for a very complex piece – the progress bar is a useful indicator something is happening

Note that we have yet to have positive results at this stage from combining multiple STL files together, so we suggest you combine STL files together outside DoreWare-P, or produce a single STL from your drawing package.

Fill Density: Medium(30% ▼)

Raft: ☒

Layer Height: 0.2 ▼

Exterior Support: ☐

Shells: Normal ▼

Full Support: ☐

Print Speed: Standard ▼

Reset

Height(mm): 141.1

Extruder Tem.(°C): 215

Platform Tem.(°C): 20

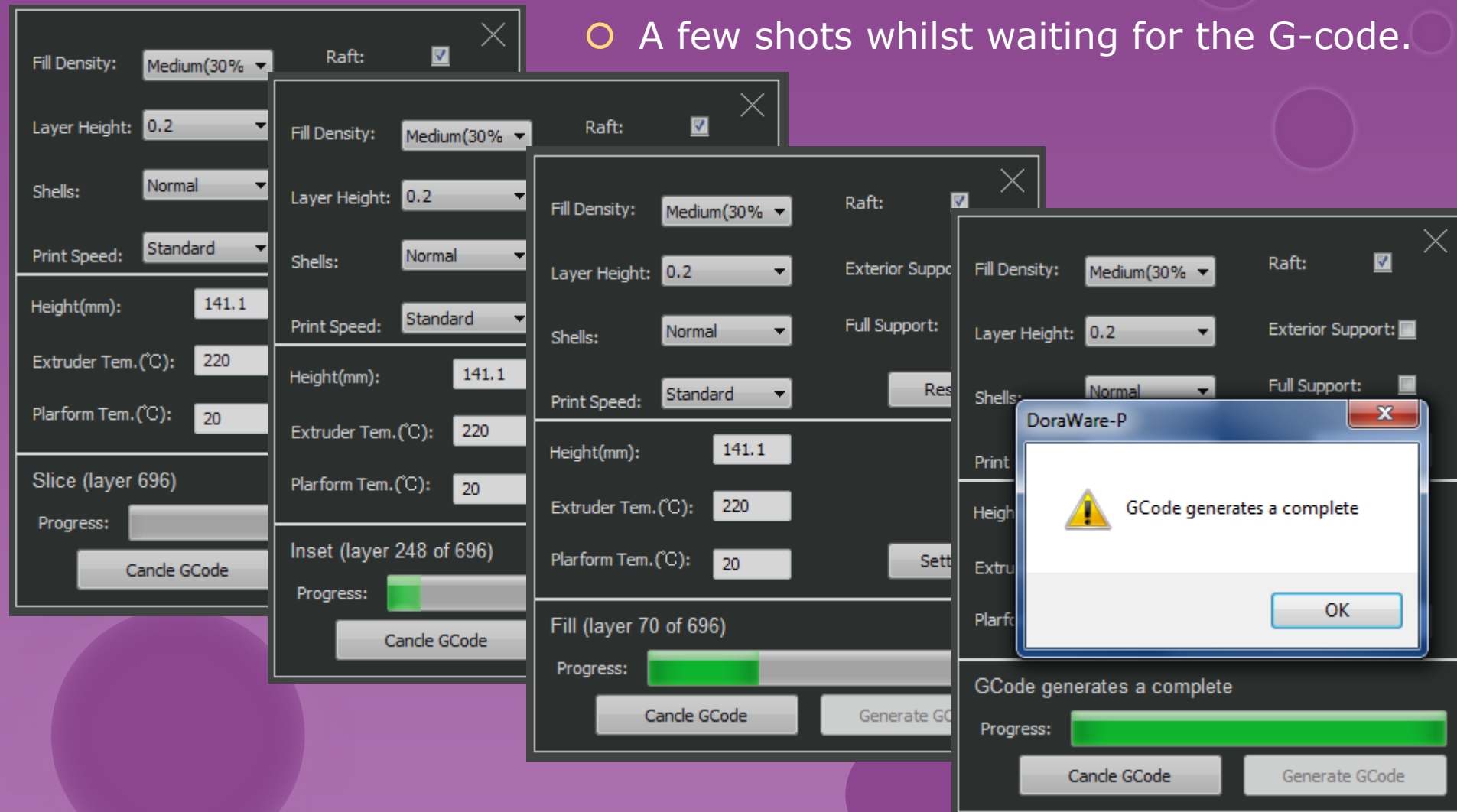
Setting

Progress:

Generate GCode

# Producing G-Code in DoreWare-P

- A few shots whilst waiting for the G-code.



...and when we get the message above, we know the G-code has been finished.  
Click "OK" in the box, click the "X" in the top right of the G-code window.

# Producing a WTK File from DoreWare-P



Use this button to  
export a WTK file to  
a USB memory stick



Note there are some peculiar requirements and restrictions:

1. Memory stick not larger than 32GB
2. WTK file must be in a directory called 3DMODEL, and this directory must not be within any other directory.
3. The model name of the WTK file before the .WTK must be no more than 8 characters long: e.g.  
E:\3DMODEL\Richitem.WTK **fine**  
E:\3DMODEL\Richardsitem.WTK **won't work**
4. The printer can recognise no more than 58 model files on the stick and better to have maximum 20.
5. Not clear of the effect of other content on the stick, and if it might/could corrupt it! (I.e. suggest a dedicated stick.)

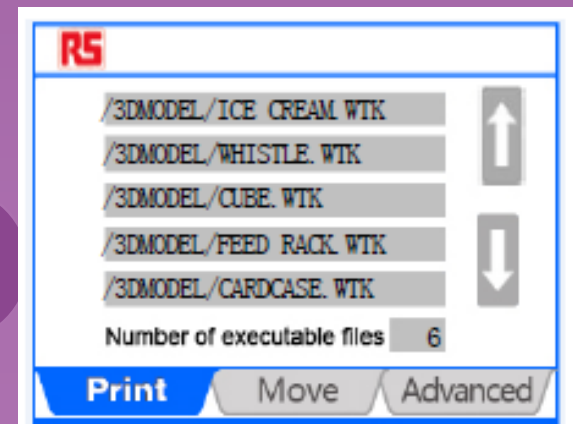
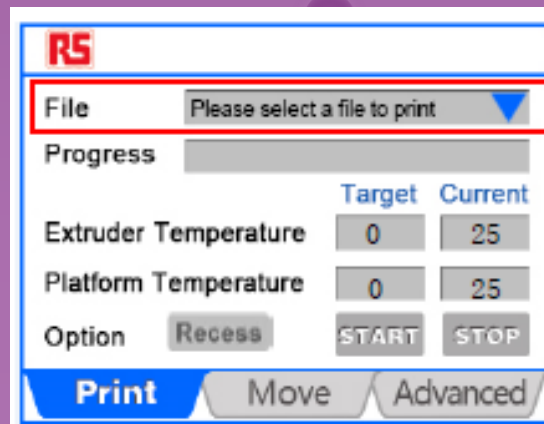


# Printing the WTK File from the USB Stick

# Setting the Printer Up From Its Touch-Screen

- Ensure the printer is on (at the wall and at at back).
- Also that a brown/black bed is clipped with four clips to the aluminium platform.
- Check that the printer is loaded with the correct filament (both type of plastic and colour)
- Insert your memory stick into the printer.
- On the 'Print' tab, use the blue triangle and then the up and down arrows to get to the WTK file you want to print – touch the file to select it.

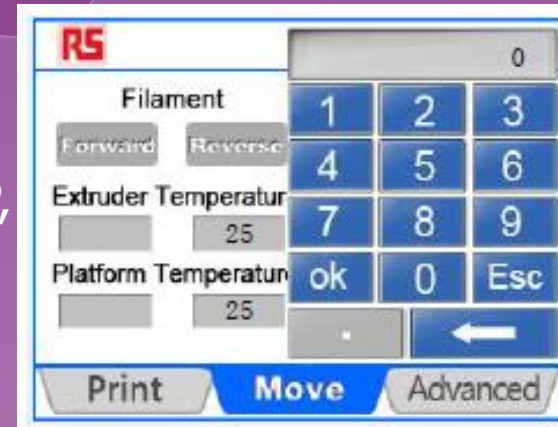
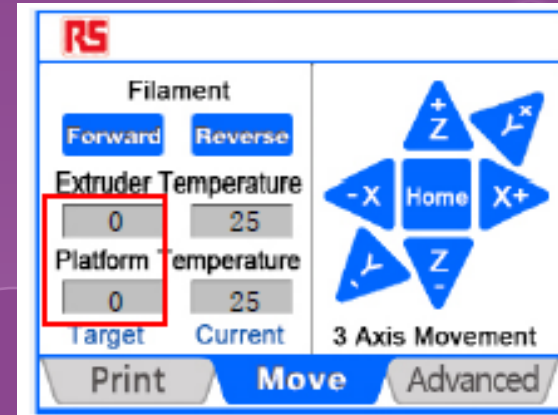
Note carefully the format of the screen: Extruder and platform temperatures, and target and current temperatures.!





# Setting the Printer Up From Its Touch-Screen

- Now select the 'Move' tab.
- Set the extruder and platform temperatures again.
- Tap on the target temperature to alter.
- Remember for PLA, extruder 220degC and platform either room temperature or 70degC for anything over about 4cm in diameter.
- Now select the 'Print' tab again.
- Observe for 20 to 30 seconds to check is changing.
- When you're happy, start the print using the 'Start' button on the 'Print' tab.
- If its still heating up it will tell you, and autostart.
- Note that for the item we considered in Doreware-P, that would probably take around 8 hours to print!



Note we are happy to leave the machines running overnight, but please see safety notes at end of slides

# What the Printing Process Should Look Like

Note black bed and four clips!



## When the Printing Has Finished

- ...it will drop the bed down to the lowest position and start cooling down...you may want to touch the touch screen (to wake it up) and see what the current temperature of extruder and platform are.
- Note that they should be cooling down – if not, set them to zero in the 'Move' tab and go back to the 'Print' tab. If they still aren't cooling down, ask for help or switch the printer off at the wall.
- (Note that throughout the print you can touch the touch-screen to wake it up and see what the percentage progress is – it is suggested you time the first percent or so to work out how long you think it will be till the job is finished.)
- When you are happy the bed is cool enough (so as not to burn you, but ALSO so that your component isn't still soft and pliable) unclip the four clips and remove the bed.
- When the printed item is cooled to room temperature, it should be possible to pull it off the bed, or gently flex the bed slightly if need be, taking care not to permanently bend it.
- Please then replace the bed and clips.
- Don't forget to pay what is owed for the cost of materials – see next few slides.

## Charging

We have funds to buy 3D printers for undergraduate use.

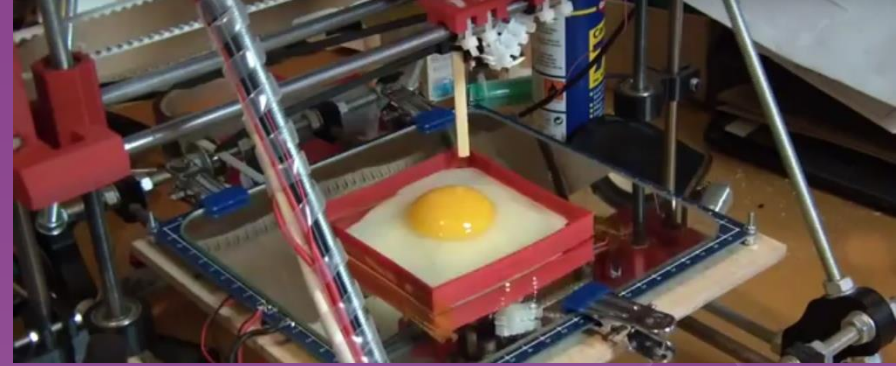
We do not (yet) have funds to buy materials, so we ask you to pay for these, but the cost is relatively low.

We do not have funds to pay for 3D printing for research, except for 4<sup>th</sup> year projects (or have enough printers for this additional use) , if you are a postgraduate/post-doc researcher or a member of staff reading this – please contact the Dyson Centre Manager to discuss further.

# Charging: RS/IdeaWerk Machine Using Standard PLA

- Please use the electronic scales to work out the mass of PLA used
  - Do include any scrap
  - Rafts, supports
  - Failed attempts (these are at your cost)
- Charge is £1 per 30g of part there-of.
  - Ie 25g is £1, 40g is £2, 60g is £2, 61g is £3
- Please use [www.dysoncentre.eng.cam.ac.uk/epos](http://www.dysoncentre.eng.cam.ac.uk/epos) to make payments
- Note: all 3D printing filament payments will go into a dedicated account intended for buying more filament.





Egg visibly cooking after just 5 seconds on a 3D printer bed.

Taken from <https://www.youtube.com/watch?v=gD59u5WafmQ>

## Health and Safety

As with many such machines in workshops, these machines are not default safe to use - you can cause harm to yourself and others and to the machine if you don't understand how to use it correctly.

An appreciation of the risks and what to do about them is important.

# Health and Safety: Burned!

## ○ What could go wrong?

- Could get burnt by extruder or by molten plastic coming out of it – usually between 200 and 280deg C (significantly hotter than boiling water!!!):

Don't touch extruder, or molten plastic coming out of extruder, even if it looks cool.

Could wear protective gloves (need to be sufficiently insulating).

Make sure you know where nearest sink is and get burns under cold water promptly and keep them there for 10 to 20 minutes!

Also seek help from a first aider – ask at reception if you can't find one, or if outside normal hours, call security on 31818 from the phone on the Manager's desk, or 01223 331818 on your mobile phone. Further details at Manager's desk.

Model : WT280A



# Health and Safety: Burned Again!

- What could go wrong?
  - Could get burnt by the platform/bed or item recently printed: if the bed is still being heated, it could be around 100 deg C (ie as hot as boiling water!!!):

Don't touch bed until you are sure it has cooled down – touch screen will tell you current temperature (be careful not to get mixed up with target temperature or same for extruder/nozzle).

Be cautious when moving to handle the bed or the item printed.

Also see advice on previous page about: gloves, treatment of burns and summoning of a first aider.

Model : WT280A





# Health and Safety: Trapped!

- What could go wrong?
  - Could get trapped above or below the moving [heated] bed and/or the moving [heated] extruder head.

Stay clear of the moving parts!

If you do get trapped:

turn the power off, which should allow you to move the bed and/or extruder head to free yourself.

Seek a first aider if you are injured in any way, as per two slides ago.

If you have been burnt by the hot bed and/or extruder head, follow advice from two slides ago for dealing with burns and summoning a first aider.



# Health and Safety: Gassed!

- What could go wrong?
  - Harmful gases coming from extruder from heating non-standard materials
  - Or from overheating standard materials.

Double check target and actual temperature of extruder.

Double check what material is being used.

Ask for advice if printing a non-standard material.

If you do think you have been exposed to potentially harmful gases, summon a first aider as per three slides ago.

Model : WT280A



# Health and Safety: On Fire!

## ○ What could go wrong?

- As the extruder is above the auto-ignition temperature of things like paper, there is a change of the machine easily being able to start a fire.

Keep the area free from paper, and any other debris.

If realistically possible, stay with the printer whilst in use, or monitor it using the webcams which will shortly be provided.

If you do find a fire:

- (1) immediately raise the alarm.
- (2) if safe to do so, use a fire extinguisher to try to put the fire out, and if possible disconnect the printer from the mains (assuming the electricity cables aren't now damp)
- (3) if in doubt, leave the building and raise the alarm.
- (4) be careful of breathing in any fumes from the fire.



# Happy 3D Printing!

(Do sleep safe and don't have nightmares!)

Hopefully this is helpful in getting you started. If you do have any questions or comments, then please feel free to ask, either in person or via email to: [RLR20@cam.ac.uk](mailto:RLR20@cam.ac.uk)

With kind regards,

Rich.  
Dr Richard Roebuck

