3D PRINTER
General Maintenance for FDM Printers

jaycar

Contents

What is 3D Printing?

The technical name for 3D printing is Additive Manufacturing and is the process of making a physical 3D object from a digital file. During the process a digital file is "sliced" and converted into a file that the printer can interpret.

More information on slicer settings and best practices for printing can be found in Jaycar's Introduction To 3D Printing workshop. You can find more information about this workshop at http://www.jaycar.com.au/workshops

Types of Additive Manufacturing

The most common types of 3D printing methods are FDM and SLA.

FDM is Fused Deposition Modelling and is a process in which layers of melted material are placed on top of each previous layer causing them to fuse together.

SLA stands for Stereolithographic Apparatus, a method in which UV light is used to cure resin.

In this workshop we will be focussing on FDM printers.

FDM Printer Types

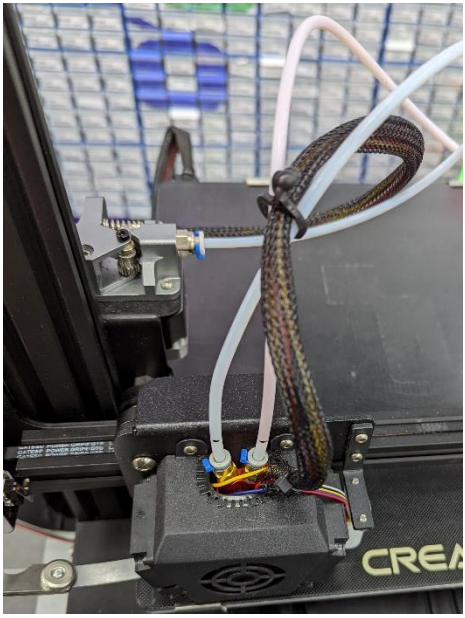
FDM printers come in two types. Direct drive and Bowden drive. They use the same systems to produce 3D prints but the difference is how they deliver the filament to the hot end

Direct drive printers pull the filament into the print head. The filament feeder is mounted above the hot end and filament is loaded directly into the top of the print head.

Bowden Drive printers have their filament feeder positioned away from the hot end and push the filament into a Bowden tube which is connected to the print head. These printers need the tube to be connected with a collet, a small mechanical connector that hold the tubing firmly but can release it when the outer ring is pushed down.

There are benefits and drawbacks to both types of printers. Direct Drive printers can handle a wider range of specialist filaments, such as flexible or abrasive filaments (such as Carbon Fibre, Wood, or Glow in the Dark) that a Bowden drive cannot but the heavy print head can cause wobble on the frame and the support rods must be inspected regularly.

Bowden drive printers can be faster and quieter because there is less weight on the carriage but are more susceptible to mechanical failure at the tube connectors (collets) and are more likely to experience stringing and oozing of filament during travel time as retraction is less responsive than a direct drive.



1 Creality CR-X - An example of a Bowden drive printer with Dual Filament

Safety Considerations

Fumes: Some materials can cause a health risk and must be used in a well-ventilated area with filtration or extraction systems. This includes ABS and most resins. PLA and PET, two common materials for FDM printing are considered safe to use without the need for an extraction system.

Burns: Nozzles of 3D printers can reach around 280 degrees and can cause painful burns if care isn't taken. Always allow a nozzle to cool before touching, or wear protective equipment.

Pinch: There are moving parts inside a 3D printer that could potentially pinch or jam your hand or fingers if placed in the wrong location while the printer is running.

Overheating: Some budget printers with little or no safety protocols built in cannot properly deal with malfunctions. An example is when the heaters are not regulated and a fault occurs, the printer often catches fire. The safety protocol to stop this is called thermal runaway cut off and will disable the machine if the temperature of the hot end goes above a maximum threshold.

Before we begin

For maintenance, you may need the following to help keep your 3D printer running at optimum condition.

Isopropyl Alcohol 99.8% Spray 250ml - NA1066

Isopropyl alcohol is one of the most useful service aids you can have around. It has many uses such as head cleaning, surface cleaning and prep, contact cleaning, stain removal in the laundry etc. It's also a medical-grade surface disinfectant. Easy to use pump pack spray bottle & dries quickly.

Paper towel

Any paper towel can be used to help clean the printer rods, build plate.

Use only plain white paper towel as printed/patterned paper towel may leach dye on to components when used with methylated spirit or isopropyl alcohol

Toolset 3D printer – TD4594

This comprehensive toolkit. It includes commonly required tools that you need to service your printer. As print head blockages are common in 3D printing, this tool kit offers various tools to unclog a blocked print head.

INOX MX6 Premium Food Grade Machinery Grease - NA1032

Ideal for bearings, ball joints, chains, sprockets, O-rings, bushes and other rubber and plastic etc.

- High temperature, non-melt
- Highly resistant to water, salt, chemicals and drying

Dust Remover Spray Can - NA1018

Jaycar's dust remover is Non-flammable gas which allows removal of dust from electronic, electrical and optical devices. It does not leave residues and is nontoxic and non-conductive.

It's great to use to remove the filament from the extruder, extruder housing or about the printer itself.

Tool set for your 3D printer

If you don't have the right tools for the task at hand can lead to frustration and possible damage to your printer. At Jaycar we have made a 3D Printer tool kit to help remove the frustration of not having the correct tools for the job. The **TL4594** tool kit has the following items inside a compact storage case.

Tools included:

- Nylon tube cutter
- Slotted screwdriver
- Phillips screwdriver
- Nozzle cleaners
- Allen key set (1.5, 2, 2.5, 3/4/5/6mm)
- M6 & M8 elbow sleeves
- Feeler gauge
- Wrenches
- Carving knife with blades
- Tweezers
- Needle nose & diagonal pliers
- Side cutter
- Spatula
- SD Card reader

Why do we need to do maintenance?

Just like any other machine, your 3D printer has lots of metal moving parts that will slowly lose its mobility that can lead to stoppages, grinding or even seize up if you don't keep the rods and linear bearings well lubricated.

Routine maintenance should be performed on your 3D printer about every two months. You should also perform basic maintenance before and after each print. Like clearing/wiping down the build plate or removing any filament that might be around the printer.

Levelling the print bed

The most important tool you will need for levelling your bed is a Feeler Gauge – some resources will say that you can use a piece of paper, however paper can be compressed, vary in thickness or even leave small fibres in your print nozzle.

Begin by preheating your nozzle and the print bed and lower the bed as far as it will go.

Most printers have a function to level the bed so begin that now. The head should move to its first position, and you will need to raise the beg until it is close, then use the 0.15mm feeler gauge between the bed and the nozzle and make small adjustments on the display or by using the knobs on the bottom of the bed until it is being held to the bed but is still able to be easily removed.

You will need to continue this at the next levelling point on your printer until the process is done.

Printers commonly have a 5 or 9-point levelling system so for best results make sure you complete this process.

Also be sure to level your bed regularly and to also relevel every time you remove or change your nozzle to avoid damage to the print surface.

Loading and Unloading Filament

When unloading filament, first heat the printer to the maximum temperature recommended for your filament. Once it is up to temperature, extrude a small amount of filament by pushing the lever on the feeder and pushing the filament towards the print head before removing it from the printer.

Unclogging Nozzles

Making sure the nozzle is heated clear away any excess filament from the nozzle with tweezers, then use a 0.4mm Wire Unclogging pin and insert it up into the nozzle then remove. If the pin can enter and exit freely try to extrude some filament.

If the clog remains you will need to try different methods for Bowden drive and direct drive printers.

Unclogging a Bowden drive printer

Remove the Bowden tube leading into the print head then heat up the nozzle. Using the push tool apply firm pressure in the same direction the filament travels into the nozzle until the clog is released and filament can exit the nozzle.

Before reconnecting the Bowden tube try pushing filament through the hot end manually. It should extrude easily from light pressure. If it does not then you will want to perform a “cold pull”.

Unclogging a direct drive printer

Begin by removing the casing and the filament feeder from the print head according to the instructions for your machine. This will allow you to access the path the filament takes to the nozzle.

Using the push tool apply firm pressure in the same direction the filament travels into the nozzle until the clog is released and filament can exit the nozzle.

Before reattaching the filament, feeder and casing try pushing filament through the hot end manually. It should extrude easily from light pressure. If it does not then you will want to perform a “cold pull”.

Cold Pull

To do a cold pull, heat the nozzle to the recommended maximum for your filament type. Push a trimmed length of the filament (approx. 20cm) into the hot end until a small amount extrudes then leave the filament in place and allow the nozzle to cool down to around 90°C then, using pliers, pull the filament out of the hot end in a firm upward motion. This should clear any remaining filament from the nozzle and you may be able to see remnants of older filaments that were stuck in the nozzle.

If you have completed these steps and you are still unable to extrude the correct amount of filament you may need to remove the nozzle and inspect it for additional material adhering to the nozzle or replace it.

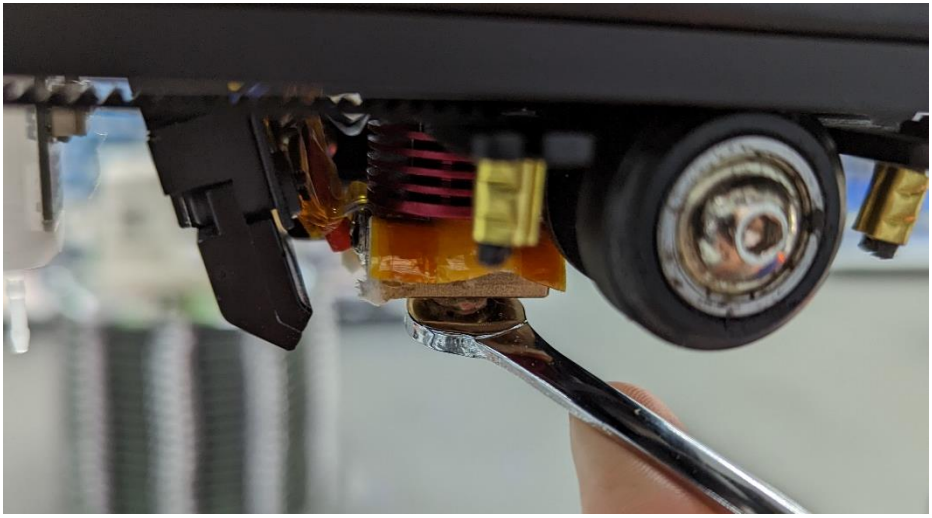
Removing the Nozzle

Some models come with a quick release nozzle that can be removed by pushing in two locking mechanisms on the side.

However, if your nozzle is not quick release, you simply need to do the following:

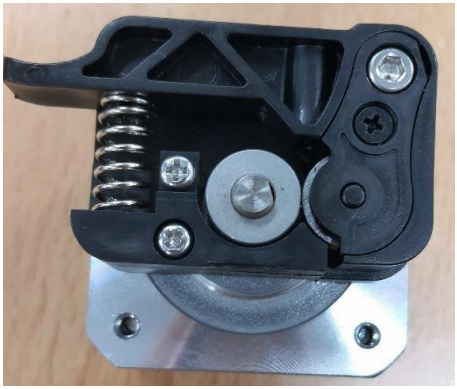
Ensure the nozzle is completely cooled. Metal expands as it heats so you will not be able to remove a hot nozzle.

Using the correct size mini spanner for your nozzle make sure the flat sides are matched to the flat edges of the nozzle and turn it anti-clockwise until it is unscrewed from the heating block.



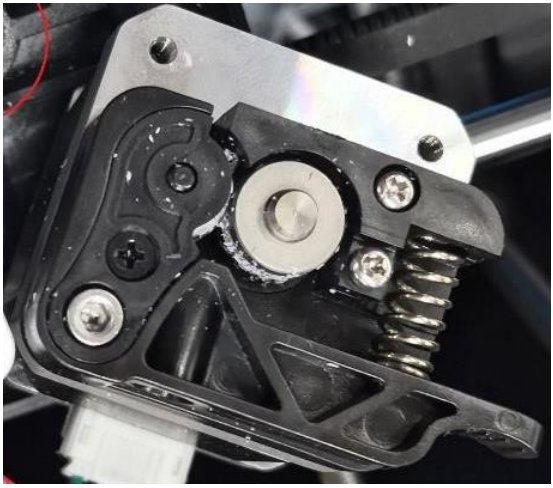
If the entire assembly turns instead of the nozzle, use a larger wrench to keep the heating block stationary while you turn taking care not to apply pressure to the heating line and thermistor that are on the side of the heating block.

Cleaning the filament feeder



After printing and changing filament numerous times the gears feeding the filament through the extruder can collect particles of plastic in the teeth, preventing them from feeding properly. This can cause an uneven extrusion of filament that can cause a print to either fail or reduce its print quality. Check the extruder gear each time you hear a clicking noise coming out of the extruder while loading in a new filament or while it's printing. If you are getting uneven prints or hearing clicking sounds don't worry as this can be easily fixed.

Best to do this when the printer's filament is unloaded. For this example, the gears below have a lot of plastic particles all around the extruder. Using NA1018 Dust Remover Spray Can, give it a good spray to clean out any particles. Spray away from yourself and aim to stop any debris from falling inside moving parts of the printer.



A small brush could also be used to help clear these particles

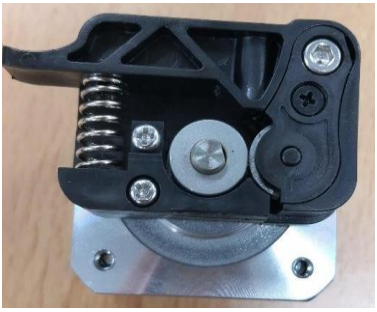
If the extruder gears are producing unpleasant squeaking noises. You will need to lubricate them. Lubricating the gears will require some disassembly and quite often, small particles or 'hairs' will be found on the gear wheels/bearings etc. These can all be cleared as required.

You will need to use the small screwdriver and Allen key as supplied with the printer or available in the 3D printer tool kit.

Start with removing the plastic cover according to your printer's instructions.

Now remove the screws that connect the feeder assembly to the print head. Any scraps or particles of filament that are found in this process are to be cleared and removed.

Cleaning and Lubricating Feeder Assembly Bearings



Remove the plastic holding piece

Any plastic filament found on bearing needs to be removed

Use supplied tweezers from the 3D printer toolkit to remove debris

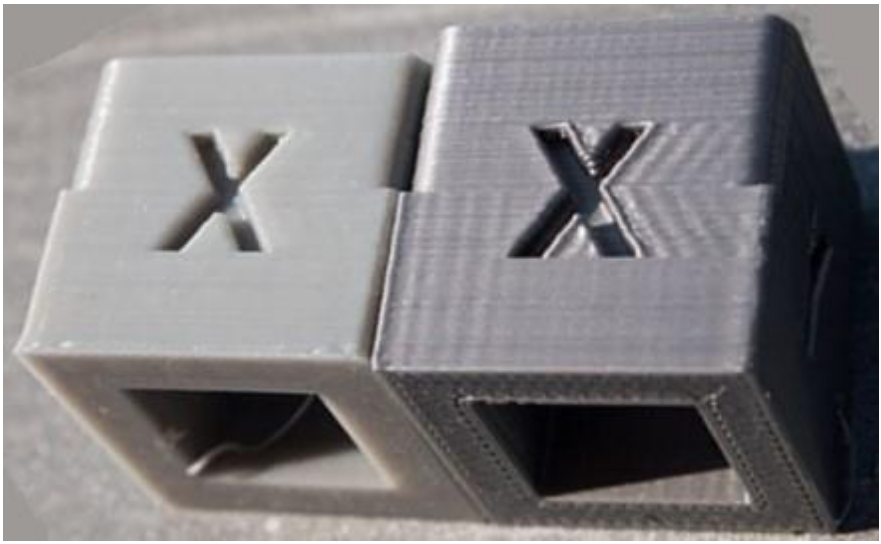
Dab the bearing with the plastic tube to release some Inox

Reassemble the filament feeder assembly.

Keeping Your 3D Printer Lubricated

Starting out in 3D printing it might be difficult to tell what a normal movement/sound is and what signs to look for when it needs to be lubricated. Start by checking some common issues of axis movement problems of the X, Y and Z-axis.

Without proper movement, your printed items won't come out right or might not even be able to print anything.



Dirty rods

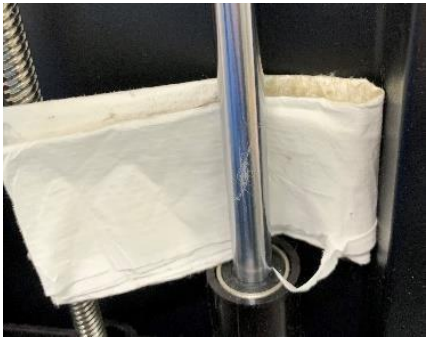
Over time the rods might become dirty and it is very easy to clean the rods with a paper towel.

Use paper towel try to fold it so you can easily move it up and down the rod.

Find the rod that you want to clean. Run it all along the rod and you should see the dirt/build up on the paper towel.

Do the same for all the rods on the 3D printer. Repeat this process on each rod until no dirt is found on the paper towel.

Once the rods have been cleaned you need to apply a little bit of general-purpose lubricant. By doing this it will increase the longevity of your printer and also improve your print quality



This lubricant sachet comes included with most new printers

INOX MX6 Premium Food Grade Machinery Grease - NA1032

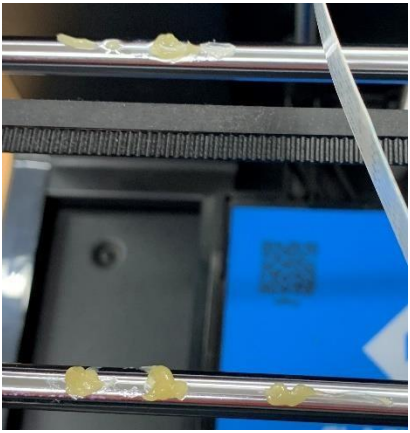
Ideal for bearings, ball joints, chains, sprockets, O-rings, bushes and other rubber and plastic etc.

- High temperature, non-melt
- Highly resistant to water, salt, chemicals and drying
- Fully synthetic

Applying Lubricant

Applying lubricant will increase the longevity of your printer. When applying lubricant, you don't need a lot

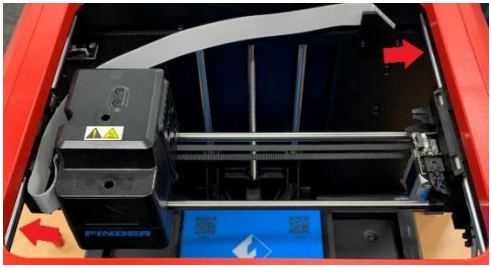
Apply a small amount of INOX MX6 lubricant along the rods.



The amount in the example photo should be enough. Remember to apply to both rods

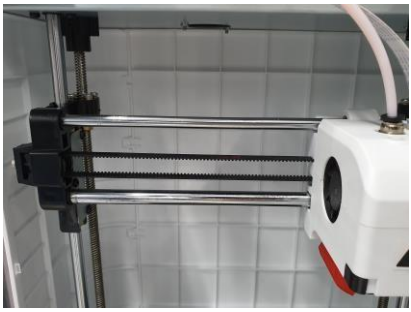
Once both rods have lubricant applied, move the extruder housing left and right a few times to help spread it over the rods.

You will also need to apply lubricant to the top rails located in the photo.



Apply on both rods then move the housing back and forth a few times to help spread it over the rods.

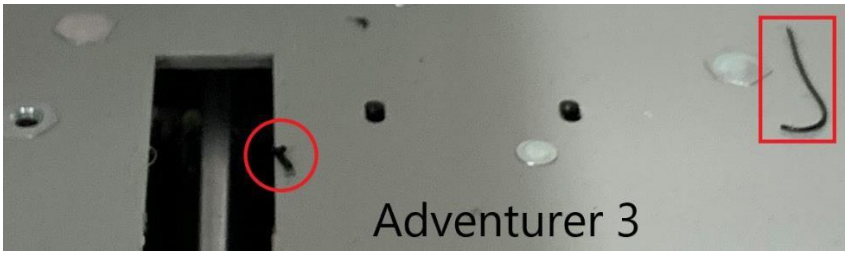
Apply on all 3 rods of the build plate then move the build plate up and down a few times to help spread it over the rods.



If using a pump pack or spray, ensure no spray is applied to the rubber belts as this could make the belt fail in time.

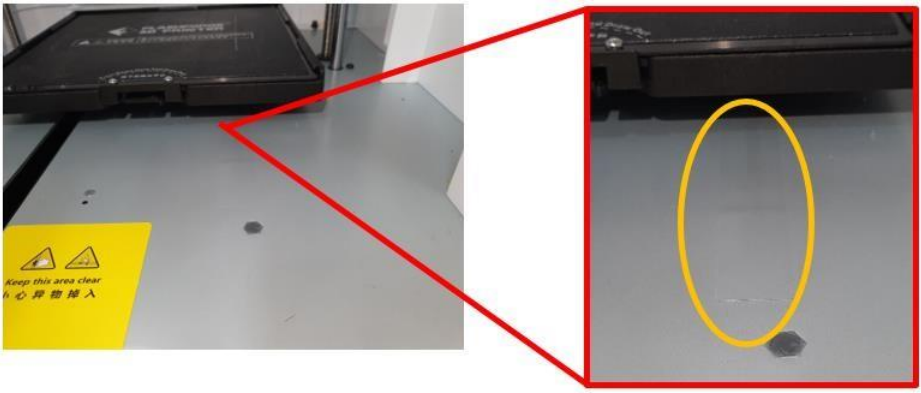
Debris

When printing you may end up with plastic debris from the pre-print primer, the printer supports falling off when removing the print from the bed or even the raft which may come off the print. Normally this debris will collect in the base of the printer and needs to be removed.



Try to make sure none of it will get between the rails, Y-axis belt and the Y-axis pulley, as it might jam or course rubbing. For example, on the Adventurer 3 seen above, you have a small gap under the build plate, and debris can get into the pulleys that are used for moving the build plate.

The best practice is to keep the base of your 3D print clean. Avoid using any harsh chemicals on the base of the printer. A small handheld vacuum or dustpan and bush is a good option. Try to keep all debris from being brushed into the cavity.



Some 3D printers like the Adventurer 3 seen above have a tape stuck down to the build plate. This tape provides traction to the wheels on the underside of the build plate. Ensure this tape is not removed or has a lubricant applied as the wheel will no longer grip properly, giving inconsistent print jobs.

Bearings jamming

This usually happens after hundreds of printing hours some Jaycar stores are already over 600 hours. You should be able to spot that the axis is not running smoothly anymore and when printing, a small grinding noise may be heard. If that's the case, then the affected bearings should be removed and greased on the inside.

Keep the print surface clean

Having the print surface clean is vital for the extruded plastic filament to stick nicely to the build plate

The image of the build plate above has many different layers of glue and other parts of leftover raft stuck to the build plate.

There are several ways of cleaning the build plate.

1. Gently wipe the surface with rubbing alcohol solution containing at least 90% isopropyl alcohol.
2. If the Isopropyl option isn't having any effect and your prints do not stick, then use Methylated spirits as it removes the grease better than isopropyl alcohol. The non-sticking print surface is mostly caused by oils in your hands.
3. If the first two options do not get the print surface clean, you can use a little bit of dish soap with warm water. Avoid using harsh or abrasive sponges on the build plate.

Build plate: Soap & warm water clean

1. Apply a small amount of dish soap to the build plate.

2. Apply some warm water. If you use a purple glue stick, once warm water touches the glue, it should turn visible again.

3. Use a sponge and give the print surface a very good clean.

4. Rinse the soap off with warm water and dry the surface with a paper towel.

By using dish soap it's able to dissolve any sugar residue that might be on the bed leftover from the filament. When creating a new print job, use the glue stick that comes with your printer. (Purple glue stick is ideal as you can see where you are placing the glue down, dry's clear and when wet will turn purple again).

Replacing a Collet

If your Bowden tube is disconnecting from the print head or the feeder mechanism you will need to replace the collet. Simply remove the outer shell near the collet you into replace then unscrew the collet with an appropriately sized wrench.

If the collet will not unlock then remove it from the printer, as above, along with the tube that will not release. Check to see if the collet will slide along the tube and if so, remove the damaged collet that way. If it will not move in any direction then replace the collet and Bowden tube.

Replacement parts

At Jaycar we have a wide range of spare parts that you might need to keep your printer running smoothly. Contact our team to see if the parts you need are available.

Common Issues

Many issues with a printed model can be corrected with changes to the settings used, however some require hardware changes or maintenance that we don't cover in this workshop. If you would like to learn more about keeping your printer in top condition, we encourage you to attend our 3D Printer Maintenance course or you can use the suggestions we have included in this section as a jumping off point to research the solution for your printer model.

Please also note that the suggestions we have included are the most common fixes for issues and may not solve the issue in 100% of cases.

Extrusion Stopped Mid-Print

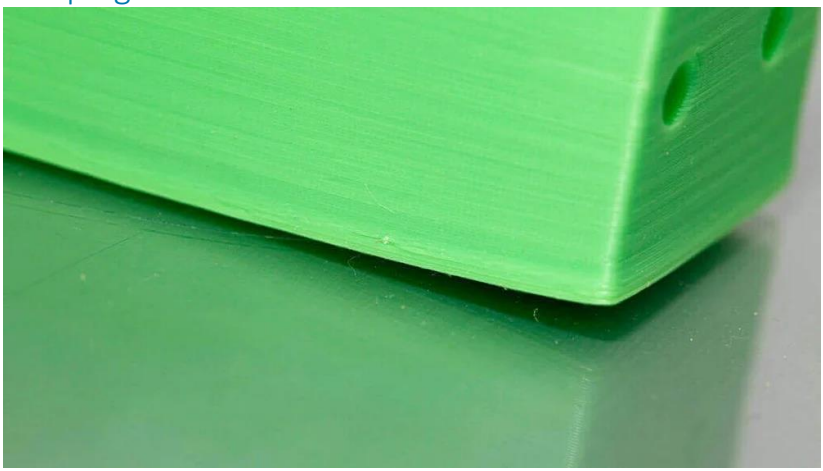
- Check You Have Enough Filament
- Check for a Clogged Nozzle
- Check for Snapped Filament
- Check for Stripped Filament (this is when the filament has been carved away by the feeding gears so much that they cannot grip the filament sides and feed it through to the hot end)

- Check the diameter of the filament is correct for your machine. Thick filament will not fit through and thin will not feed through the gears.

Print Doesn’t Stick to Print Bed

- Check the print bed temperature is correct (60+°C).
- Clean the Print bed
- Add an adhesive to the print bed
- Add a raft or supports for additional points of adhesion
- Add Texture to the print bed
- Adjust the Nozzle Height and level the print bed

Warping



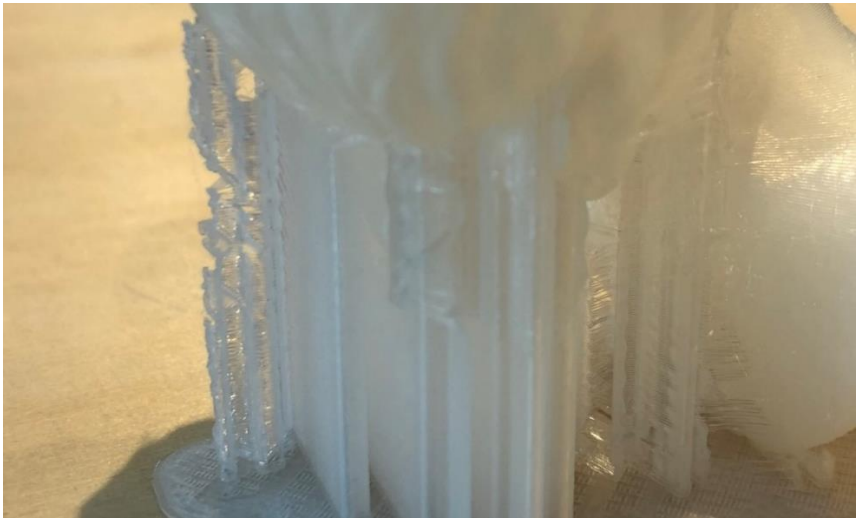
- Calibrate print bed and nozzle height
- Add a raft or brim
- Adjust the temperature and/or fan settings
- Increase the temperature of the heated print bed
- Add an adhesive to the print bed

Under-Extrusion

- Check that the hot end is clear (unclog nozzle)

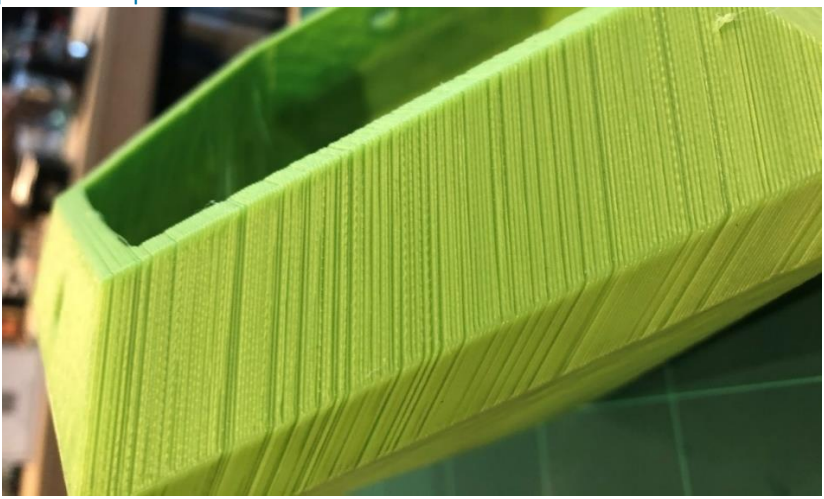
- Check the filament diameter is correct for your printer
- Adjust the extrusion multiplier in 5% increments

Supports Fall Apart



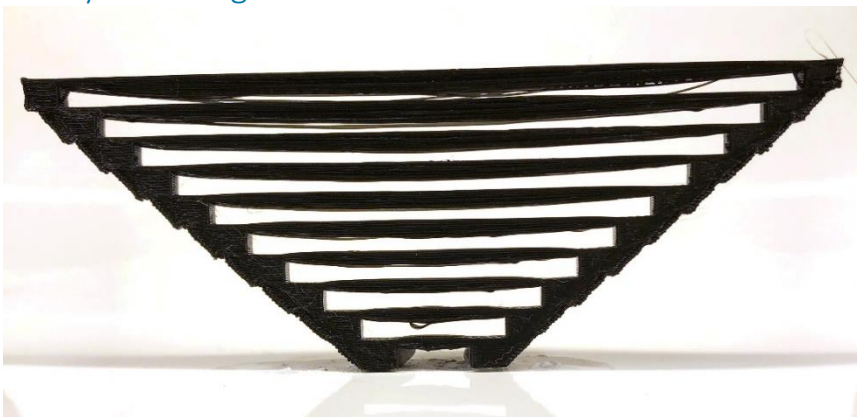
- Change Support Type
- Add bed Adhesion
- Increase Support Density or Width
- Create In-Model supports
- Check over the mechanics and make sure everything is tight

Gaps in the print



- Slow down the print speed
- Unclog nozzle
- Check over the mechanics and make sure everything is tight
- Double-check the printer's construction and alignment
- Relubricate shafts and lead screws to keep things running smoothly

Messy overhangs



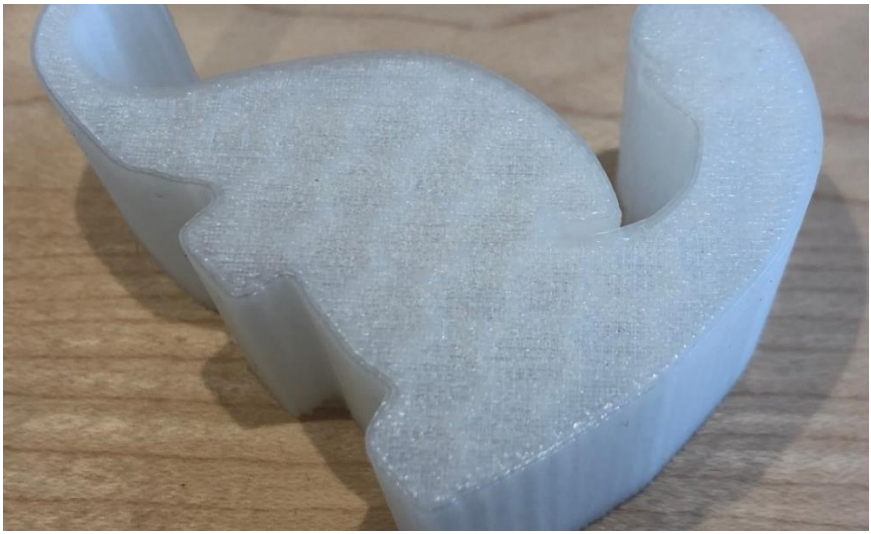
- Add supports
- Re-orient the model to reduce overhang

- Separate the model into smaller prints

First Layer is Messy

- Level the print bed
- Lower bed temperature
- Calibrate nozzle distance from print bed

Infill Visible from the Outside

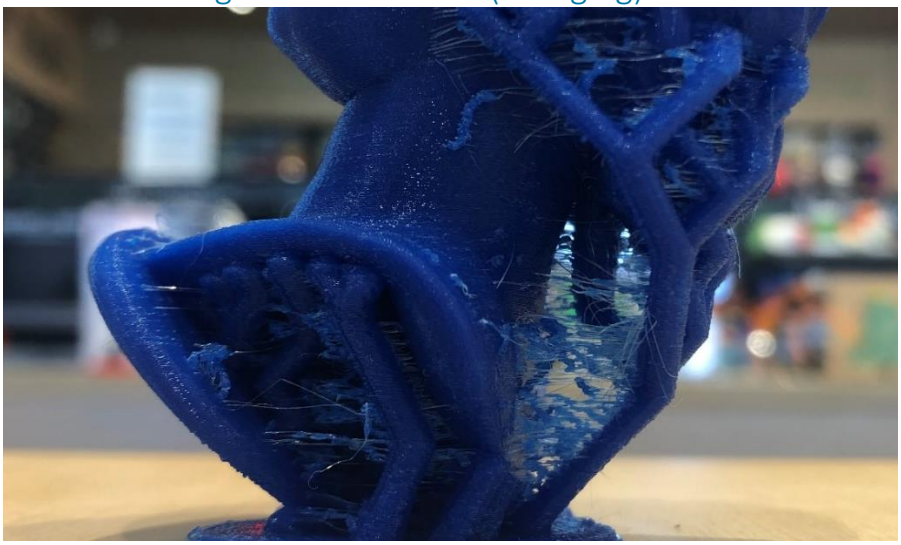


- Check the shell thickness
- Increase the number of top and bottom layers
- Use infill after perimeters
- Check print bed and re-calibrate if necessary

Print Looks Melted and Deformed

- Check the material settings
- Decrease the hot end temperature
- Speed up the print
- Check the fan position

Web-like Strings Cover the Print (Stringing)



- Enable/increase retraction
- Adjust the minimum travel before retracting starts
- Just clean the print with a scalpel or hot air

The Print Has Offset in Some Places

- Check that the printer is on a stable base
- Check the print bed is secure
- Watch out for warped upper layers
- Printing too fast for your machine
- Check the belts
- Check the drive couplers
- Check the rods are clean and apply some oil
- Check for deformed rods

Print is Stuck to Print Bed

- Try a little patience
- Use a palette knife on a low angle so you don’t gouge the print bed
- Give the print bed a clean
- Stick it in the oven
- Make some holes in the model

Fine Detail Not Printing Correctly

- Low resolution
- Nozzle diameter
- Make sure everything is serviced
- Clean your nozzle
- Slow it down
- Use quality filament
- Check print bed level