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3D2ACT:

FOSTERING INDUSTRY 4.0 AND 3D TECHNOLOGIES THROUGH SOCIAL ENTREPRENEURSHIP: AN INNOVATIVE PROGRAMME FOR A SUSTAINABLE FUTURE

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3D Printing Troubleshooting Guide

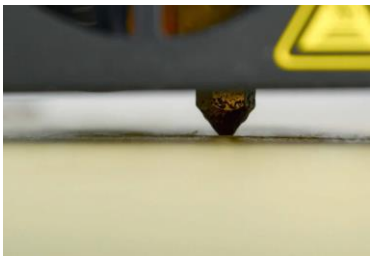
Cross Level Material

Chapter 4.1: 3D Printing Troubleshooting Guide

When you 3D print you can encounter different kinds of problems and issues. The following FAQ summarizes the most common problems, is divided into main categories, and suggests ways to deal with them.

1. Nozzle Problems

1.1. Nozzle Too Close to Print Bed



Inexplicably, despite loading the filament and the print head moving without a hitch, no filament is deposited on the print bed.

Solution

Re-leveling your bed or raising the nozzle can often help. Most 3D printers in their system settings will allow you to set a Z-axis offset. To raise your nozzle away from the print bed you will need to increase the offset to the positive value. Be careful though, too high of an offset and it won't stick to the platform (see 2.1).

1.2. Blocked/Clogged Nozzle

You initiate a print job but whatever you try, nothing comes out of the nozzle. A clogged nozzle may be caused by a small piece of the filament that may have been left behind in the nozzle after changing spools, often because the filament has snapped off at the end. When the new filament is loaded, the piece of old filament that is left in the nozzle does not allow the new filament to be pushed through. Another cause is dust and dirt that can stick to your filament and travel with it down into your hot end. Once there, they burn and start adhering to the inside surface of the nozzle.

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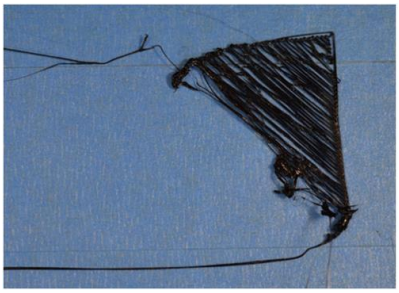
Solution

Start by removing the filament. Then using your printer's control panel (if it has one) select the "heat up nozzle" setting and increase it to the melting point of the stuck filament. Alternatively, hook your printer up to a computer running compatible control software and heat the nozzle using that. If you find that the nozzle is still blocked then you may be able to push the filament through with another bit of filament. Another method is to break out the clog and essentially break through it using a small enough needle. In extreme cases when the nozzle remains blocked, you will need to dismantle the hot end or replace the nozzle. Check your printer's manual to see exactly how to dismantle the hot end.

2. Bed Problems

2.1. Not Sticking to the Bed

It is very important that the first layer of your print is strongly connected to the printer's build platform so that the remainder of your part can be built on this foundation. If the first layer is not sticking to the build platform, it will create problems or failures later on.



Solution

The first thing you will want to verify is that your printer's bed is flat and level. If the bed is not level, one side of your bed may be too close to the nozzle, while the other side is too far away, or the nozzle may be too far from the build platform. Achieving a perfect first layer requires a level print bed. Another very common issue that causes low bed adhesion is finger oil or dirt. Clean your build platform with a soft cloth and an alcohol solution. Many people also use special sprays or other adhesion materials on the print bed. Changing your build platform (e.g. using a PEI sheet) is also a popular option for improving bed adhesion. Finally, another possible cause for low bed adhesion is when the first layer is printing too fast, in this case, the solution is to print the first layer at a slower speed so that the plastic has time to bond to the bed.

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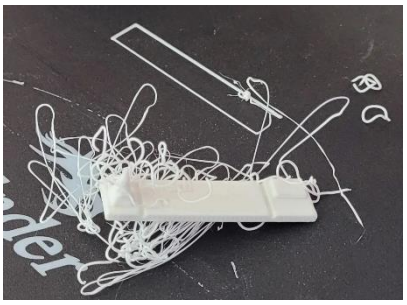
2.2. The Print is Stuck to the Bed

Sometimes the print model sticks to the print platform and you cannot remove it easily.

Solution

The most important is waiting a little longer for the print to cool down completely. After some cooling time, it may release of its own accord. Another solution is to carefully use a spatula/scraper to work around the edges and prize the print free (after the build plate has cooled down). To avoid dealing with this problem, many people install flexible (magnetic) build plates.

2.3. The Nozzle Knocks Off the Model from the Print Bed



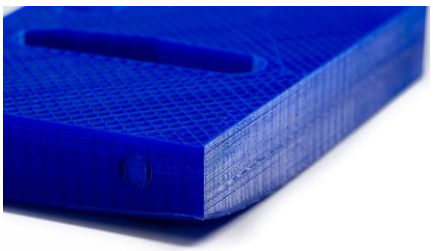
You've leveled out your 3D printer correctly and done the normal process of 3D printing, but for some reason, a little bit of contact with the print head and nozzle is likely to knock over your 3D print.

Solution

The main cause of this problem is poor layer adhesion i.e. your model does not stick well on the print bed (see 2.1 for possible solutions). Wrapping is another cause of such problems (see 4.1 for ways to fix this). Enabling the Z hop option (vertical lift) on your slicer may also fix this problem. Z hop causes the print head to move up or the build plate to move down (depending on the type of printer) by a slight margin after a retraction.

3. Print Quality Problems

3.1. Print Edges Are Bending (Warping)



At the base of the model, the print bends upwards until it's no longer level with the print platform. This can also result in horizontal cracks in upper parts and cause your print to come unstuck from the print bed

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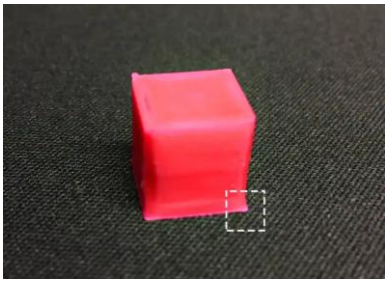
Solution

The easiest solution is to use a heated print bed. If you get that temperature right then the first layer will stay flat on the print platform. The print platform temperature is set by the slicer software. If you still find your print lifting at the edges then you can apply special sprays or other materials (e.g. special glue) on the bed to increase adhesion. Print platform calibration may also be needed (see 2.1), check that the bed is level and nozzle height is correct.

3.2. Print Bows Out at Bottom (Elephant's Foot)



The base of the model is slightly bulging outwards, an effect otherwise known as "elephant foot".

Solution

To stop elephant foot from appearing in your 3D prints the base layers of the model need to be cooled sufficiently so that they can support the structure above. Apply too much cooling however, and you risk the base layers warping. Getting the balance right can be tricky, start by lowering the temperature of the print platform by intervals of 5 degrees, (to within +/- 20 degrees of the recommended temperature). Another solution that can often help is to raise the height of the nozzle slightly, but be careful, too high and it won't stick to the platform.

3.3. Ripples and "Echoes" in Print (Ringing)

The effect of visual waves or rippling on the print surface is one of those minor and annoying problems that many simply overlook.

Solution

The issue of waves in your 3D prints is usually caused by one of two things: vibrations and speed. Make sure that the surface you use for your 3D printer is solid and there are no visual vibrations during printing. Also, you could reduce the print speed (see your slicer settings).

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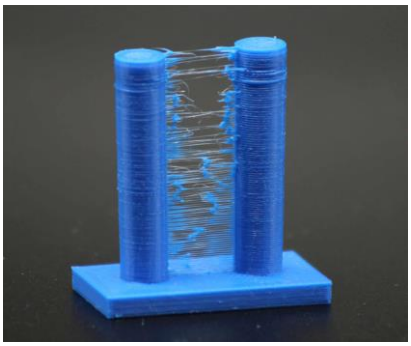
3.4. Stringing



Stringing (otherwise known as oozing, whiskers, or "hairy" prints) occurs when small strings of plastic are left behind on a 3D printed model.

Solution

This is typically due to plastic oozing out of the nozzle while the extruder is moving to a new location. One common solution is to change the retraction distance. This determines how much plastic is pulled out of the nozzle. In general, the more plastic retracted from the nozzle, the less likely the nozzle is to ooze while moving. Most direct-drive extruders only require a retraction distance of 0.5-2.0mm, while some Bowden extruders may require a retraction distance as high as 15mm due to the longer distance between the extruder drive gear and the heated nozzle. If you encounter stringing with your prints, try increasing the retraction distance by 1mm and test again to see if the performance improves. The next retraction setting that you should check is the retraction speed. This determines how fast the filament is retracted from the nozzle.

3.5. Pits and Hollows in Top Layer (Pillowing)

The top surface of the print shows unsightly bumps or even holes. The two most common causes are improper cooling of the top layer and that the top surface isn't thick enough.

Solution

To avoid top layer problems follow the combination of the following methods: increase the top layer thickness and adjust or improve the cooling fans (make sure to turn them on). Pillowing can also be reduced by lowering the print temperature, slowing down the print, and increasing the infill percentage. However, these solutions should only be used as a last resort as they can cause other problems.

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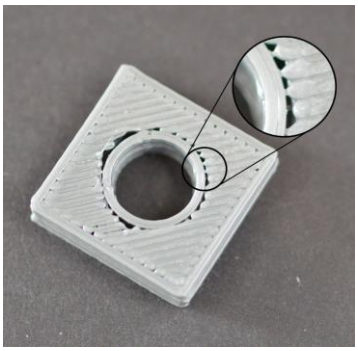
3.6. Gaps Between Infill and Outer Wall

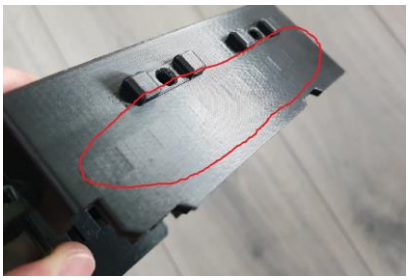


When you look at the top or bottom of the print, you can see a slight gap between the infill and the outer perimeter walls.

Solution

This is by far the most common issue and is really easy to resolve.
In your slicing software locate the "Infill Overlap" option and increase the value. Furthermore, you can increase the temperature and reduce the printing speed.

3.7. Infill is Visible from the Outside



An outline of the internal support structure can be seen through the walls of the print. This is also often referred to as "ghosting".

Solution

Make sure that the value you have selected for the shell thickness is a multiple of the nozzle size. Increasing the shell thickness will solve this problem. By doubling the size it should cover any overlap caused by the infill. If you still have this problem then select the option: "infill after perimeters" in your slicing software.

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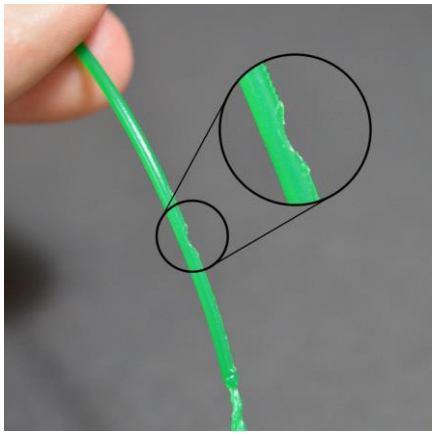
4. Filament Problems

4.1. Grinding Filament



Most 3D printers use a small drive gear that grabs the filament and sandwiches it against another bearing. The drive gear has sharp teeth that allow it to bite into the filament and push it forward or backward, depending on which direction the drive gear spins. If the filament is unable to move, yet the drive gear keeps spinning, it can grind away enough plastic from the filament so that there is nothing left for the gear teeth to grab onto. If this is happening on your printer, you will typically see lots of small plastic shavings around the extruder. You may also notice that the extruder motor is spinning, but the filament is not being pulled into the extruder body.

Solution

One of the first things you will want to check is the retraction settings for your extruder in your slicer software. If the retraction speed is too fast, or you are trying to retract far too much filament, it may put excessive stress on your extruder and the filament will struggle to keep up. As an easy test, you can try reducing your retraction speed by 50% to see if the problem goes away. If you continue to encounter filament grinding, try to increase the hot end temperature by 5-10 degrees so that the plastic flows easier. If you continue to encounter filament grinding, even after increasing the temperature, then the next thing you should do is decrease the printing speed. By doing this, the extruder motor will not need to spin as fast, since the filament is extruded over a longer period of time. The slower rotation of the extruder motor can help avoid grinding issues.

4.2. Snapped Filament

The filament spool still looks full, and when you check there appears to be filament in the feed tube, but nothing's coming out of the nozzle. This is more of an issue with Bowden feed printers than direct feed as the filament is hidden so breakages aren't always immediately obvious. This problem is caused by a number of issues but primarily old or cheap filament.

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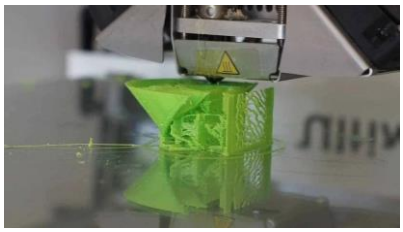
Solution

The first thing to do is to remove the filament from the printer in the usual way. If after reloading the filament it happens again, use another filament to check to see if it's not just the old brittle filament that should be disposed of. If this happens again check the nozzle isn't blocked and give it a good clean. Furthermore, check that the hot end is getting hot and to the correct temperature.

5. Other Printing Problems

5.1. Collapsing Supports



Supports are a regular and necessary part of 3D printing. Trying to minimize supports could lead to collapse during the printing.

Solution

Most slicing software allows you to generate support structures automatically and change the shape of the support structure you use. Structure types are fairly standard across different slicer software. Tree-type supports are more commonly used as they minimize the points of contact between the support structures and the actual 3D print, which means that they are easier to remove. If your supports reach all the way down to the print bed, you should be aware that the contact area has a significant effect on its likelihood to stick and avoid collapsing.

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