Module 6:

Basic Maintenance

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References

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6.1 Regular maintenance of i3 printers

It is recommended to regularly take some time to maintain your printer. This should be done even if the printer is working perfectly. **The inspection and maintenance of its various components should be done every couple of hundred hours of print-time.**

You can check the number of printing hours from your printer in the *LCD menu - Statistics*.

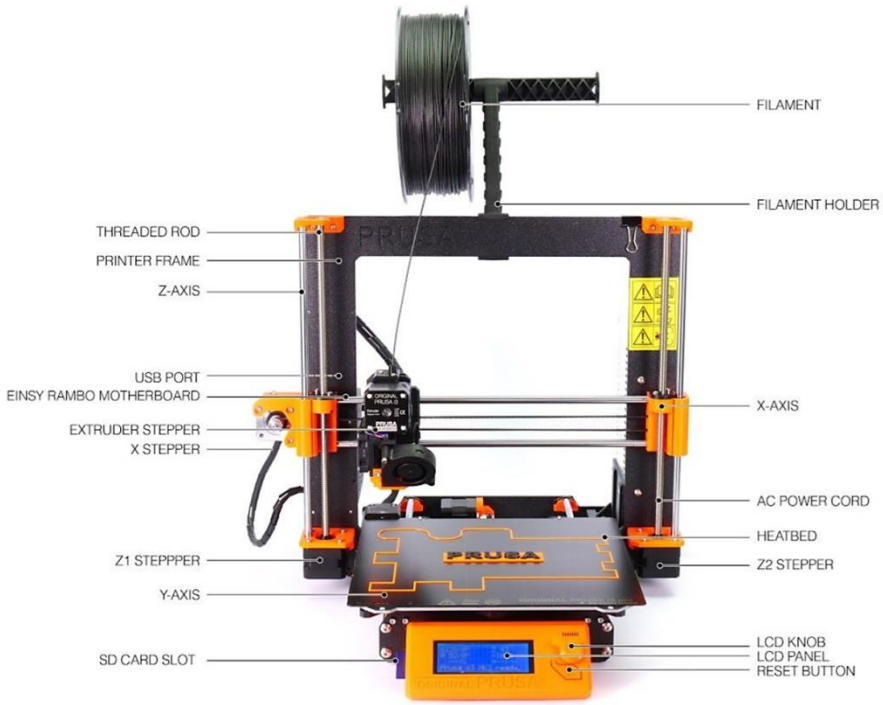


Figure 1 The printer Prusa

Useful tools:

Besides the usual tools, such as Allen keys, needle-nose pliers, and IPA + paper towels, you might need:

- Lubricant: the best option is the Prusa lubricant. One is sent with the printer, but it can also be found in our e-shop. Other recommended lubricants are Super Lube 210XX, GLEIT-µ HF 400, and Mogul LV 2-EP. We do not recommend lubricants with a very high viscosity.

Do not apply lubricant on the trapezoid nuts or the threaded lead screws of the Z-axis!

- **Compressed air:** also known as canned air. Be sure to not hold it upside down while spraying - otherwise, you could damage any electronic components while trying to clean them.

- **Brush:** a small brass brush is an ideal tool for cleaning the Bondtech filament pulleys. If you don't have a brass brush any brush with hard bristles will do the job. Alternative: You can use the acupuncture needle that comes with the printer or a toothpick.

Axes check

What to check on your printer:

- **Smooth rods:** scratches/grooves - take each rod between two/three fingers and move them slowly from one end of the rod to another, while rotating the fingers around the rod. If you notice any scratch, verify it with your fingernail.

- **Bearings:** Clean and lubricate the bearings and rods as shown this guide. Despite cleaning and lubricating the smooth rods, it can happen that the axes' movement is still not smooth. In this case, please remove the bearings from the printer and lubricate them from the inside with a pea-sized amount of lubricant.

Screws on the back of the extruder (X-carriage-back) or the U-bolts, should NOT be overtightened, as this might deform the bearings and cause scratches on the smooth rods.

- **Belt pulleys:** any debris around the belt pulleys and belts should be immediately removed to ensure smooth operations. Also, check if the set screw of the belt pulley is firmly secured on the flat side of the motor shaft.

- **Idler screw** (M3x40 with the spring on it) is not overtightened or too loose. Generally, the head of the screw, on the left side, should be about flush with the printed parts of the extruder. Details on the ideal tension of the idler screw can be found in Idler screw tension.

- **Y- and X-axis belts:** Both of the belts should be tight enough to sound like a low bass note when plucked. On the MK3/S/+, the belt status can be checked in the *LCD menu - Support - Belt status*. Recommended values are between 260 and 290. For details on adjusting the belt tension please see this article.

Flexible steel sheet

Only use acetone on the Smooth steel sheet! **Never use acetone on the Textured or Satin steel sheet** as the surface will be permanently damaged.

All flexible steel sheets should be cleaned regularly to ensure adhesion, but the exact methods and washing solutions can differ depending on your type of sheet.

You can find more information on how to take care of your flexible steel sheet in this article.

Fans

The Original Prusa i3 MK3/S/+ can spot if any of the fans stop spinning. However, that does not mean you should not check them during maintenance. Dust or plastic build-up can decrease their efficiency or even damage them.

A cotton swab can also be used to clean off dust and debris from the propeller or canned air will clear the dust. Tweezers can be used to take out any plastic strands. **Hold the propeller of the fan to prevent it from spinning while cleaning it with canned air**. Otherwise, it can get damaged. Clear away any debris that may be stuck and check that it can rotate freely.

Extruder driver gear

The MK2.5/S and MK3/S/+ printers are equipped with two Bondtech gears, made of hardened carbon steel. One is the **pulley gear,** secured on the extruder's motor shaft by a set screw. The other is the **idler gear**, which spins freely mounted on the idler door. **If you have had a clog, they can also have collected residue grinding the filament** which will, in turn, reduce their grabbing force on the filament.

Regular cleaning and lubrication will:

- Reduce wear and noise.
- Increase the grabbing force on the filament.
- Lower friction between the two pulley gears.
- Protect against rust.

If you're cleaning the gear inside the extruder without removing the extruder motor first, be sure to cover the PTFE tube to avoid any debris falling in. You can use a cotton swab - it will reliably cover the tube without damaging it). After you're done cleaning, give it a good puff of air to clear any remains, while the PTFE tube is still covered.

Open the Extruder idler door by releasing the screw(s) on the left side of your extruder.

- The **MK3, and MK2.5** extruders have two idler screws.
- The **MK3S/+ and MK2.5S** extruders have one idler screw.

Both hobbed gears can have a build-up of filament shavings stuck in the grooves. Using a brass brush, clean what you can, then rotate the gear a few degrees and repeat until you do a full turn. They can also be cleaned one at a time using the acupuncture needle that comes with the printer.

The gears can be covered by rust. There is no need to worry. The gears themselves should not be damaged. Remove any problematic bits of filament and clean them with a brush.

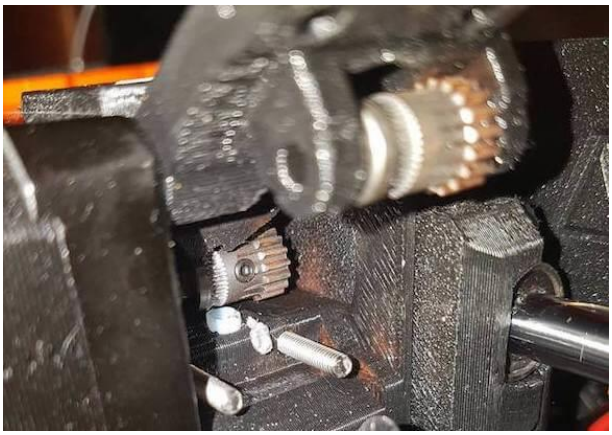


Figure 2 3D printer maintenance

Make sure the Bondtech pulley gear is aligned with the path of the filament and secured on the flat side of the motor shaft. Also, check that the shaft of the idler gear goes through both

"ears" of the Extruder-Idler-door plastic part and spins freely. You can find a more detailed guide in Checking/re-aligning the Bondtech gear (MK3S/MK2.5S).

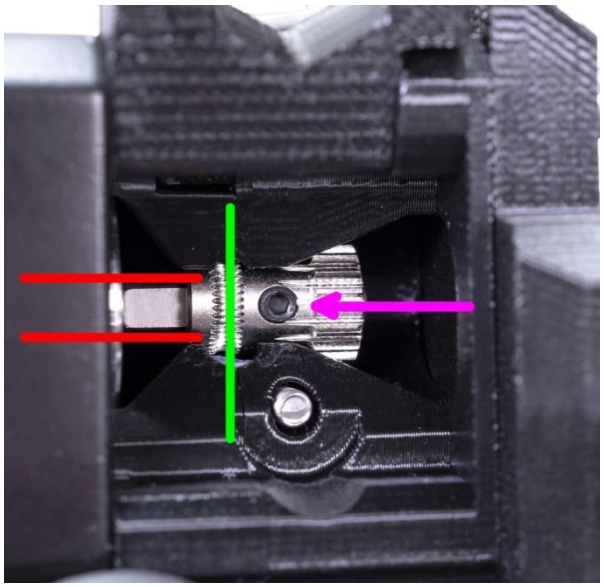


Figure 3 3D printer maintenance

Apply a tiny amount of the grease only to the teeth protruding outwards from the gear. **Make sure that the lubricant never gets in contact with the filament teeth.** Do not use oil-based lubricant as it may spread to unwanted sections, like where the filament is fed into the hotend.

Figure 4 3D printer maintenance

Electronics

On the MK2/S and MK2.5/S - Check and reconnect the electrical connectors on the miniRAMBo board **after the first 50 hours of printing and then every 150-200 hours.**

On the MK3/S/+ - Check and reconnect the electrical connectors on the EinsyRAMBo board **every 600 - 800 hours of printing.**

Before touching the electrical connections, please make sure that the printer is off, and unplugged from the main power source.

- Check if there are any pinched or worn cables on the printer.
- Open the electronics casing and blow compressed air in between the cables to get rid of dust.
- Check the connection of all of the wires on the mini RAMBo board or EINSY RAMBo board. Especially pay attention to the cables from the PSU (power source) and heaters. Make sure they are inserted all the way in and well-tightened.
- Users of the **Original Prusa i3 MK2/S** and **MK2.5/S** need to pay special attention to the printer's power-input and heatbed's power connectors. Make sure both the connector and socket are not damaged in any way.
- Users of the **Original Prusa i3 MK3/S/+** should lightly tug the power and heatbed connectors. If any movement is felt, then re-tighten the screws.

Nozzle change

Putting an exact number on how long a nozzle will last is very difficult, as it depends on how much you print, what types of filament you use, and how often you change between filament types. **It is not the first thing you should look to if you are experiencing extrusion issues**, but if the printer has been in use for more than 3-6 months and you are getting poor print quality, even after doing the mentioned maintenance, you may want to consider replacing the nozzle.

Firmware and software

You should always be using the latest **stable** firmware version that we have published for your specific printer model. You can check the firmware version you have in the *LCD menu - Support*.

- See this article to flash the fimware on your **MK3/S/+**.
- See this article to flash the firmware of your **MK2/S or MK2.5/S**

We also recommend using the latest version of our PrusaSlicer, as it enables you to **enjoy all the features of your printer**. It even saves information about the printer model, nozzle diameter, and firmware version directly into the g-code file so that the printer can warn you if anything is out of date or incompatible.

6.2 Nozzle replacement

The Original Prusa i3 printers use the E3D V6 Hotend. They are compatible with E3D V6 1.75 mm nozzles. The stock nozzle that accompanies the printer is an E3D 0.4 mm brass nozzle, but other types and diameters can be used as well. **The following procedure applies to all nozzles, except the Olsson Ruby.**

To replace the Olsson Ruby nozzle, follow the instructions on the official 3DVERKSTAN website. Otherwise, you could damage it!

Procedure

Have ready a 2,5 mm Allen key, pliers or 7 mm socket, 17 mm spanner (M10), and a non-flammable surface for the used nozzle (i.e. small plate or aluminum foil).

1. Gain better access to the nozzle by moving the extruder (Z-axis) as high as possible: Go to *LCD Menu - Settings - Move Axis - Move Z.* Spin the **Knob** to adjust the height.

2. Unscrew the two screws on the print fan and the single screw securing the fan shroud. Remove both parts (picture below).

Figure 5 3D printer maintenance

3. Preheat the nozzle to **285 °C** from *LCD Menu - Settings - Temperature - Nozzle*. Heating the nozzle is essential for this process.

CAUTION: Heated parts can cause severe burns!

4. Unload the filament from the *LCD Menu - Unload filament*. Optionally, perform a Cold pull (MK3S/MK2.5S).

5. Hold the heater block with a 17 mm spanner (M10) or adjustable wrench.

Be extra careful around the **fragile** hotend heater and thermistor wires. You can break them off or **short circuit the heater with your spanner!**

6. Unscrew the nozzle using the supplied pliers. If you are using the E3D nozzles from our online store, use a 7mm spanner (M4) or 7 mm socket. **Be careful, the nozzle is still hot! Place it out of the way on your non-flammable surface.**

7. Make sure that the set temperature (285 °C) didn't change. Holding the heater block with your spanner, carefully screw the new nozzle in and tighten it gently, but firmly. **Do not use excessive force!**

Our service- and assembly-team use a torque wrench rated for 1 - 5 N m, and **tighten the nozzle with a force of 2.5 N m** (Newton Meter).

Final inspection

There must always be a gap (~0.5 mm) between the nozzle and the heater block (left picture). The nozzle must be tightened/secured in the heater block, **locked against the heat break,** while heated (right picture). Failing to do so will cause leaks (center picture).

It may also be necessary to redo the First Layer Calibration after replacing the nozzle.

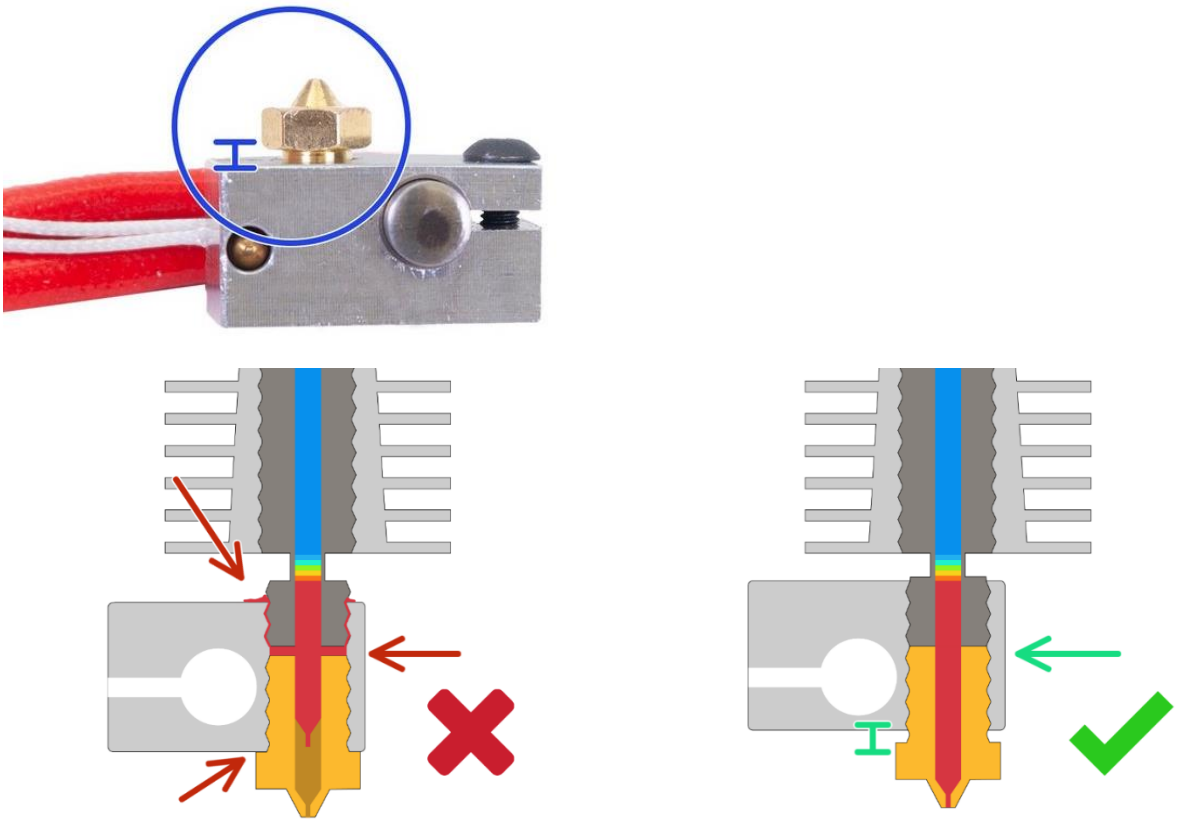


Figure 6 3D printer maintenance

6.3 Belt tension adjusment

Loose belts would cause a printer malfunction and prevent proper printing. It can cause Layer shifting, Ghosting, or other print abnormalities like getting an irregular shape instead of a perfect circle, when printing a cylinder. **The Y-axis belt is located under the heatbed, X-axis belt moves the print head. All adjustments are done with the 2.5mm Allen key.**

Checking belt tension

Run the Self-test or the Belt test, from Calibration on the LCD. The check *LCD-menu -> Support -> Belt-status.* You want the number between **240 and 300 (275~)**. *The lower the number, the tighter the belt is. Imagine it is a fictive count of teeth in circulation.*

For the MK2.5 and MK2.5S, a great way to check whether your belt is at the correct tension is to prints this Tension Meter for the GT2 belts.

Another way is to use the technique described in this step of the assembly manual to test if the pulley is correctly tightened and if the belt is not too loose. Hold the X-axis motor shaft with pliers (take advantage of the flat part of the shaft), fixing it in place (**purple circle**), then try to move the extruder by hand. **You should see no slack on the belt as a result of pushing on the extruder.** The same procedure can be applied to test the Y-axis pulley and belt.

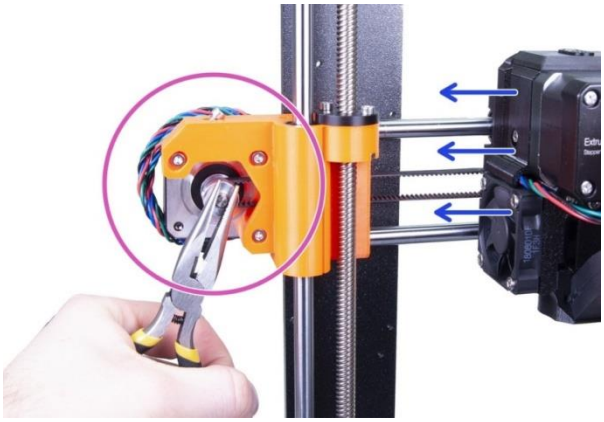


Figure 7 3D printer maintenance

X-axis belt

Slight adjustments MK3S

Loosen the two front-facing screws and make sure they have space to their right to move (**yellow circles**). While assisting with the rotation of the motor with your hand, tighten the M3x18 screw on top of the X-end-motor (**purple arrow**).

After each turn or two check the tension in the belt by pressing them together. For the optimal performance, the belt must need some force to press together with your fingers (green arrows). **Move the extruder all the way to the X-end-idler and try the belt tension in the middle of the X-axis.**

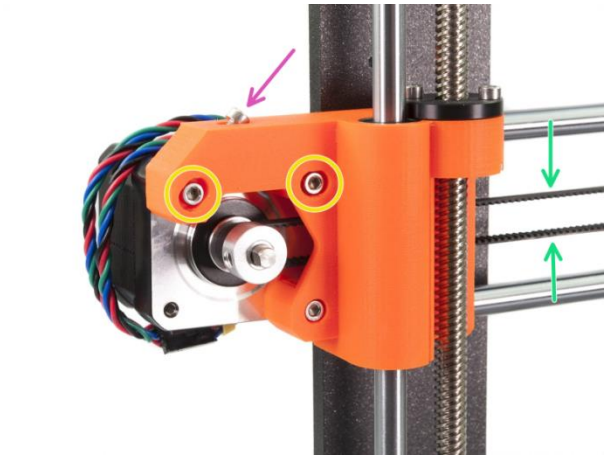


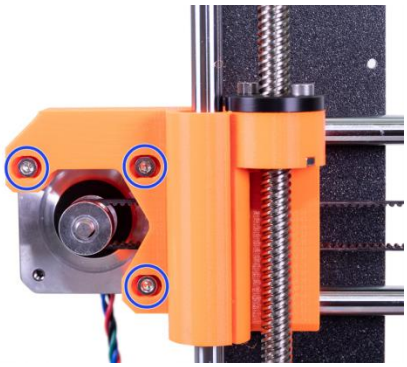
Figure 8 3D printer maintenance

Slight adjustments MK3S+

1. Slightly release all the screws holding the motor, otherwise, the "tensioner" won't work as the motor must be able to move (left picture).

2. Using the ball-end of the Allen key, start tightening the screw on the rear side of the X-end-motor, but after each turn or two check the tension in the belt (right picture).

3. When you achieve optimal tension, please tighten the screws again (left picture).



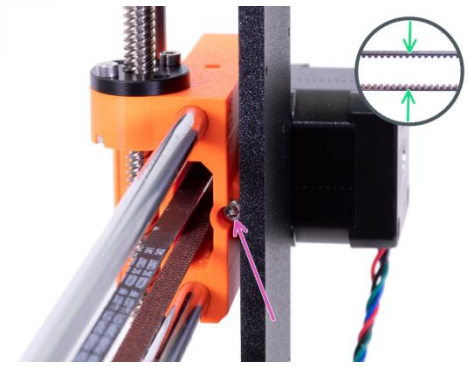


Figure 9 3D printer maintenance

Large adjustments (on extruder)

If a slight adjustment is not sufficient you must adjust it at the belt-holder. This is found on the back of the extruder and requires a little disassembly.

First, remove the two top-screws from the motor-holder to let the belt have some slack in order to easier manipulate the belt.

1. Snip the zip-ties on the back of the extruder (**red arrows**), which are securing the hotend wires **and** ones securing the cable-wrap.

Figure 10 3D printer maintenance

2. Unscrew the 4 screws circled in the picture below.

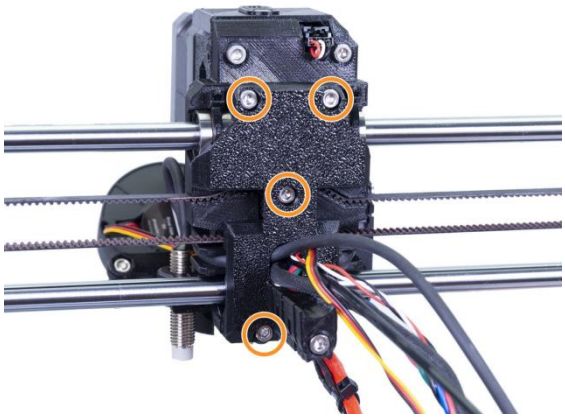


Figure 11 3D printer maintenance

3. Carefully pull the back-plate loose, making sure wires are safe, and turn the whole plate to the left or right.

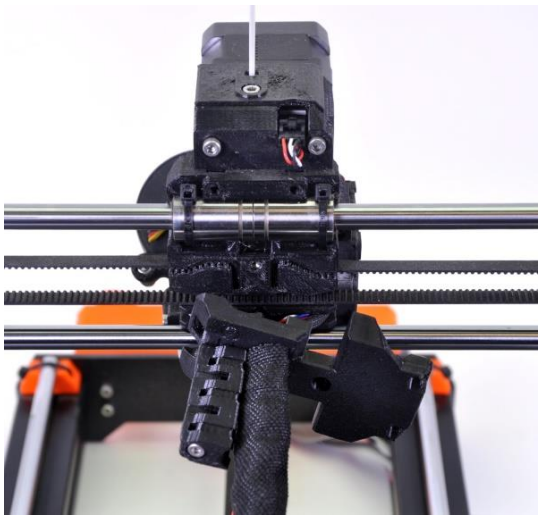


Figure 12 3D printer maintenance

4. You now have access to where you mount the belts. Put a mark on the belt with a pen or marker as close to the plastic part as possible, so you know how it was adjusted. Now, take out the belt from the mount and move it in 1-2 teeth.

It may be necessary to cut off the last tooth of the belt.

5. Place the back-plate back on, secure the screws, starting with the center one for alignment, then put on new zip-ties.

6. Re-tighten the screws on the x-motor, securing it. Adjust it tighter if needed.

Y-axis belt

Slight adjustments

On the front plate of the printer's frame, behind the LCD module, you will find the printed Y-axis belt idler. This is held by two M3X10 screws (**purple arrow**), going through the front plate.

If you have a gap between the idler part and the front plate of the frame (**blue arrows**) you can tighten the belt by using your 2.5 mm Allen key to turn the screws clockwise (**purple arrow**), closing the gap.

The easiest way to access the screws is from below, by moving the printer to the edge of its table, with the LCD module sticking out. You now have access to the bolts from below the LCD module.

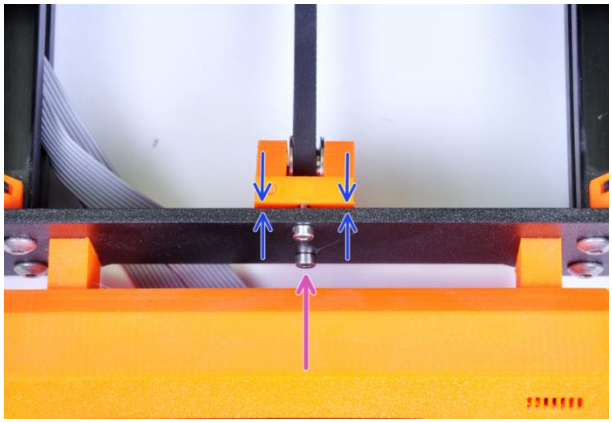


Figure 13 3D printer maintenance

Large adjustments

If a slight adjustment is not sufficient you must adjust it at the belt-holder. There are two main types of the Y-axis belt holder, one adjustable and one fixed. The adjustable belt holder was introduced in the first quarter of 2019, with the S-upgrade for the Original Prusa MK3. Adjustments for this are explained in '**Method 1**'. For an earlier Original Prusa MK3, follow '**Method 2**', for the fixed belt holder.

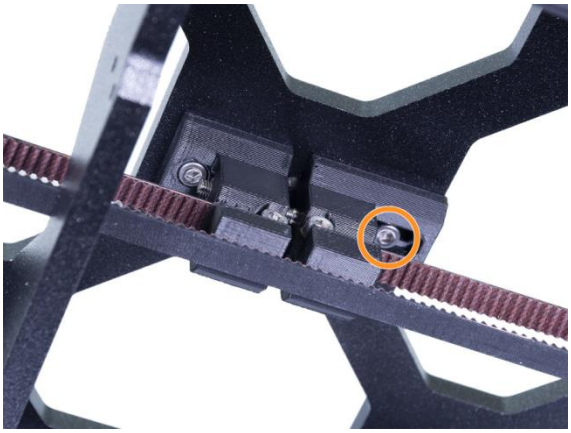
Method 1 - Adjustable belt holder

1. Unplug the printer and lay it over on the side of the PSU.

2. Below the bed carriage, you will find the belt holder. Loosen the right screw by turning it **counterclockwise** (**orange circle** left picture).

3. Turn the screw going through the two halves of the belt holder (**purple arrow** right picture). Turn **clockwise** to tighten the belt, moving the two halves together (**blue arrows**).

4. When at the correct tension, secure the right half of the belt holder again by turning the screw from step 2 clockwise (**orange circle** left picture).



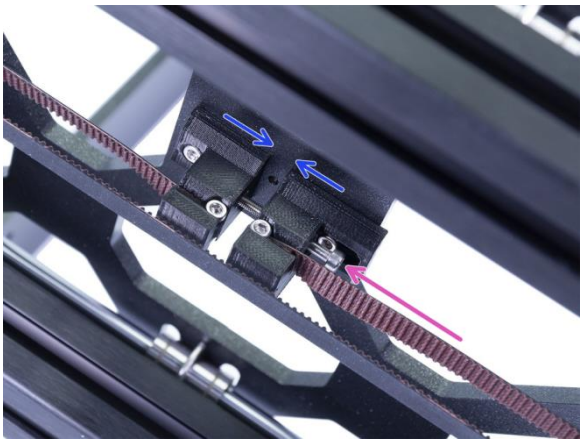


Figure 14 3D printer maintenance

Method 2 - Fixed belt holder

1. Unplug the printer and lay it over on the side of the PSU.

2. Detach the belt-idler in order to easier manipulate the belt (**purple arrows**). *Detaching the idler completely may not be necessary, but will make it easier to adjust the belt in the next step.*

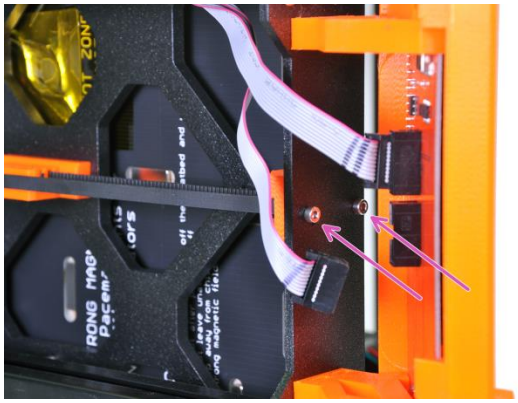


Figure 15 3D printer maintenance

3. Set a mark on the belt so you know how much you are moving it. Now take out the belt of the top slot, move it in 1-2 teeth (**blue arrow**), before pushing it back into the slot (**green arrows**).

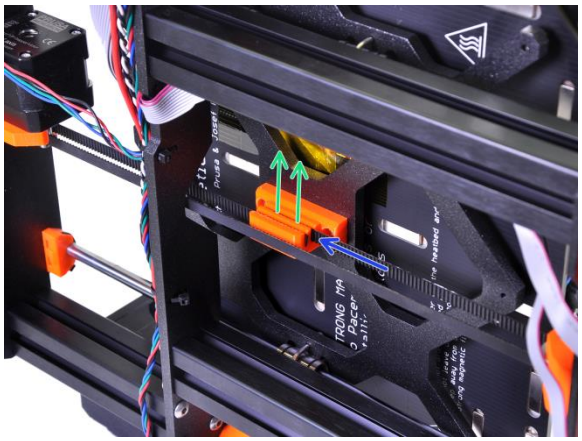


Figure 16 3D printer maintenance

Your belt mount may look slightly different, being another iteration, but the procedure remains the same.

4. Re-attach the belt-idler with its two M3x10 screws through the frame (**purple arrow**). Leave a gap with the frame, for slight adjustments (**blue arrows**).

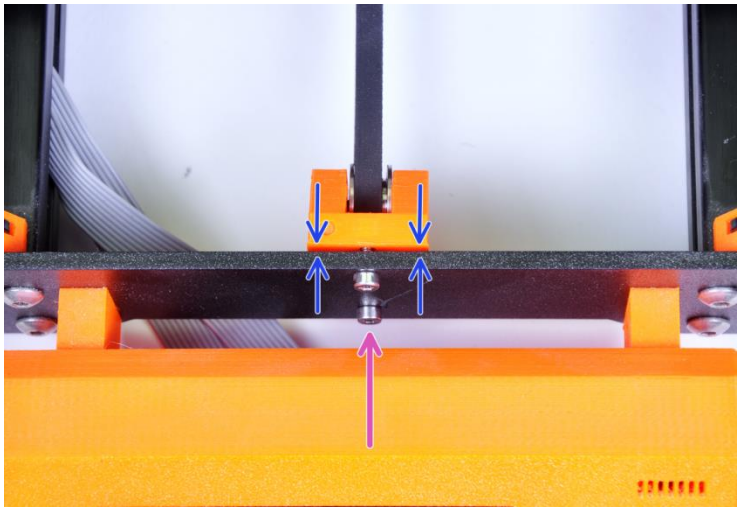


Figure 17 3D printer maintenance

6.4 Disassembly of hotend & heatbreak stuck in cooler

You can find the complete E3Ds assembly manual of the V6 hotend, which can be followed backward for disassembly. **This is the stock hotend on an Original Prusa MK3S/MK2.5S/MK2S.** However, as the manual works with brand new parts, it does not consider the changes that happen when being heated repeatedly to hundreds of degrees, again and again. Metal contracts and expands and thermal paste will turn crusty over time. Therefore there are some changes to the procedure when disassembling after a long time of use.

To extract the hotend follow this simple guide for MK3S/MK2,5S/MMU2S, and for MK3/MK2.5.

Disassembly

The assembly manual for the V6 is still optimal for most of this procedure, with a few exceptions. Moving backward, you are first removing the nozzle (at 280 °C) to release the heatbreak. However, this makes it harder to remove the heatbreak from the heat sink in later steps.

As the heatbreak can be quite fragile, and its threads me be damaged if you try to grip it with pliers, **we recommend that you unscrew the heatsink from the heatbreak, before removing the nozzle,** which locks the heatbreak in place. A Heatbreak can still bend and break so do not unscrew it at an angle. A bend will create a whole range of printing issues.

After you have unscrewed the heat sink from the heatbreak, proceed with the E3Ds assembly manual, by heating the block and unscrewing the nozzle.

Too late, it is already stuck!

Follow this procedure to resolve the issue.

1. Without any heat, manually screw your nozzle into its threaded hole in the heater block.

2. Screw it all the way in, then loosen it back a full turn (as described in step 3 of the E3D V6 Hotend assembly) creating a gap of about 1mm between nozzle and block.

3. Then screw the heatbreak, with the attached heatsink, into the heatblock from the other side as far as it will go.

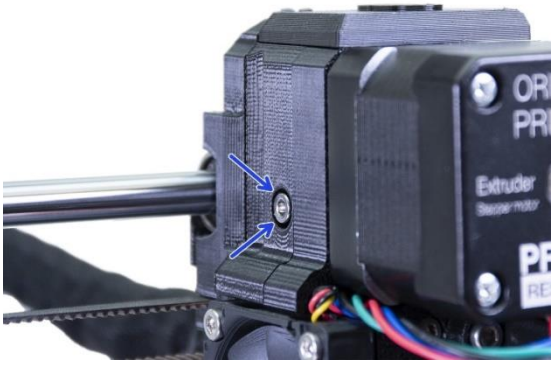
4. Tighten the nozzle with a pair of pliers and you now have a better handle. You can also grab this with pliers for some leverage when unscrewing the stuck heatsink.

6.5 Manual removal of fiber from the extruder

In case there is a clog in your hotend, the filament might grind against the Bondtech-gears and be damaged enough so it can't be unloaded. It might snap right above the PTFE-tube when you try to pull it out by hand. In this case, the filament will need to be removed manually.

Idler door open

Open the idler door by removing the spring-loaded tension-screw(s), on the left side of the extruder.



MK3S/MK3S+/MMU2S extruder (single idler screw)

MK3 extruder (two idler screws)

Figure 18 3D printer maintenance

MMU2S idler door

On the MMU2S, due to the "chimney" (IR-sensor-holder-mmu2s), you must remove the whole idler door by unscrewing the hinge- screw (red arrow) on the back.

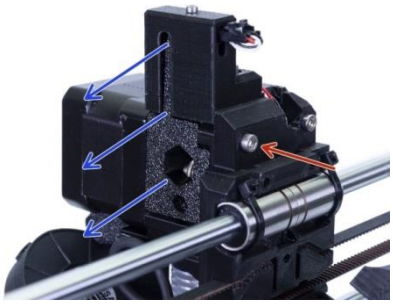


Figure 19 3D printer maintenance

If the filament snapped right at the edge of the PTFE you should start with Method number 1, where you try to push the filament through the hotend. If there is 0.5-1cm sticking out of the filament, reaching the Bondtech filament-pulley starts with Method number 2, pulling it out with pliers.

Setup

1. Go to the *LCD Menu -> Settings -> Temperature -> Nozzle* and set the temperature to 280º C. Wait for 3-5 minutes with the hotend at this temperature.

2. In the LCD menu in *Settings,* select *Disable steppers*.

3. Go to the *LCD Menu -> Settings -> F. Autoload,* so *Autoload* will not interfere.

From now on the hotend will be hot! Avoid touching the lower part of the extruder (heaterblock + nozzle)!

Method 1: Pushing the filament through the hotend

Using another piece of filament, a thin (1-1,5 mm) Allen-wrench or same diameter wire, at least 4.5 cm long for the MK3(s) and 6 cm long for the MMU2s, you are often able to simply push it through.

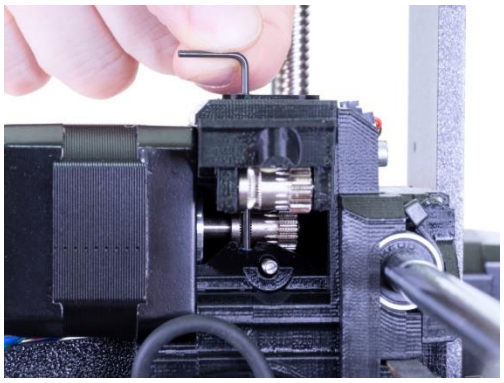


Figure 20 3D printer maintenance

1. Feed in from the top of the extruder your tool of choice, down past the Bondtech-gear, and on top of the stuck filament.

If you are able to push the stuck filament down the PTFE-tube with an Allen-wrench, switch to using filament after about 1-2 cm. Some Allen-wrenches may only be long enough to get it started.

2. In case the filament starts being extruded from the bottom, Keep pushing the filament to clear the nozzle and see the color change.

Method 2: Pull out filament with pliers

While hotend is heated to 280° C, firmly grab the filament with the needle-nose pliers that came with the printer. Slowly drag/feed the filament upwards, bit by bit, through the top of the extruder body, until it is completely removed from the PTFE-tube.

The filament can get stuck on geometry on the path up through where it is fed. It is also possible to pull it out of the idler door.

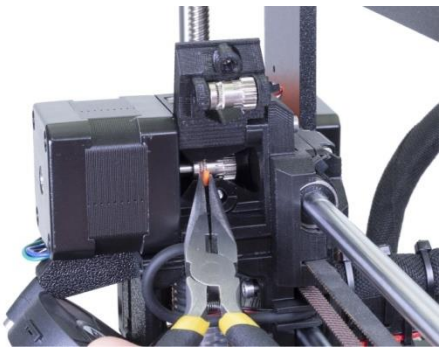


Figure 21 3D printer maintenance

After removing the filament, do a Cold pull (MK3S/MK2.5S) to ensure you have fully cleared the clog.

6.6 Checking / aligning the feed wheels

The Bondtech gears have a lot of pulling force. They might seem secure, but unless properly tightened, **on the flat side of the motor's shaft,** they can come loose and remain stationary around the spinning shaft. This might only be intermittent at first, acting like under extrusion, but the gear will continue to loosen and/or slide out of alignment with the filament path.

Typical issue (false clog)

This might appear as a clog at first, but you can see the motor axle rotating fully, and there no clicking sound, which is common during a hotend clog. The filament is not moving at all and when pulled out, it does not look like it has been ground by the gear, hence the name "false or ghost clog".

Figure 22 3D printer maintenance

It can be helpful to draw a line on the radius of the axle, to see if it spins or not.

Accessing the Bondtech gear

Start by getting out your 1,5 mm and 2.5 mm Allen key. Using the 2.5 mm Allen key, release the spring-tensioned idler-screw(s) completely and open the idler-door. It is 1 on the Original Prusa MK3S & MK3S+ (left picture) and two on the Original Prusa MK3 (right picture). The MMU2S extruder has one screw, but some additional parts.

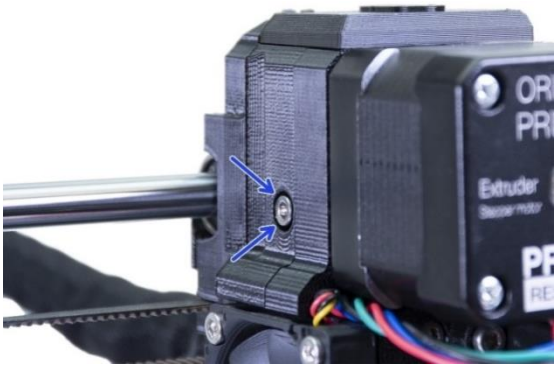


Figure 23 3D printer maintenance

Original Prusa MK3S & MK3S+

Original Prusa MK3 (Non S/+-upgrade)

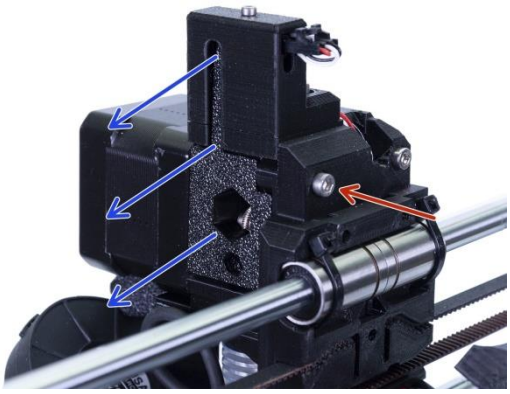


Figure 24 3D printer maintenance

On the Original Prusa MMU2S, you must remove the whole idler-door (blue arrows),

by removing the screw acting as its hinge (red arrow).

On the Original Prusa MK3S, remove the single screw on the top of the extruder to remove the fil. sensor cover to open the idler-door all the way.

Rotating the motor's shaft

You will now have access to the Bondtech gears. With the idler-door open, we will check if the Bondtech gear is secured on the **flat side of the motor shaft and if the gear is out of alignment with the filament path.** We do not recommend moving the motor shaft by hand. The best is to start rotation from the LCD-menu:

- Preheat the nozzle from the *LCD-menu -> Setting -> Temperatures -> Nozzle -> 180 °C.* The firmware will not let you manually move the extruder motor unless heated to at least 175 °C.

The nozzle is now hot! Careful so you do not burn yourself.

- Navigate the LCD-menu to *Settings -> Move axis -> Extruder*, and you can now spin the extruder motor, with the knob on the LCD panel.

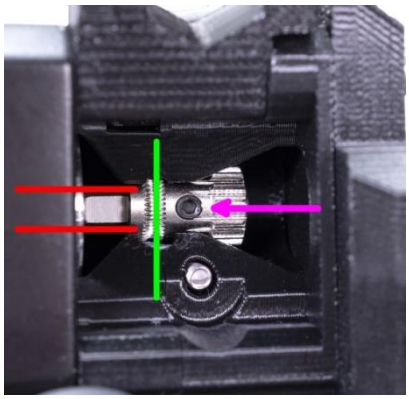


Figure 25 3D printer maintenance

Make sure the flat side of the motor shaft is visible (**red lines**), aligned with the black set-screw on the pulley (**purple arrow**), and that pulley-grooves are aligned with the filament (**green line**).

The set-screw may be stuck due to rust or Loctite. If you have to use a lot of force you may risk stripping the head of the screw. Consult with our technical support before you use excessive force.

You can use a piece of filament, inserted from the top (**blue arrow**), to check alignment. Then use the 1.5 mm Allen wrench or your nail to move the Bondtech gear into position, before securing the set screw.

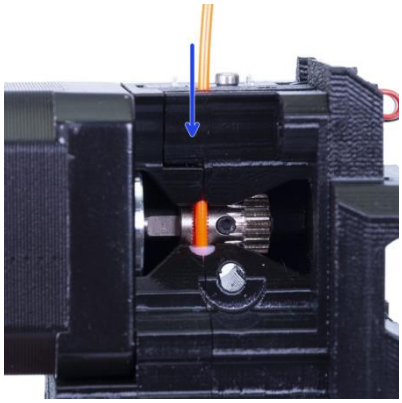


Figure 26 3D printer maintenance

6.7 How to shorten a PTFE tube - Original Prusa printer

Step 1 **Introduction**

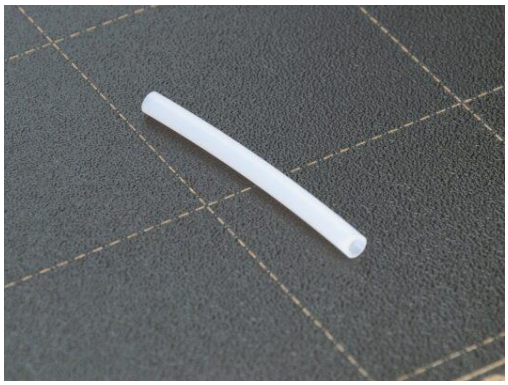


Figure 27 3D printer maintenance

*This guide is dedicated to the PTFE trimming for **Original Prusa printers**, supported models are listed later on.

For **Multi Material** PTFE trimming guide, go to: How to trim PTFE tube - Multi Material

*Read all these instructions before proceeding with the actual trimming and drilling! First few steps explain necessary tools, exact dimensions are given later.

***Where to get the PTFE tubes?**

*Trimmed and drilled tubes are available as spare parts at our eshop (shop.prusa3d.com), in case any tube is missing, please contact our support via the live-chat window.

*Alternatively, you can purchase the PTFE tubes from other suppliers. Make sure the PTFE tube has the desired dimensions (diameter), the lowest possible tolerances and also the hole is properly centred.

Regarding the brands, we have very good experience with FESTO. You can also get PTFE tubes from E3D.

Step 2 **Proper cutting and trimming tools**

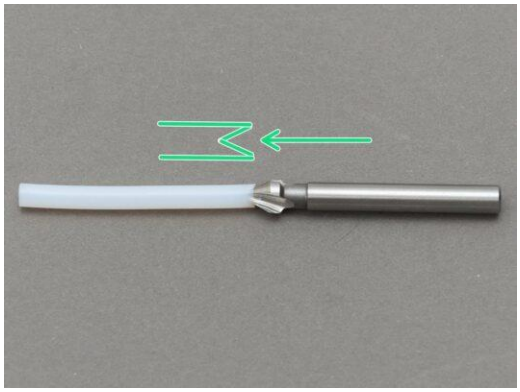


Figure 28 3D printer maintenance

Figure 29 3D printer maintenance

ATTENTION!!! Please read all instructions at least twice! If you trim or drill the tube improperly, you will have to order it again!

READ CAREFULLY instructions for the tools before you proceed further. Prusa Research is not responsible for any harm or injury.

*For trimming get a cutting tool with a thin blade. Use either razor or carpet knife. **DON'T** use kitchen knife.

*For drilling is recommended to use a drill bit with conic head or you can use a drill bit with diameter 3,5 - 4 mm. The point is to make a conical entrance in the tube.

Step 3 **Trimming the PTFE tube**

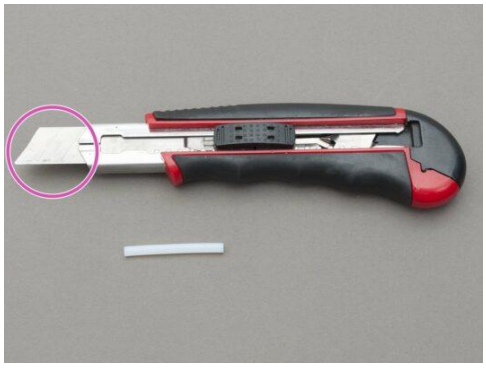
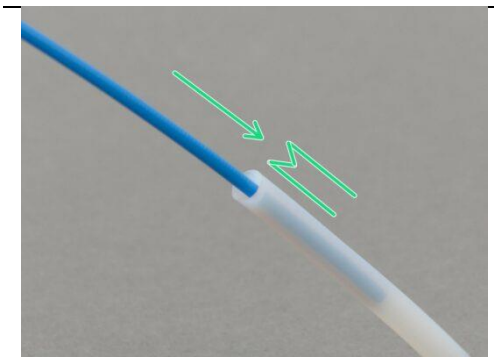


Figure 30 3D printer maintenance

*Take the razor or knife and carefully trim the tube.

Don't press too hard during the cutting on the tube, you can deform the circular shape and this will lead to filament jam!

Step 4 **Drilling the tube's edge**



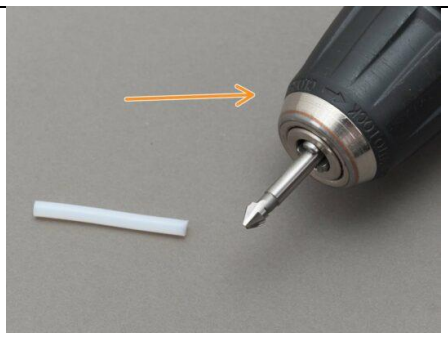


Figure 31 3D printer maintenance

*After cutting the tube to the appropriate length, you need to create the conical entrance.

*Use the drill bit you've prepared in the beginning. You can use an electric drill, but set it to low RPM and press very gently.

*For the other end, it is possible to use a pencil sharpener.

*It is important to achieve smooth entrance, so the filament will slide in. Clean the tube from any particles, which might prevent it.

Step 5 **Latest printers**

Figure 32 3D printer maintenance

***Latest printers:**

*Original Prusa i3 MK3S+

*Original Prusa MINI/MINI+

Step 6 **Obsolete printers**

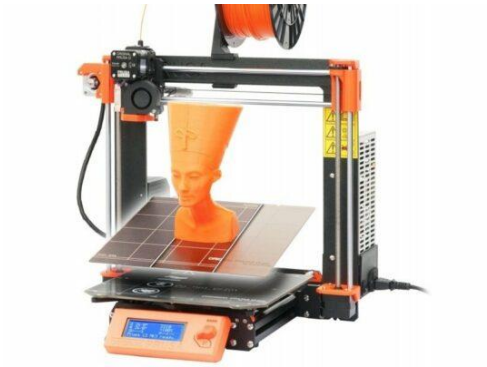


Figure 33 3D printer maintenance

***Obsolete printers:**

*Original Prusa i3 MK3S

*Original Prusa i3 MK2.5S

*Original Prusa i3 MK3

*Original Prusa i3 MK2.5

*Original Prusa i3 MK2/S

Step 7 **PTFE for the MK3S+**

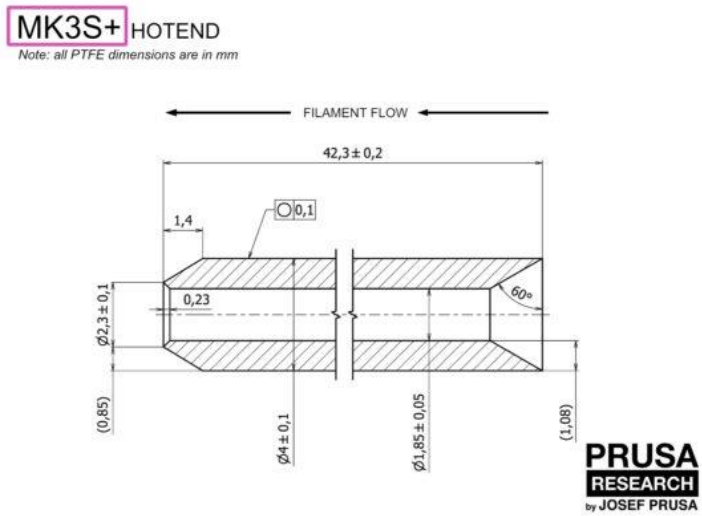


Figure 34 3D printer maintenance

This an ideal shape of the PTFE tube for Original Prusa i3 printer. Given dimensions and angles are recommended values.

*HOTEND PTFE

All dimensions are in millimetres.

6.8 Replacement of PEI foil

Step 1 **Damaged PEI surface**

Figure 35 3D printer maintenance

*The PEI surface is very durable, however, it is possible to damage it.

*Make sure you always wait a while after bigger prints are finished. Before you try to remove the printed objects.

*Have a look in the 3D Printing Handbook for materials, which need special treatment of the PEI surface to avoid future damage to your printer.

*If your printing surface is damaged severely, let's move to the next step.

As soon as you remove the damaged PEI sheet, please apply a new one. The PEI sheet works also as protection against atmospheric corrosion.

Step 2 **Shopping list (part 1)**

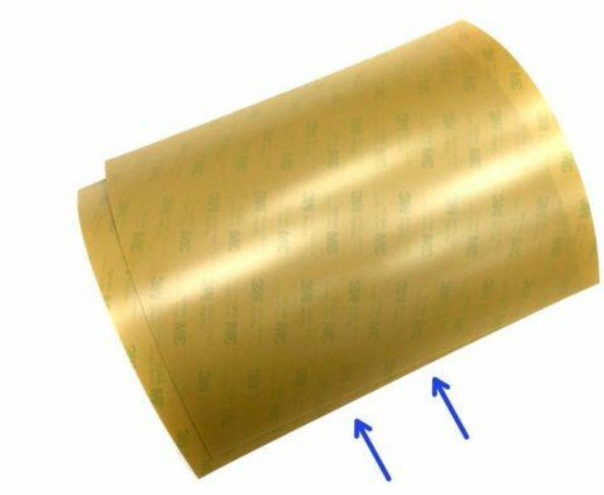


Figure 36 3D printer maintenance

Figure 37 3D printer maintenance

***Please prepare following tools and equipment before you start:**

*Kitchen freezer

*New PEI sheet (order here, you must be logged in)

*Slotted screwdriver for PEI sheet removal

*Limonene (Lemonesol, D-limonene or something similar)

*Nitrile gloves (more than one pair)

*Paper towels (on a roll)

*Disposable fabric towels (on a roll)

Step 3 **Shopping list (part 2)**

Figure 38 3D printer maintenance

Figure 39 3D printer maintenance

*Sharp knife for PEI sheet trimming

*Plastic scraper (ice scraper will do fine)

*Microfibre cloth to prevent scratches to the new PEI surface

*Plastic bag bigger than the steel sheet

*Surface to work on - best is sturdy foam board, ideally at least twice the size of the steel sheet. A thin plastic sheet isn't recommended.

*Glass of clean tap water

*IPA or acetone

Get all those items in advance, it is very complicated to stop or even pause in the middle of the process.

Step 4 **Other compatible products**

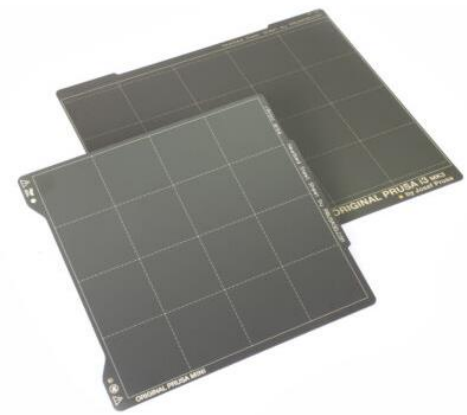


Figure 40 3D printer maintenance

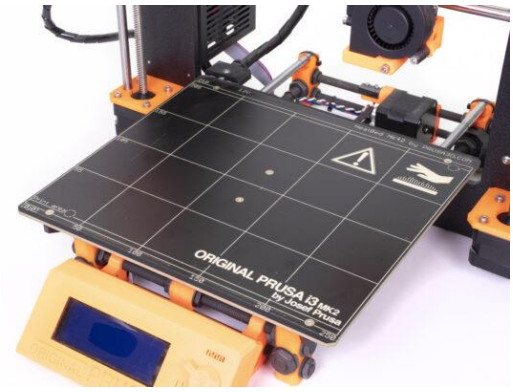


Figure 41 3D printer maintenance

*

This guide works also for **Original Prusa MINI/MINI+** smooth PEI steel sheets.

Since these are a little bit smaller, the difference is that after applying a new PEI sheet you have to trim more material from its sides.

*

The same new uni-size replacement MK3S+ PEI sheet can also be used for older MK2S printer heatbed. Compared to the discontinued MK2S PEI sheet, the MK3S+ PEI is a bit larger and more material has to be trimmed after applying.

After you get the new PEI sheet and all the other necessary materials, please follow the older guide for MK2S printer.

Step 5 **Freezing the damaged PEI surface**

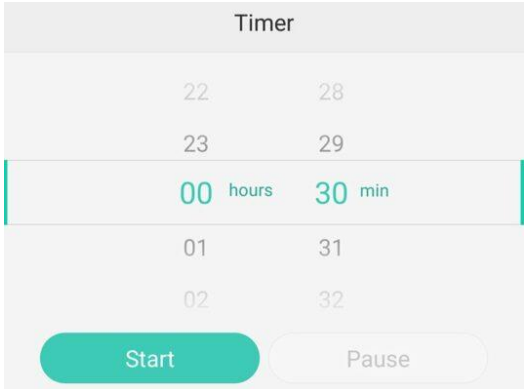


Figure 42 3D printer maintenance

*For easier removal of the damaged PEI surface, we need to place it in the freezer.

*Set the temperature below -20°C (-4°F) or lower if your freezer allows it.

The more you freeze the steel sheet the more time you get to remove the PEI sheet before the glue starts to stick again.

*Place the steel sheet in **at least for 30 minutes**.

Don't place the new PEI sheet in the freezer as well ;)

Step 6 **Removing the PEI sheet**

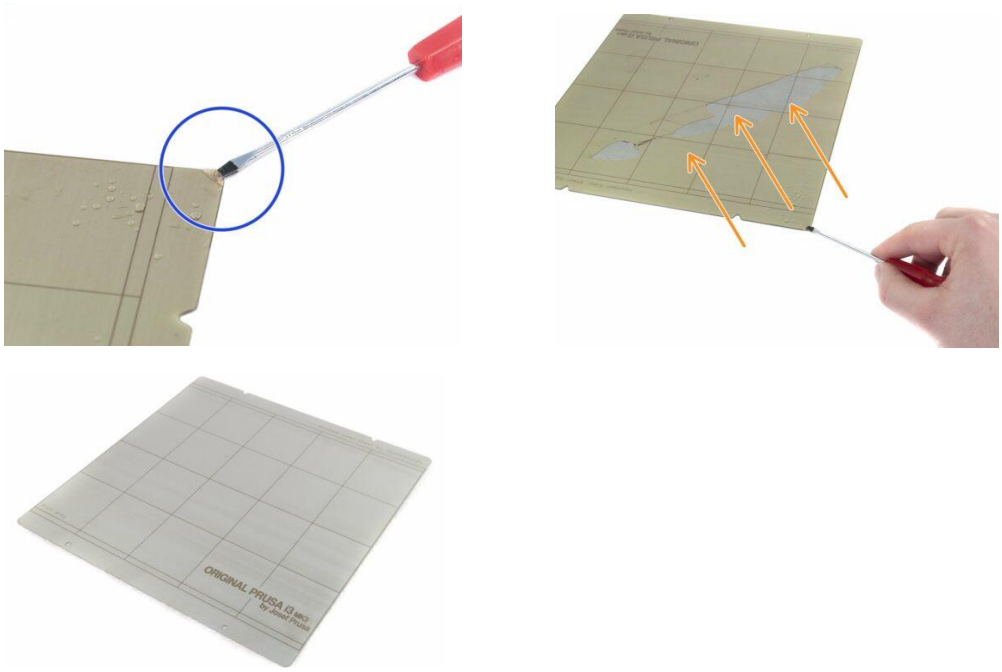


Figure 43 3D printer maintenance

***Time is of the essence here**! As soon as the temperature increases, the glue between the PEI sheet and surface of the steel sheet activates again!

*Take the steel sheet out from the freezer and using a sharp tool (e.g. screwdriver) lift one edge of the PEI sheet.

*Peel the entire PEI sheet off. The frozen glue will remain on the steel sheet. Proceed quickly!

Be careful, you can easily scratch the steel sheet or hurt yourself!

If your PEI surface is damaged from the other side as well, you can remove it now.

Step 7 **Glue removal - placing the PAPER towels**

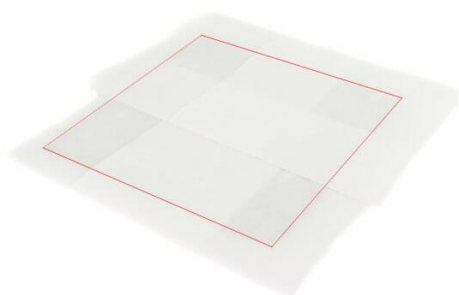


Figure 44 3D printer maintenance

*As stated in the previous step, the glue will remain on the sheet and we need to remove it.

First, take the board or any sturdy disposable underlay and place the steel sheet on it. Don't take the board away until you finish the glue removal process.

*Place the paper towels on the steel sheet as shown in the picture. The whole glue surface has to be covered.

The red line represents the steel sheet under the towels.

Step 8 **Glue removal - it is Limonene time**

Figure 45 3D printer maintenance

IMPORTANT: this step requires you to work the cleaning solvent (e.g. Limonene). Use the nitrile gloves and don't leave the bottle unattended. **Read the safety instructions first!!!**

*Pour the Limonene on the paper towels until they are completely soaked with it.

*Place the steel sheet with towels in a plastic bag to slow down Limonene evaporation.

Seal the bag to prevent the Limonene evaporating out. You can use the plastic bubble bag your steel sheet originally arrived in or any other plastic bag, which can be reasonably sealed.

Step 9 **Glue removal - letting the Limonene work**

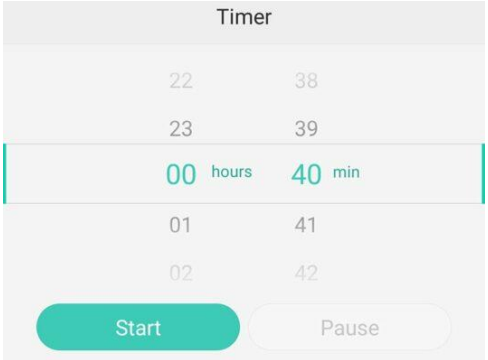


Figure 46 3D printer maintenance

*Let the Limonene do its magic **for at least 40 minutes.**

Make sure no child or your house pet can reach plastic bag during this period.

Open window(s) and let new fresh air in the room, however, don't allow the room temperature drop too much.

Step 10 **Glue removal - removing the plastic bag**

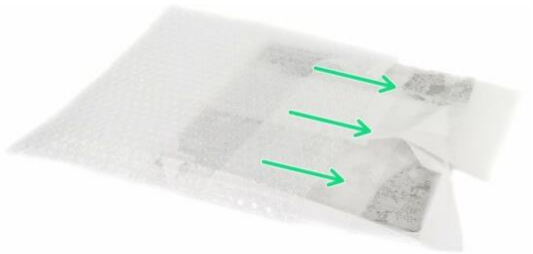


Figure 47 3D printer maintenance

*Remove the steel sheet from the plastic bag.

*Make sure you still have the disposable board below your steel sheet as now it gets a bit messy.

*Remove the paper towels.

Step 11 **Glue removal - scrapping the glue**

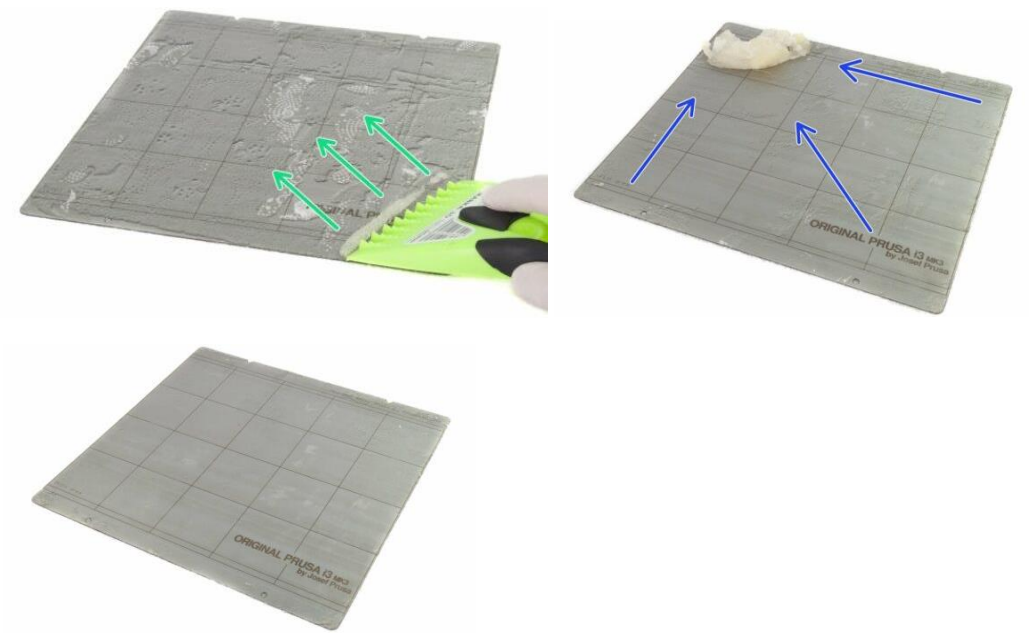


Figure 48 3D printer maintenance

Proceed carefully and with patience. You might damage the scraper or the steel sheet.

*Get a plastic scraper and start peeling the glue from one corner.

*Try concentrating the glue in one place, it will be easier to remove it as one piece.

*Sheet looks almost clean, but we need to make sure all the glue is out. Proceed to the next step.

Now, use the fabric towels to clean the scraper. Paper ones tend to tear up easily.

Step 12 **Glue removal - looking for "dirty" spots**

Figure 49 3D printer maintenance

*Take a closer look at the sheet, there might be spots with the remaining glue.

*Soak them with Limonene again, let it interact for few seconds and start removing the glue with the scraper again.

*This is how the steel sheet should look like. No bumps or spots with the glue.

*Apply this procedure on the entire sheet and repeat it until the steel sheet is completely "glue-free". Clean your scraper after each round, so you won't spread the previously removed glue.

Use the fabric towels to clean the scraper. Paper ones tend to tear up easily.

Step 13 **Cleaning the steel sheet (water)**

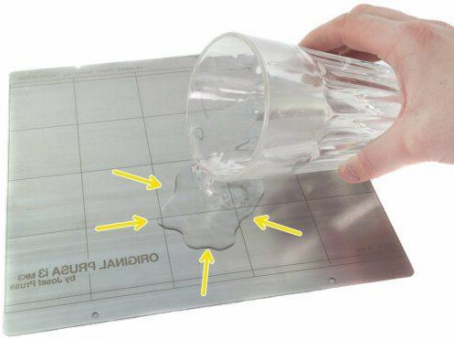


Figure 50 3D printer maintenance

*Limonene tends to evaporate, but we need to make sure, there is none of it left including the smallest particles of the glue.

*Use distilled or clean tap water and pour (or spray) a reasonable amount on the surface.

*Wipe the entire sheet with a towel (paper or fabric).

Step 14 **Cleaning the steel sheet (IPA)**

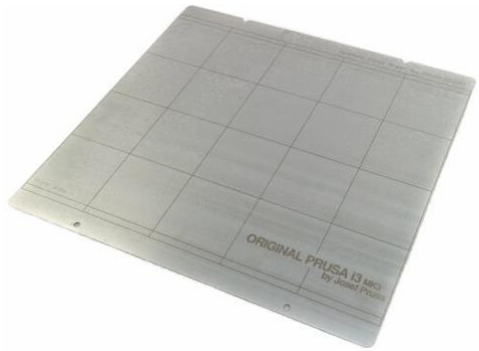


Figure 51 3D printer maintenance

*Clean the steel sheet using IPA (or something similar that can remove grease marks) and a fabric towel.

After doing this, make sure no dust or fibres remain on the steel sheet surface! Also, avoid touching the sheet with your bare hands!

*The cleaning process is finished, now you can close the Limonene and get rid of the board below the steel sheet. Make your workspace clean.

If you removed the PEI sheet from both sides, turn the sheet to the other side, go back to the Step 6 and repeat the glue removal process.

Step 15 **The PEI sheet preparation**

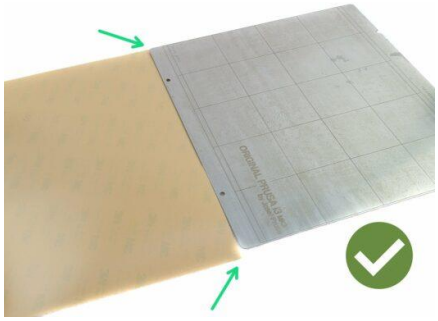


Figure 52 3D printer maintenance

WARNING: Read all the instructions first and proceed carefully. Once you glue the PEI sheet wrong, there is **NO WAY BACK !!!**

*The **PEI sheet** is **NOT SQUARE**, compare it to the steel sheet to find proper orientation

*Properly oriented PEI sheet must stick out 1-2 mm on each side. There may be a larger overhang if you´re replacing the PEI sheet on Prusa **MINI/MINI+** steel sheet or your **MK2/MK2S**

DO NOT try to peel out the PEI sheet when it's glued, even in small area, it'll ruin the glue at that place!

Step 16 **Gluing the new PEI sheet**

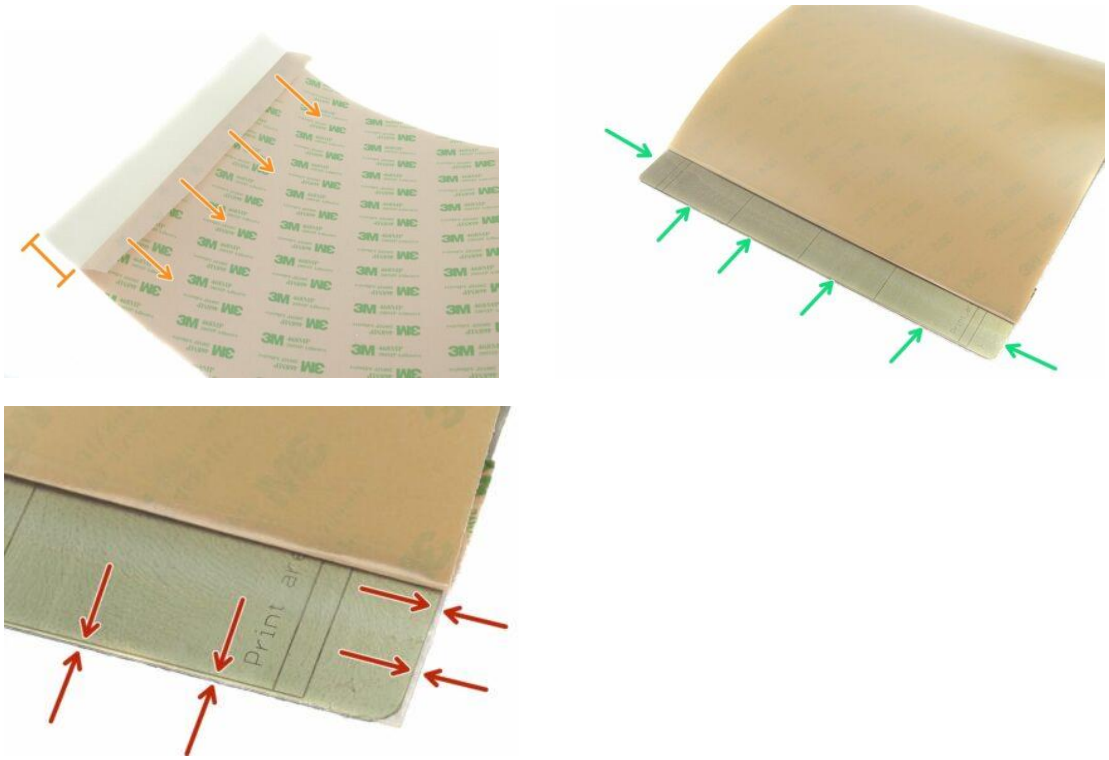


Figure 53 3D printer maintenance

*Peel out about 2 cm (1 inch) of glue protector from the SHORTER side of PEI sheet as shown in the picture.

*Make sure the PEI sheet is placed as shown in the picture. **The edges of the PEI sheet have to be aligned with the edges of the steel sheet.** The PEI sheet can slightly overlap the steel sheet edges, we will trim it later.

*Take a closer look to ensure both the PEI sheet and the steel sheet edges are aligned (parallel).

Step 17 **Bonding the PEI and steel sheet**

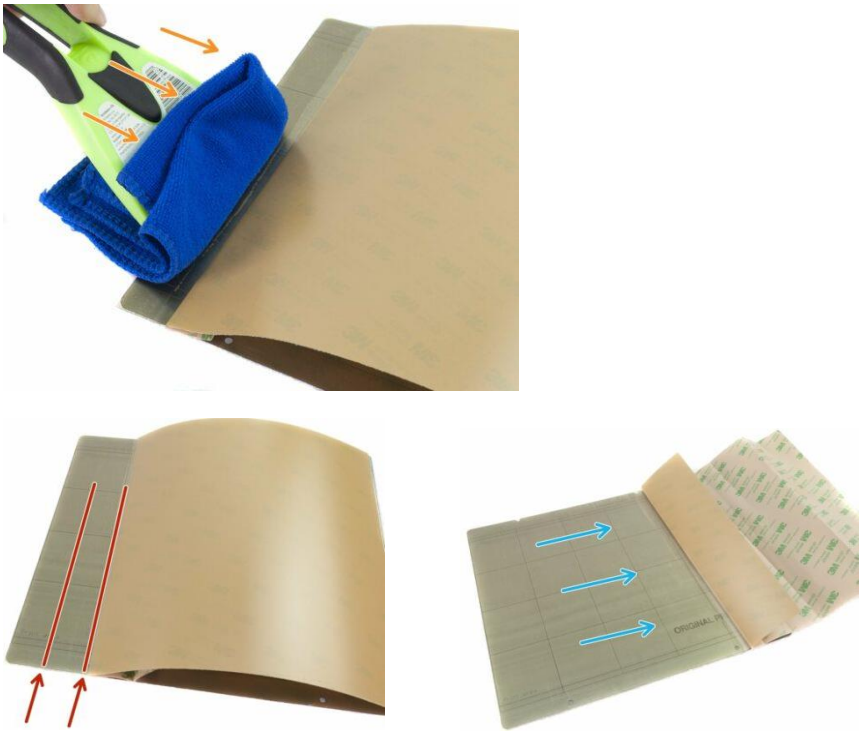


Figure 54 3D printer maintenance

*Wrap the plastic scraper in the microfibre cloth and start pressing the PEI sheet against the steel sheet.

Proceed by 2-3 cm strips at MAX!!! Larger strips might trap air inside and cause an uneven surface.

*Cover the entire surface of the steel sheet, use the scraper in all directions, **BUT BE CAREFUL** around the edges! See the next step for more.

Step 18 **Applying the PEI sheet near the edges**

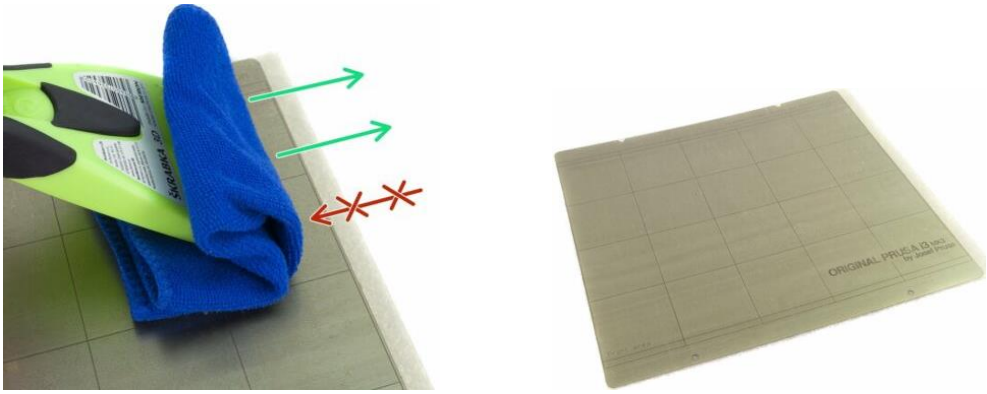


Figure 55 3D printer maintenance

*__BE EXTRA CAREFUL__ while working near the edges. **ALWAYS** swipe only out from the sheet, **NEVER** back. You might accidentally lift the PEI sheet up and let some air under it.

*Swipe across the entire surface and be careful around the edges.

*When ready, leave the glue do its work for a few minutes. You can clean most of the tools, leave just the knife, IPA and towels with you.

Step 19 **Trimming the edges**

Figure 56 3D printer maintenance

*Trim the extra PEI sheet using a sharp knife you prepared earlier. **ALWAYS** cut from the side of the applied PEI sheet.

*No need to perforate the circular openings. Those are used to hang the steel sheet during the manufacturing process.

*Be careful while cutting out the V-shaped openings, **ALWAYS** cut towards the steel sheet, **NEVER** outwards. Again, you might lift the PEI sheet.

Step 20 **ALL DONE!**

Figure 57 3D printer maintenance

***Congratulations!** Your printing surface is like brand new!

*Place the steel sheet on the printer, clean it with IPA and give it a test print ;)

6.9 How to replace a hot end thermistor

Step 1 **Cut selected zip ties**

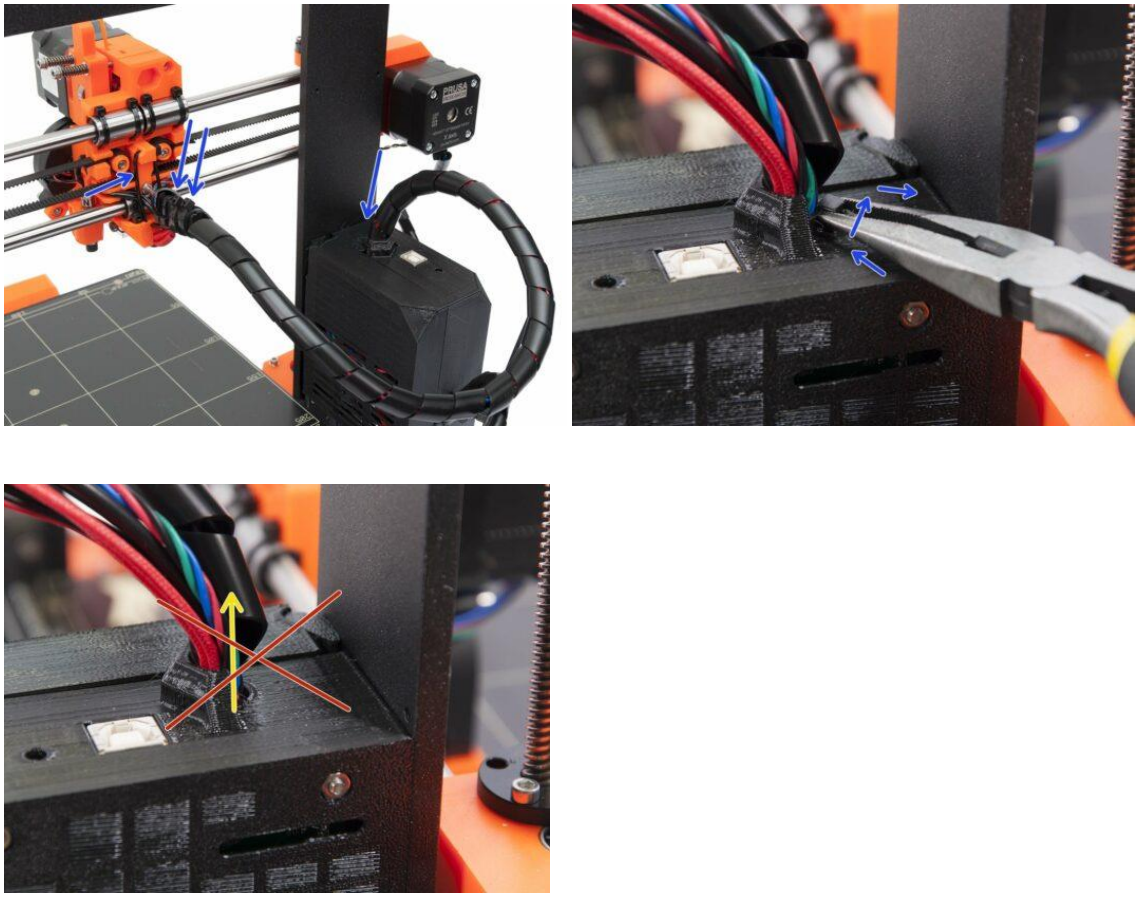


Figure 58 3D printer maintenance

BEFORE YOU START ensure the printer is turned off and unplugged from the electricity to avoid damage to you and the printer!

*Turn the back of the printer towards you.

*Using pliers cut the selected zip ties.

Don't try to remove the spiral wrap yet, it might be wrapped partly inside the cover and you can damage the cables. Wait for the next step!

Step 2 **Unwraping the spiral wrap**

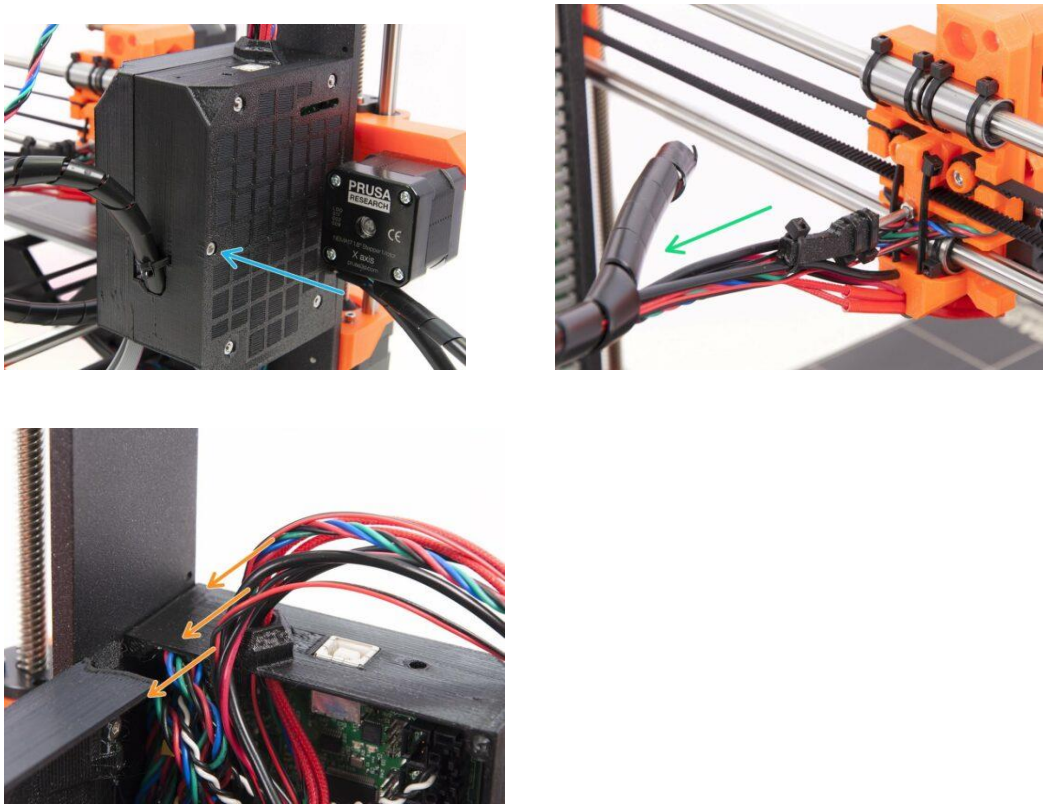


Figure 59 3D printer maintenance

*Using 2.5 mm Allen key release the bolt holding the RAMBO cover door.

*Unwrap the spiral wrap all the way to the Rambo cover.

*Unwrap spiral wrap inside the cover and remove it completely.

*Gently take all the cables away from the top opening. Proceed with caution and don't pull hard on the wires.

Step 3 **Unplugging thermistor from RAMBo**

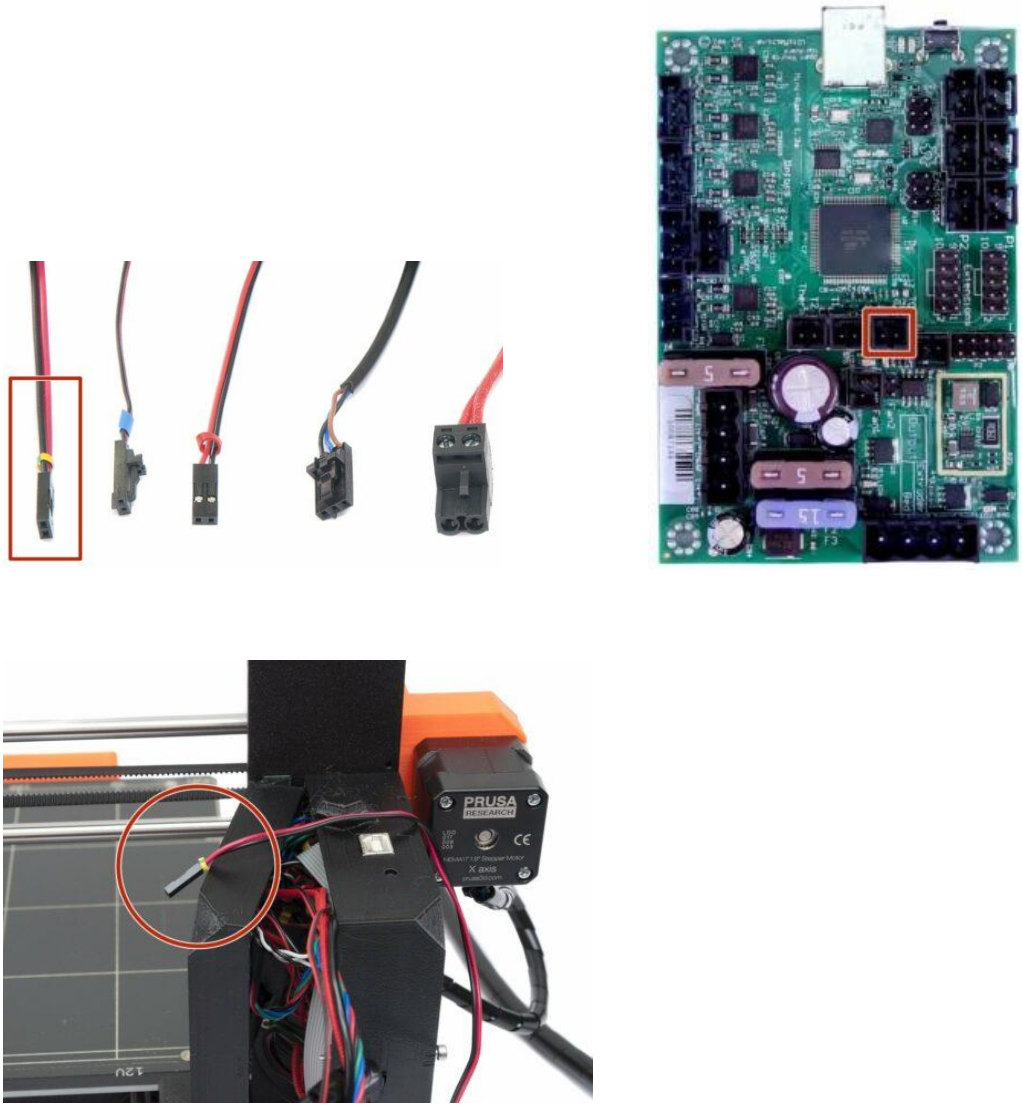


Figure 60 3D printer maintenance

*There are multiple cables coming out from the Extruder, look for the cable with **Yellow/Green heat shrink**!

Unplug this connector, **DO NOT PULL** the cable! Leave the remaining cables (connectors) plugged in.

Step 4 **Removing old thermistor**

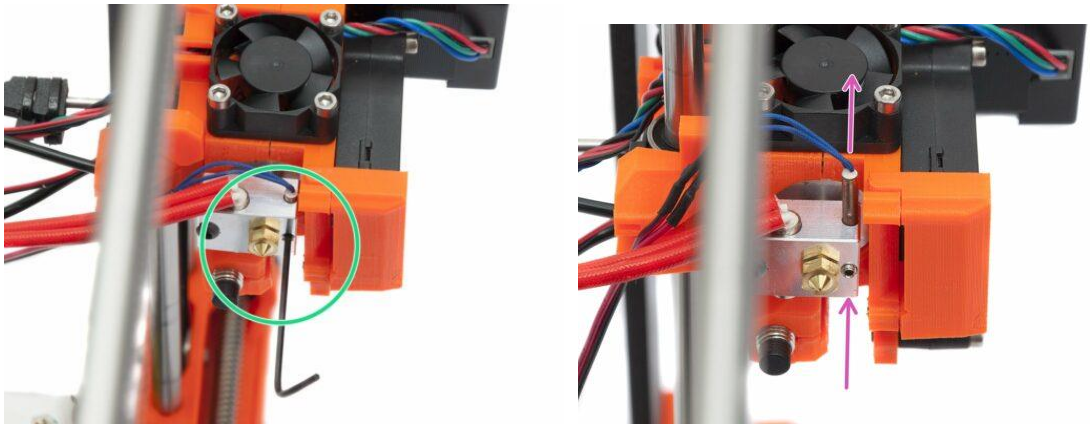


Figure 61 3D printer maintenance

*Lay the printer on the PSU side so you have better access to the thermistor.

*Using 1.5mm Allen key release the screw on the heater block. **BE GENTLE** while unscrewing the screw or you might damage the thread!

*Use the Allen key again and carefully push the thermistor "head" upwards.

*Remove the thermistor completely.

Step 5 **Inserting new thermistor**

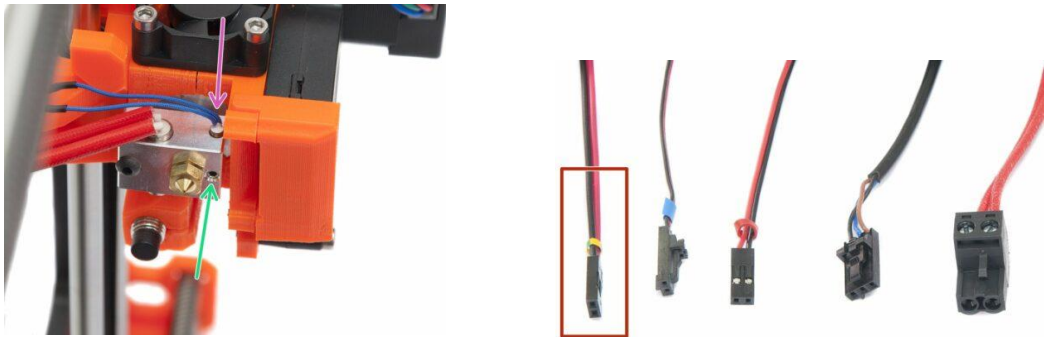


Figure 62 3D printer maintenance

Figure 63 3D printer maintenance

*Carefully insert the new thermistor inside the heater block, check it is aligned properly.

*Using 1.5 Allen key tighten the screw again. **DO NOT USE** excessive force or you might damage the thread!

*Take the thermistor connector and connect it to the RAMBo board.

Step 6 **Wrap the cables by spiral wrap**

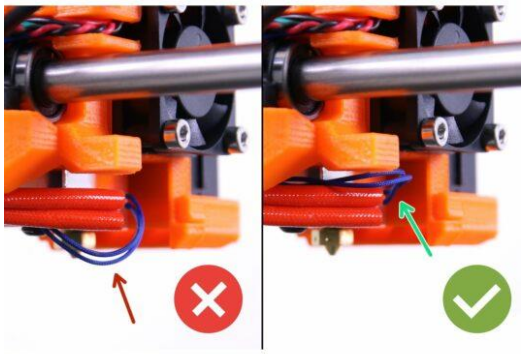


Figure 64 3D printer maintenance

*Now it is time to wrap the cables back to the spiral wrap.

*Use our guide for the kit assembly and skip steps, which are already done.

*Start by setting proper position of the thermistor cables Extruder - Step 28

6.10 How to replace a heatbreak / heating block / cooler

Step 1 **Introduction**

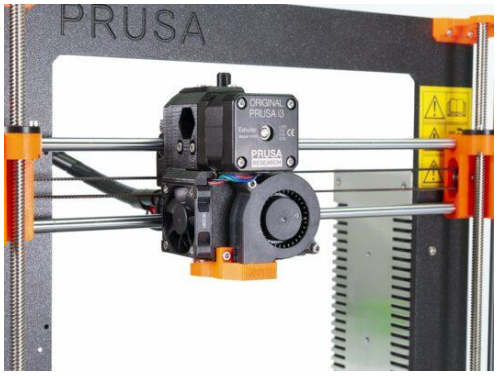


Figure 65 3D printer maintenance

*This guide will take you through the replacement of the **heatsink**, **heatbreak** and **heaterblock**.

*All necessary parts are available in our eshop shop.prusa3d.com

NOTE: Read the instructions carefully. Some steps may vary depending on the type of replacement part.

Step 2 **Tools necessary for this guide**

Figure 66 3D printer maintenance

*Needle-nose pliers for zip ties (1x)

*Wrench size 16 EU / 0.63" US (1x)

*Allen keys - 2.5/2.0/1.5 mm (1x)

*Torque wrench (1x)

*Standard socket size 7mm EU / 1/4" US (1x)

*Cloth or piece of fabric *15x15cm* (2x)

The torque wrench has to be set to values around 2-3 Nm and is critical for the proper tightening of the nozzle. You can use a regular wrench, but there is a risk of damaging the hotend.

Step 3 **Prepare the printer**

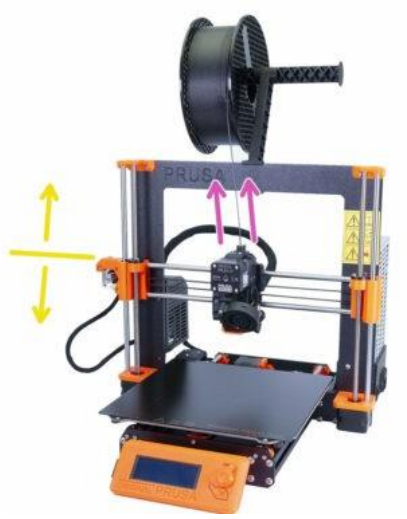


Figure 67 3D printer maintenance

Make sure that:

*The filament is unloaded from the hotend (remove also the spool and the spool holder).

*X-axis with the extruder is slightly above the middle of the height (Z-axis) of the printer.

CAUTION: In some steps, you will need to preheat the printer. **Avoid touching the HOT parts!**

Step 4 **Partial disassembly of the extruder**

Figure 68 3D printer maintenance

*Release and remove marked M3 screws.

*Remove the fan-nozzle completely.

*Carefully insert the Front print fan in the X-axis belt.

Step 5 **Preheating the nozzle**

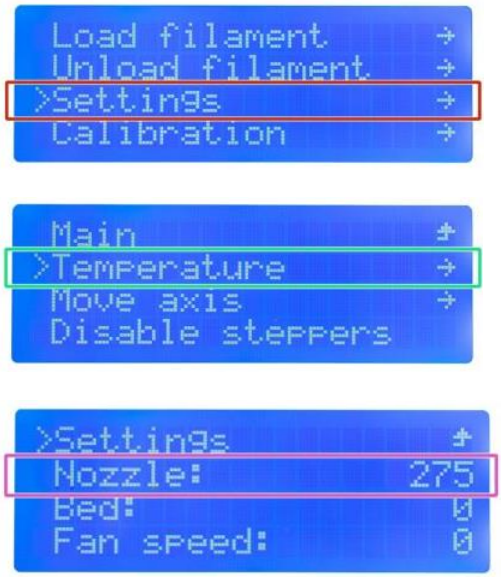


Figure 69 3D printer maintenance

WARNING: This and the next step are not intended for the HEATSINK replacement! Skip to Protecting the heatbed

*On the information screen navigate to the **Settings**.

*Open the **Temperature** menu.

*Set the **nozzle** temperature to **275 °C** by turning the knob.

Step 6 **Releasing the nozzle**

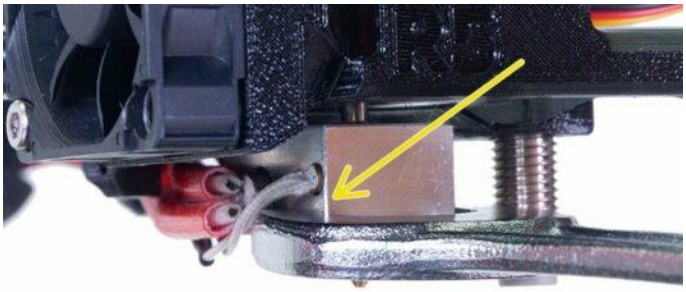


Figure 70 3D printer maintenance

WARNING: Avoid touching the **HOT nozzle!!!**

*Set the torque wrench to 3 Nm (26.5 in-lb).

Some torque wrenches are not intended for loosening. **Read the instructions for your torque wrench**. Alternatively, you can use a ratchet or a side wrench size 7 mm / 0.28".

*With one hand, hold the heaterblock using the wrench size 16 (0.63"). **Place the wrench under the cables to avoid damage.**

*With the other hand, use a torque wrench, place it on the nozzle and slightly loosen it. **Do not remove the nozzle at the moment.**

*Navigate to the Preheat menu and at the end of the menu select **Cooldown**.

Wait 15 - 20 minutes to cool down completely before proceeding to the next step.

Step 7 **Protecting the heatbed**

Figure 71 3D printer maintenance

Turn the printer off and unplug it!

***Before these steps, it is recommended to protect the heatbed!**

*Tak off the flexible steel sheet.

*Use any cloth or piece of fabric, which is thick enough and cover the heatbed. This will ensure you won't damage (scratch) the surface during the disassembly.

Step 8 **Partial disassembly of the extruder**

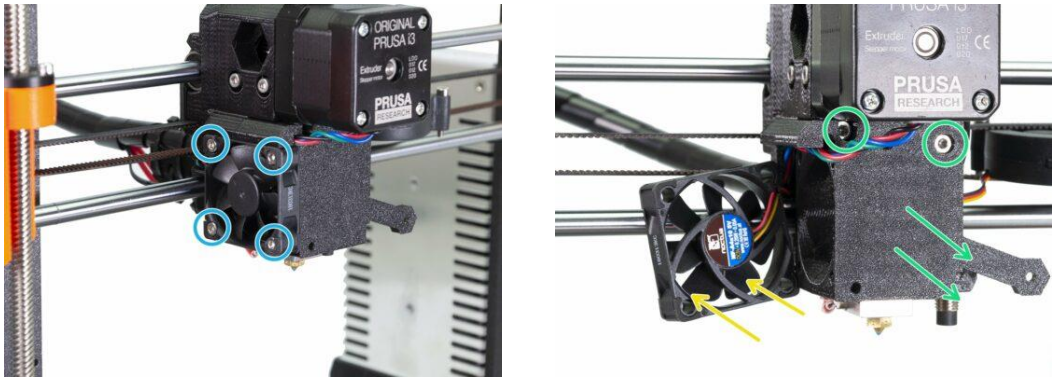


Figure 72 3D printer maintenance

Figure 73 3D printer maintenance

*Release and remove all four M3x18 screws on the Left hotend fan.

*Release and remove both M3x25 screws, then remove carefully the extruder-cover part.

*Your extruder and fan arrangement should look like in the last picture.

Step 9 **Partial disassembly of the extruder**

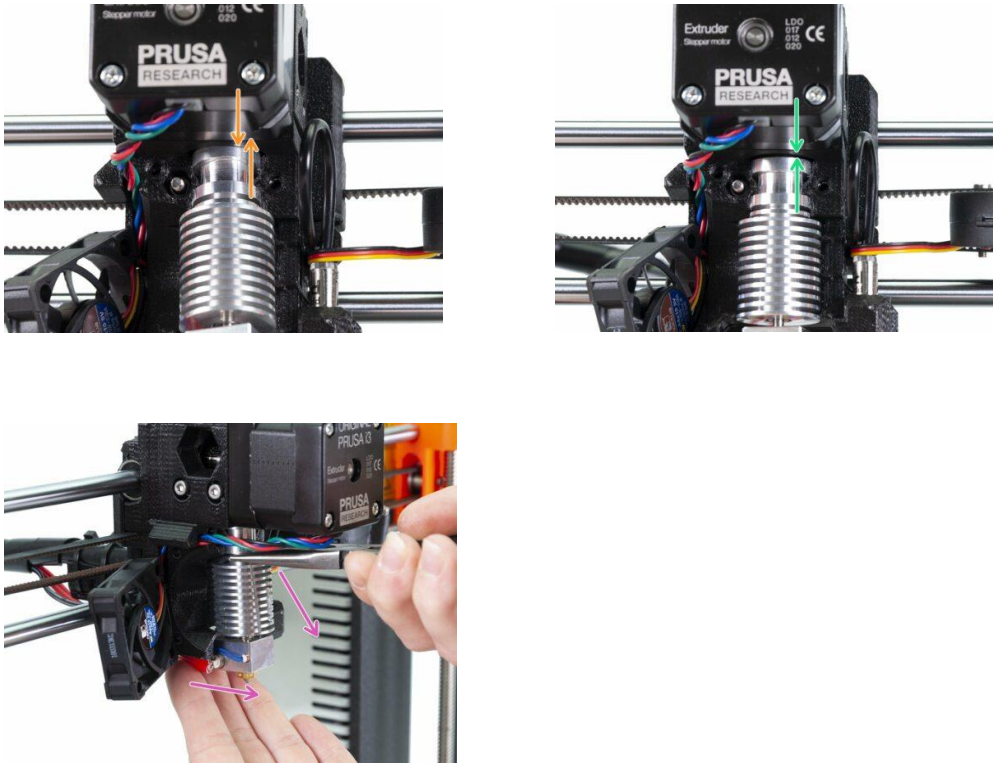


Figure 74 3D printer maintenance

WARNING: Removing hotend from the extruder needs a "special" technique, then the hotend slides out quite easily. Don't use excessive force, or you will damage some parts irreversibly!!!

*The hotend is removed by inclining and pulling at the same time. See the first picture showing the **WRONG inclination**. This hotend is inclined too much to the front and there is no gap

between the hotend and the extruder body. Hotend is partly inside and you won't be able to remove it.

*The second picture is showing the **CORRECT inclination**. The hotend is tilted, but there is a gap between the hotend and the extruder body. You will be able to remove it.

*Now, let's incline the hotend properly. Take pliers in the second hand, grab the hotend above heatsink's ribs, pull downwards and slightly towards you. The hotend should "jump" out. Make sure you don't stretch the cables too much or you might damage them.

Step 10 **Guidepost**

Figure 75 3D printer maintenance

***Choose the guide for the part you need to replace:**

*Heatbreak replacement

*Heatsink replacement

*Heaterblock replacement

Step 11 **Heatbreak replacement - parts preparation**

Figure 76 3D printer maintenance

***For the following steps, please prepare:**

*New heatbreak (1x)

*Thermal paste (1x)

Step 12 **Removing the PTFE tube**

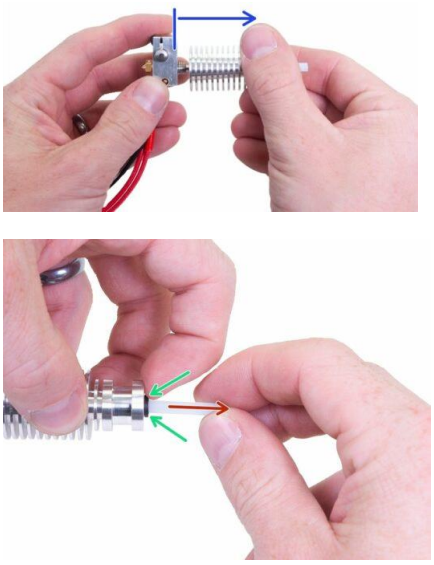


Figure 77 3D printer maintenance

Before you continue with this step, make sure the nozzle is loose.

*Hold the heaterblock with one hand and start screwing the heatsink with the heatbreak out.

*Press the black plastic collet down to release the PTFE tube.

*Pull out the PTFE tube from the heatsink.

Step 13 **Removing the heatbreak**

Figure 78 3D printer maintenance

Use the second cloth to **protect the thread** of the heatbreak.

*Hold the heatsink and using pliers release and remove the heatbreak.

*We are done with removing the old heatbreak, let's move to the next step and install a new one ;)

Step 14 **Applying the thermal paste**

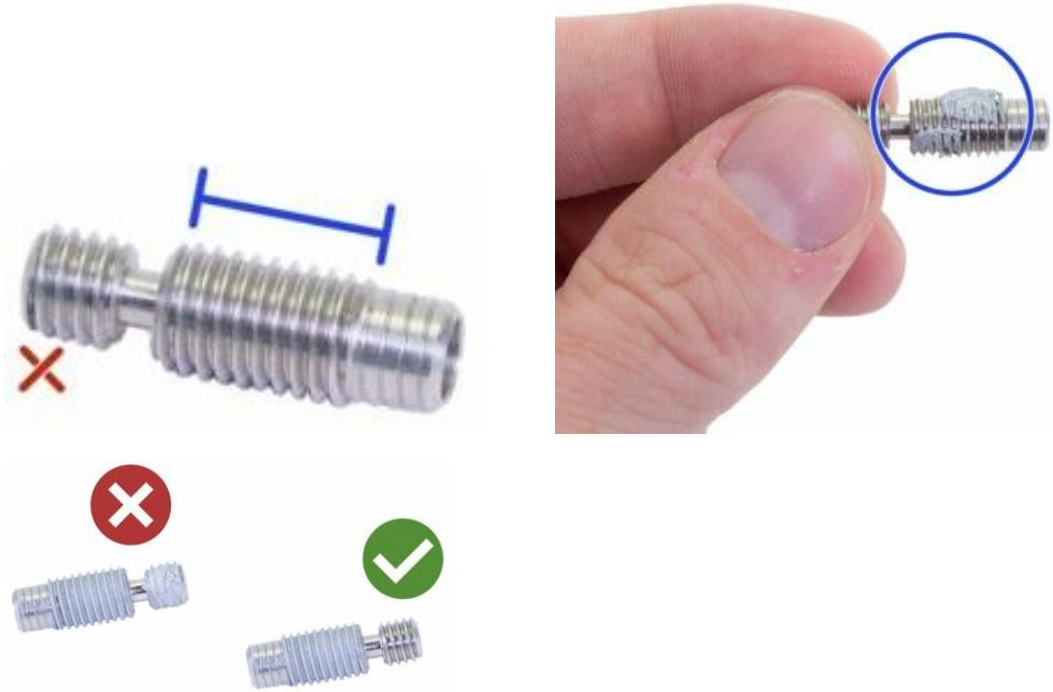


Figure 79 3D printer maintenance

***Take the new heatbreak** and apply most of the content of the thermal paste package on the long thread. Spread it evenly with a paper towel.

Do not apply the paste on the short thread!:

***Incorrect application:** the thermal paste is covering both threads of the heatbreak.

***Correct application:** the thermal paste is covering on the longer thread of the heatbreak.

Applying the paste on the short thread can create a gap between the heatbreak and the nozzle. The nozzle might then become clogged when the filament is loaded.

Step 15 **Placing the heatbreak back in**

Figure 80 3D printer maintenance

*Screw the longer thread of the heatbreak (with the paste) into the heatsink. Ensure the entire thread is screwed in.

*After you screw the heatbreak in clean the excess paste residues.

***To finish the replacement process** jump to Reassembly of the hotend

Step 16 **Heatsink replacement - parts preparation**

Figure 81 3D printer maintenance

***For the following steps, please prepare:**

*New heatsink (1x)

*Thermal paste (1x)

The heatsink includes a new black plastic collet, don't use the old one.

Step 17 **Removing the PTFE tube**

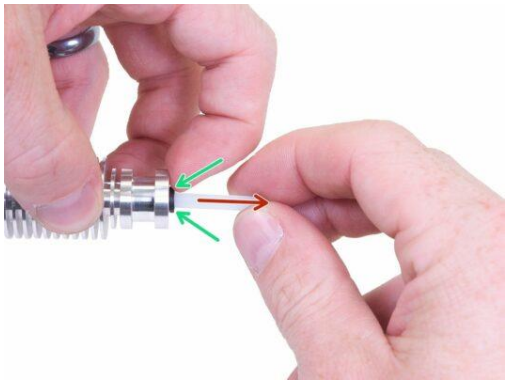


Figure 82 3D printer maintenance

*Press the black plastic collet down to release the PTFE tube.

*Pull out the PTFE tube from the heatsink.

Step 18 **Removing the old heatsink**

Figure 83 3D printer maintenance

*Hold the heaterblock with one hand and start screwing the heatsink out.

Avoid loosening the heatbreak from the heaterblock!

To hold the heaterblock firmly we recommend using the wrench size 16 (0.63") **Keep the wrench away from the cables to avoid damage.**

*We are done with removing the old heatsink, let's move to the next step and install a new one ;)

Step 19 **Applying thermal paste**

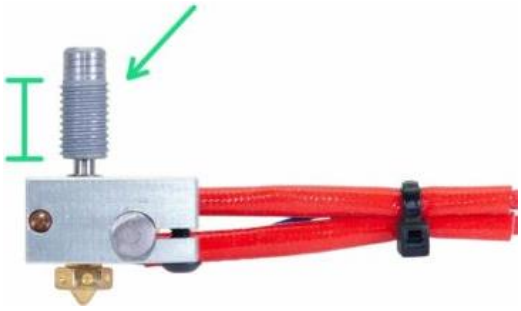


Figure 84 3D printer maintenance

*Before we install the new heatsink, clean the old thermal paste from the heatbreak.

*Apply most of the content of the thermal paste package on the longer heatbreak thread. Spread it evenly with a paper towel.

Step 20 **Reassembly of the hotend**

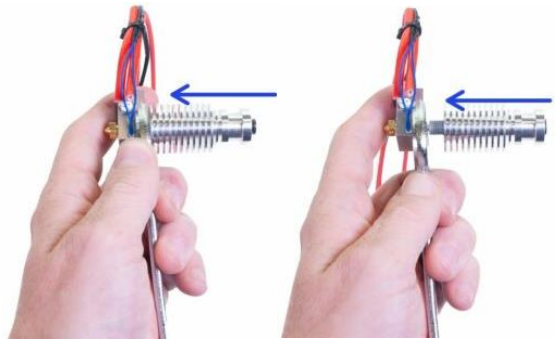


Figure 85 3D printer maintenance

***Screw the new heatsink** on the heatbreak. Make sure the heatbreak is all the way in the heatsink.

*After you screw the heatbreak in, clean the excess paste on the surface of the heatsink.

***To finish the replacement process** jump to Assembling the PTFE tube

Step 21 **Heaterblock replacement - parts preparation**

Figure 86 3D printer maintenance

***For the following steps, please prepare:**

*New heaterblock (1x)

Step 22 **Disassembly of the hotend**

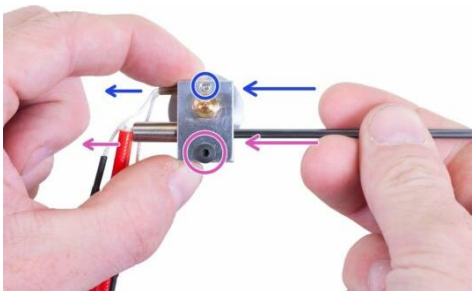


Figure 87 3D printer maintenance

WARNING: Do not pull the thermistor or heater cables. Follow the instructions!

*Release the thermistor screw with the 1.5mm Allen key. Using the Allen key gently push the thermistor out.

*Release the heater screw with the 2.0mm Allen key. Using the Allen key gently push the heater out.

Step 23 **Disassembly of the hotend**

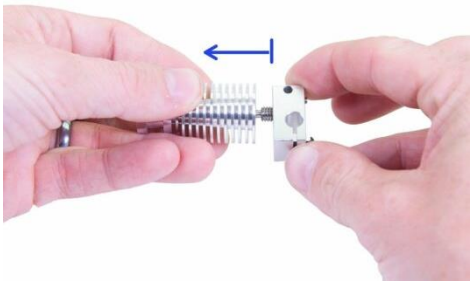


Figure 88 3D printer maintenance

*Remove the nozzle from the heaterblock and keep it for later use.

*Hold the heaterblock with one hand and start screwing the heatsink out.

*We are done with removing the old heaterblock, let's move to the next step and install a new one ;)

Step 24 **Reassembly of the hotend**

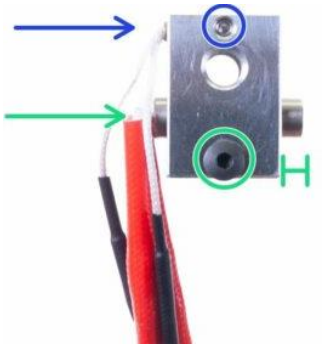


Figure 89 3D printer maintenance

*Insert the thermistor to **the new heaterblock** and secure by tightening the lock screw.

*Then insert the heater to the heaterblock and secure it by tightening the black screw. **Make sure the heater hangs over on the right side,** see the picture.

Ensure both **thermistor and the heater** are **properly inserted** and **tightened!**

Step 25 **Reassembly of the hotend**

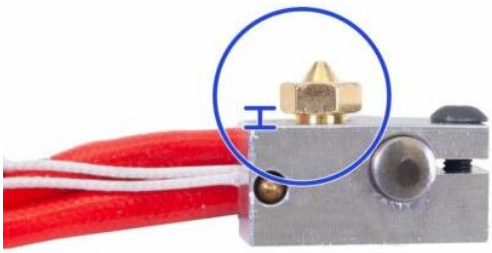


Figure 90 3D printer maintenance

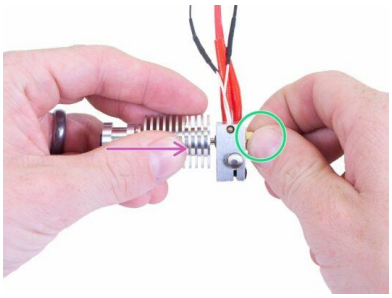


Figure 91 3D printer maintenance

*Lightly screw in the nozzle. Create a gap 0.5 mm (0.02 inch) - similar to the picture.

*Secure the Nozzle against movement with one hand.

*With the other hand, lightly screw the heatbreak with heatsink into the heaterblock until it touches the nozzle. **Do not tighten by torque wrench at the moment.**

Step 26 **Assembling the PTFE tube**

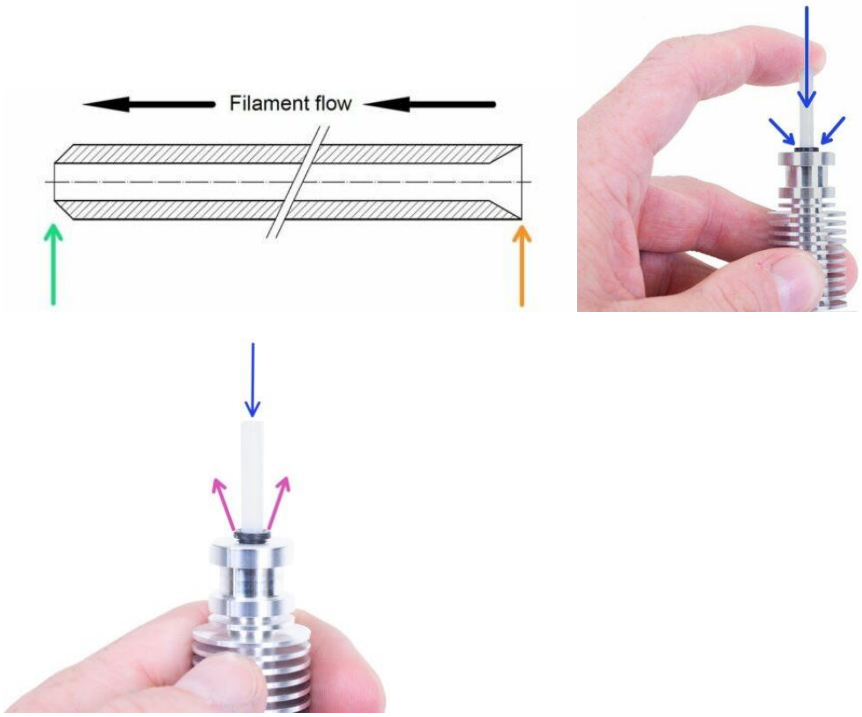


Figure 92 3D printer maintenance

*Now it is time to insert the PTFE tube back in. Note, that each end of the tube is different:

*One end of the tube has **"rounded" outer edge.** This end must be **inside the hotend.**

*Look at the other end, where the tube is drilled inside, the shape of the **edge is "conical"**. This is the side, where filament enters the tube. This part must be **outside the hotend.**

*Push the black collet in. Slide the tube all the way in and hold it!

*Using the other hand pull the collet out and only then release the tube!!! **THIS IS CRUCIAL** for the hotend to work properly.

Step 27 **Reassembly of the extruder**

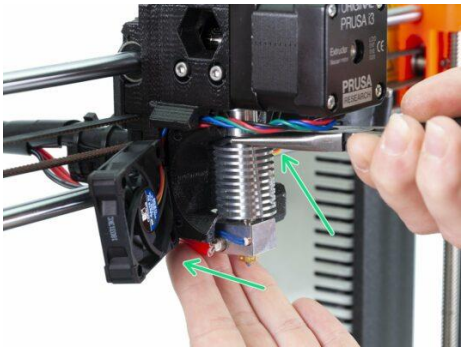
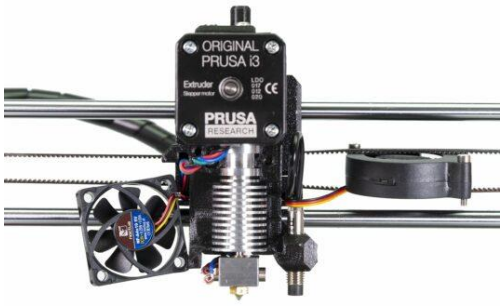


Figure 93 3D printer maintenance

*Carefully slide the hotend back to the extruder-body.

Step 28 **Reassembly of the extruder**



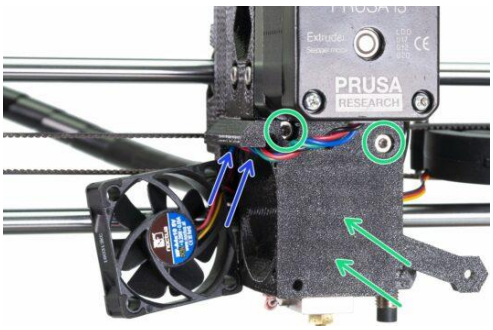


Figure 94 3D printer maintenance Figure 95 3D printer maintenance

*Move back to the front side of the printer.

Be careful while assembling the extruder! Make sure you don't pinch any wire (e.g. P.I.N.D.A. cable).

*Assemble back the extruder-cover and tighten both M3x25 screws.

*Guide the motor cable back in the slot.

Ensure all the parts of the extruder are tight and not moving. **Pay special attention to the hotend!**

Step 29 **Tightening the nozzle**

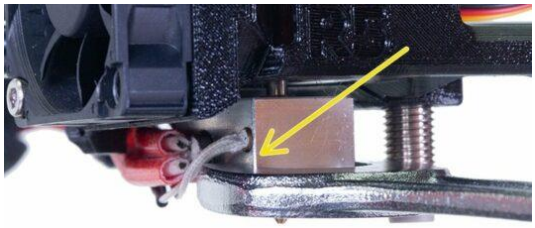


Figure 96 3D printer maintenance

NOTE: This and the next step are not intended for the HEATSINK replacement! Skip to the next step.

*Plug printer in, turn on it and preheat the nozzle to 250°C.

WARNING: Avoid touching the **HOT nozzle!!!**

*Set the torque wrench to 2.5Nm (22 in-lb).

*With one hand, hold the heaterblock using the wrench size 16 (0.63"). **Place the wrench under the cables to avoid damage.**

*With the other hand, use a torque wrench to grasp the nozzle. And tighten the nozzle.

*Navigate to the Preheat menu and at the end of the menu select **Cooldown.**

Wait for 15 - 20 minutes to ensure the hotend is cooled down completely before proceeding to the next step.

Step 30 **Reassembly of the extruder**

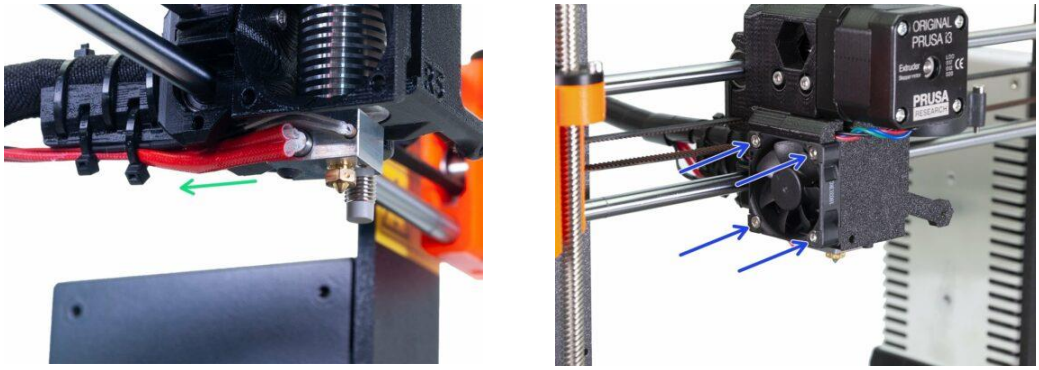


Figure 97 3D printer maintenance

***Check once again the correct position of the hotend.** Look from below the extruder. The heater block should be oriented as shown in the picture.

*Move back the Left hotend fan and tighten all four M3x18 screws. Tighten carefully, you can crack the plastic frame of the fan.

Step 31 **Reassembly of the extruder**

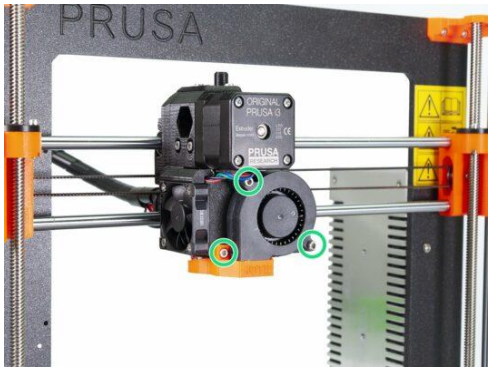


Figure 98 3D printer maintenance

*Place back the Front print fan and the fan-nozzle. Tighten all three screws. Proceed carefully, you can crack the plastic frame of the fan.

*Now, please follow the instructions for the First Layer Calibration.

Step 32 **It is done!**

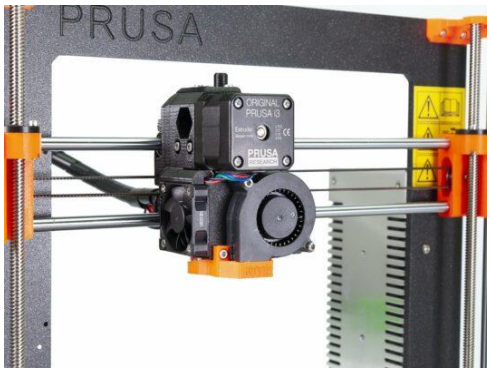


Figure 99 3D printer maintenance

***Great job!**

*Heat up the printer and try it out ;)

6.11 Firmware update

Updating the firmware is **recommended for all users** as every new version brings new features and fixes.

To flash the firmware onto your printer, you need:

- Computer running Windows, macOS, or Linux
- USB cable, preferably the original included with your printer
- PrusaSlicer and the printer's driver installed (download here)

To check which firmware version you already have on your printer, power it up and go to *LCD menu -> Support*. Scroll down and you will see the firmware version**. The procedure for installing an older version of the firmware (downgrading) is exactly the same.**

If you want to flash the firmware, the printer must be **on**.

Preparations

- **PrusaSlicer and the printer's driver must be installed.** If you do not have this installed, it is found in the Drivers and Apps package available where you download the latest firmware.
- Enter our our downloads section and download the firmware (green square). To find the correct firmware, see the name and picture of the printers/upgrades and compare it to your machine. **Be aware that Original Prusa MK3 and MK3S do not use the same firmware file. *However, MK3S and MK3S+ use the same firmware.***

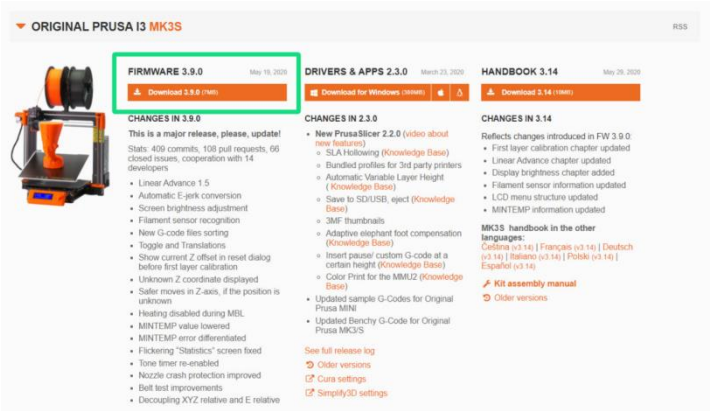


Figure 100 3D printer maintenance

Flashing procedure

1. To flash the firmware into your printer, connect the RAMBo board to your computer using the square-shaped **USB-B 2.0 cable**. The printer must be ON!

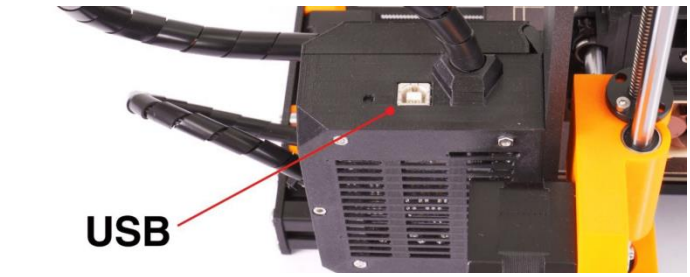


Figure 101 3D printer maintenance

2. Unzip the .zip-file to a folder on your computer.

3. Open PrusaSlicer, click on the 'Configuration' menu, and select 'Flash printer firmware' (left picture).

4. Click on the **Browse** button (green arrow right picture) and choose the .hex file from the location you **unzipped** it. *The file name with the firmware for the MK3S is **prusa3d_fw_MK3S_x_x_x_xxx** where the **x** is the firmware version number.*

5. Make sure the Serial Port field (red square right picture) displays your printer's name (Original Prusa i3 MK3) and has a COM port assigned (ex. COM4). Click Flash! and let the procedure complete. *Progress is indicated on both the Firmware flasher and the printer's display.*

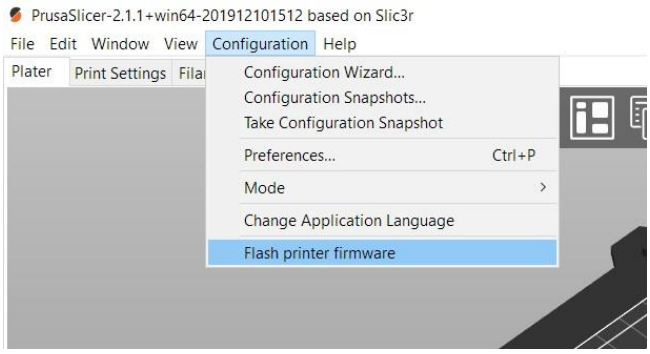


Figure 102 3D printer maintenance

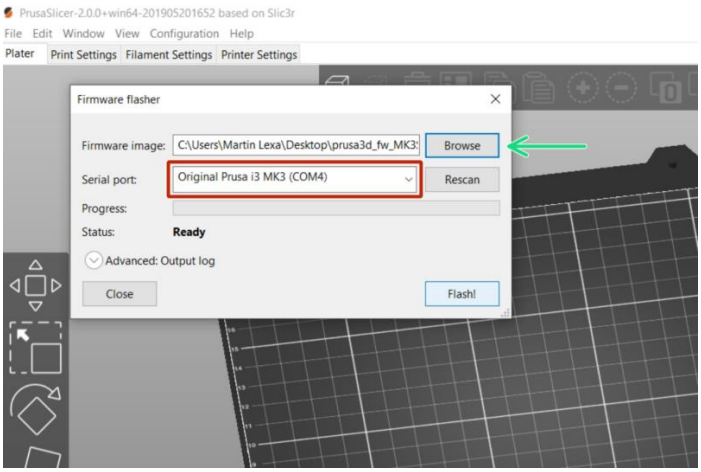


Figure 103 3D printer maintenance

If the Serial port field display anything but the name of the printer (ex. usbmodemfa141 or /dev/tty.*usbmodem*) you should try another USB port on your computer, reinstall the driver or restart your computer.

6.12 Safety testing

ll of these features must be tested **during a running print.** You can use models from the bundled SD card, for instance, the **Batman** or **Prusa logo.**

Filament sensor

How to test the filament sensor

1. First, you must make sure that the Filament sensor is turned on. You can check that in the **LCD Menu - Settings - Fil. sensor ON/OFF.**

2. Let the print run for 5-10 minutes, then simply **cut the filament** and wait until the sensor triggers it.

3. The printer will then ask you to **press the knob** and unload the filament.

4. After that, simply load a new filament into the extruder. Either by **pressing the knob** or if you have the autoload turned on, it will be done automatically.

5. If changed correctly. Select **YES**. If you did not load the filament, select **Filament not load** or if the color is not clear select **Color not clear.**

False sensor reading and debugging

1. Check if the sensor is positioned correctly and **connectors are properly seated.**

2. Make sure that there is no **dust on the sensor** or **extreme light conditions.**

Skipped steps and layer detection

How to test the "crash" detection

1. Make sure that your printer is running in the **normal mode.** You can check that in **LCD - Settings - Mode Normal/Stealth** and that the crash detection is enabled in **LCD - Settings - Crash** det**. ON/OFF.**

2. **Pinch** the smooth rods close to the extruder, which will result in stopping it while printing.

3. **Do not** push the extruder. As this does not simulate a real printing scenario.

4. If done properly, the extruder will **auto home** and restore printing automatically.

The printer is not recognizing hits and skips

1. Double-check that you are running the printer in the normal mode.

2. Make sure that your belt and pulley are tightened. Would any of them be loose, it may cause the belt to **jump** over the pulley or the pulley to **spin** around the motor shaft.

3. If the crash detection does not work, you can visit Layer shifting for more information. (Layer shifting has a lot in common with none working crash detection.)

Power panic

How to test power panic

1. Do not use the **power switch.** That does not trigger power panic.

2. You can pull the power cord from the wall. However, it may not work all the time. **Best practice** is to have a **power strip** with an ON/OFF switch.

3. So simply **switch off** the power strip in the middle of your print.

4. The printer will then raise the nozzle and once the power is back, it will heat up and restore printing without user interaction.

5. **If the power goes off for a longer period of time and the nozzle/bed is cool. The printer will wait for you and ask if you want to restore printing.**

Power panic did not trigger or work

1. If it did not trigger while **unplugging** the power cord (which we do not recommend). It may have been caused by **arcing** produced by the cord.

2. **Nozzle did not rise far enough.**

1. Make sure that you are running **the newest** firmware version. The actual firmware version running on your printer can be found in the **LCD menu under *Support -> Firmware*.** The latest version can be always found at prusa3d.com/drivers

2. Check your Z-axis assembly. Any extra friction might prevent the proper Z movement

6.13 Printer maintenance tips

Step 1 **Introduction to the maintenance**

Figure 104 3D printer maintenance

*This guide will take you through the maintenance of your printer. Most of the steps are shown on the model MK3S but can be used at almost any Original Prusa i3 printer.

Before you start, make sure the printer is properly cooled down!

Step 2 **Cleaning and lubricating all the axes**

Figure 105 3D printer maintenance

The upcoming steps will take you through the process of cleaning and lubricating all smooth rods on the X, Y and Z axes.

For a regular maintenance it is enough to apply the lubricant on the smooth rods. It will lubricate the inner surface of the linear bearings.

***For the following steps, please prepare:**

*Prusa lubricant or similar

*Several paper towels or cloths

Approved lubricants: GLEIT-µ HF 400, Mogul LV 2-EP or Super Lube 210xx.

Step 3 **Cleaning all the axes**

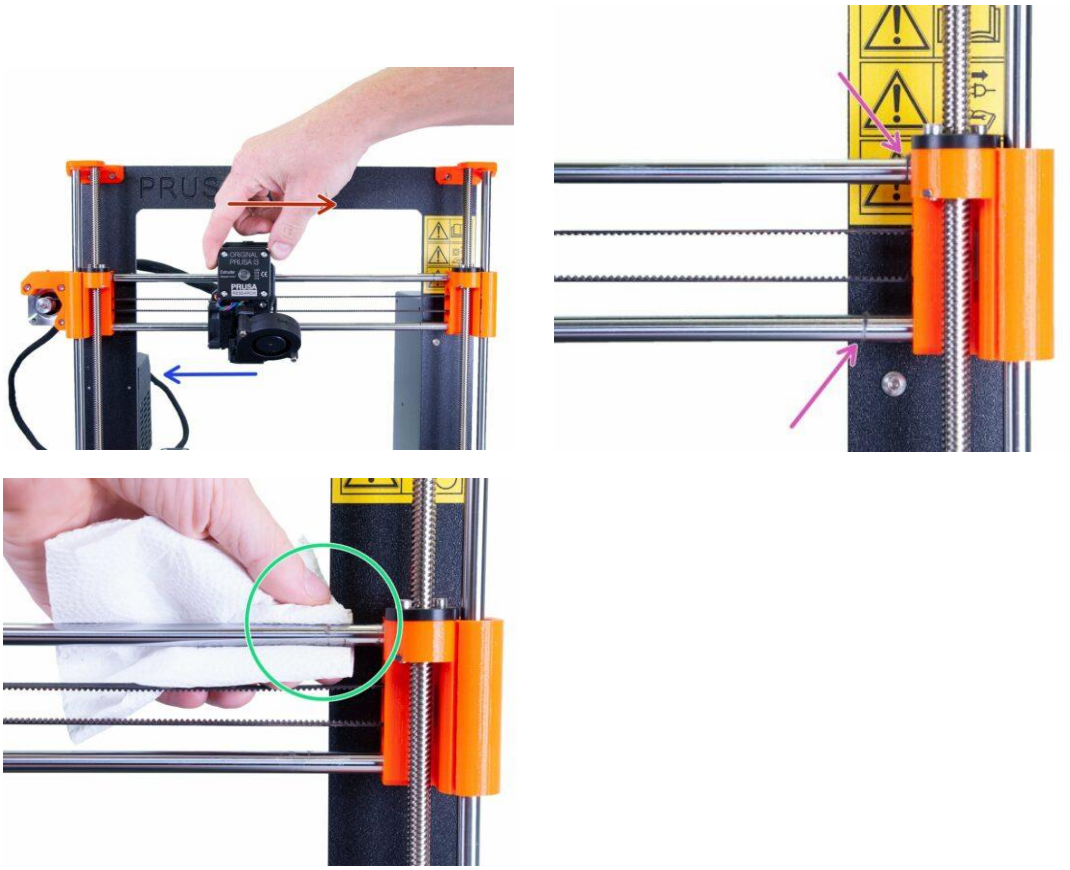


Figure 106 3D printer maintenance

First, let's clean the printer axes. We will use X-axis as an example, but you can apply a similar approach to the remaining axes. *Keep in mind that the Z-axis should be moved using the printer's menu.*

*Move the extruder head all the way to the left. This way you will expose most of the smooth rod.

*Clean the entire exposed rod and focus on the edge, where most of the dust is accumulated.

*Use a paper towel or any soft fabric cloth. Apply IPA or similar degreaser to remove any unwanted grease.

*Return to the extruder (first picture) and move it to the other side of the axis. Repeat the cleaning procedure and again focus on the edge of the axis.

Use the same technique for the Y and Z axes. Don't forget to use different piece (part) of the towel or you might spread the dust from the previously cleaned axis.

*Continue in the next step(s) with the lubrication.

Step 4 **Lubricating the X-axis**

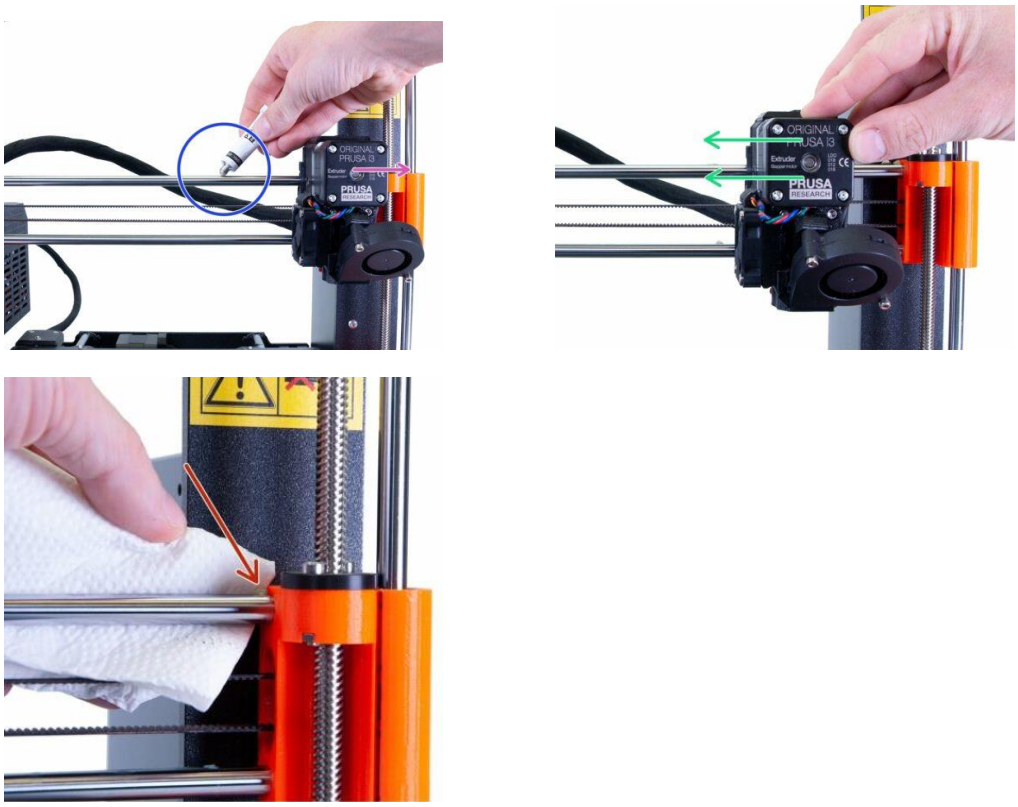


Figure 107 3D printer maintenance

Assuming the X-axis is cleaned, let's move to the lubrication process. Open the tube and if needed perforate its protective cover.

*Ensure the extruder is moved all the way to the side.

*Apply a small drop of the lubricant on both smooth rods. Using your finger or the towel spread the paste around the circumference of each rod. *Don't apply too much of the paste, it will have the opposite effect.*

*Move the extruder all the way to the other side.

*Apply an even smaller drop on the parts of the rods, which were previously covered with the extruder and move the extruder all the way back.

*You should create a very thin layer of the lubricant on both rods, check for any significant excess of the paste and clean it, as it will catch a lot of dust over time.

Step 5 **Lubricating the Y-axis**

Figure 108 3D printer maintenance

Assuming the Y-axis is cleaned, let's move to the lubrication process. Open the tube and if needed perforate its protective cover.

*Ensure the heatbed is moved all the way to the side.

*Apply a small drop of the lubricant on both smooth rods. Using your finger or the towel spread the paste around the diameter of each rod. *Don't apply too much of the paste, it will have the opposite effect.*

*Move the heatbed all the way to the other side. Then back and forth several times.

*You should create a very thin layer of the lubricant on both rods, check for any significant excess of the paste and clean it, as it will catch a lot of dust over time.

Step 6 **Lubricating the Z-axis**

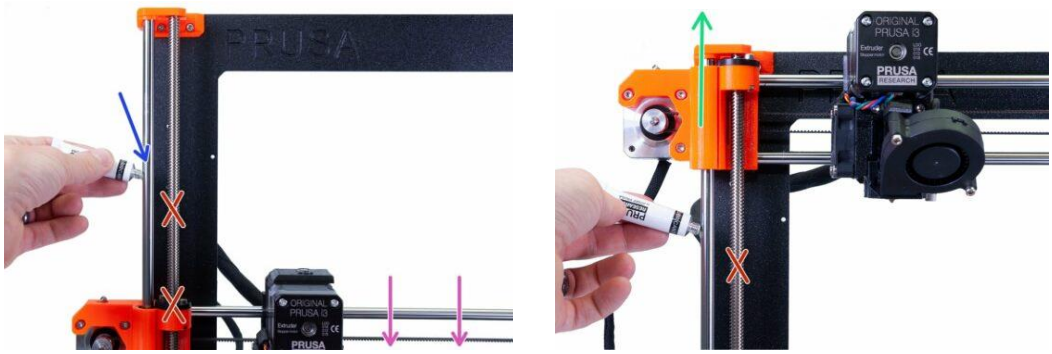


Figure 109 3D printer maintenance

Assuming the Z-axis is cleaned, let's move to the lubrication process. Open the tube and if needed perforate its protective cover.

*Turn the printer on and using the printer's menu (press and hold the knob button, then rotate it) move the Z-axis, all the way down. **Make sure won't damage the heatbed!**

*Apply a small drop of the lubricant on both smooth rods. Using your finger or the towel spread the paste around the diameter of each rod. *Don't apply too much of the paste, it will have the opposite effect.*

*Move the Z-axis all the way up. Use again the menu.

*Apply an even smaller drop on the parts of the rods, which were previously covered with the X-ends and move the Z-axis all the way down.

*You should create a very thin layer of the lubricant on both rods, check for any significant excess of the paste and clean it, as it will catch a lot of dust over time.

DON'T APPLY THE LUBRICANT ON THE LEADSCREWS OR TR. NUTS!!!

6.13 First Layer Calibration

The First Layer Calibration is used to calibrate the distance between the tip of the nozzle and the print surface. The aim is to adjust the nozzle height until the extruded plastic sticks nicely to the bed and you can see that it is being slightly squished.

The printers assembled in the Prusa factory are already fine-tuned and this calibration is needed only in case you build the kit version at home or change the nozzle. The First Layer Calibration is part of the Wizard (last step of the XYZ-Calibration). You can also recalibrate the first layer later on from the LCD-menu - Calibration - First Layer Calibration. During this process, rotate the knob to manually adjust the distance between the nozzle and the bed, while the printer is printing a zig-zag pattern.

As **each type of sheet (smooth, satin, and textured) has a different thickness** you must use a different First layer calibration for each of them. For this, we have a convenient feature called Steel sheet profiles.

With a newly assembled printer, you will start at zero and move into a negative (-) value, reducing the distance between nozzle and heat bed. The initial zero-value is set by the P.I.N.D.A./SuperPINDA. position. **Turn the knob counter-clockwise to bring the nozzle closer to the bed and moving the value away from zero.** The value is unique to each printer and it may also slightly change with time and use. You must, therefore, **check visually when adjusting the height, not by a set value.**

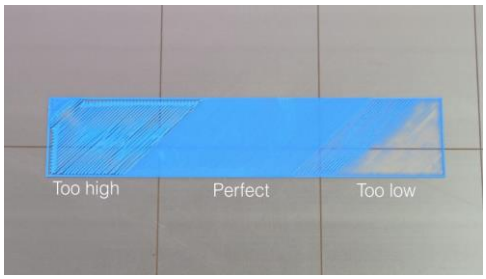


Figure 110 Calibration

The first layer calibration being set incorrectly can lead to various issues. With the nozzle too far from the print surface, you risk your print not sticking properly, which can result in a blob. On the other side, if set too close, you can experience extrusion problems and clogging and poor print quality, **or even damage to the hardware, like the Flexible steel sheet** due to the print sticking too much. **It is therefore** important to get this right.

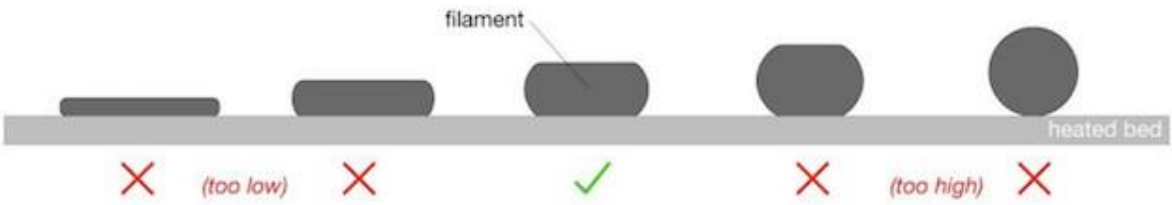


Figure 111 Calibration

Before you proceed, make sure that the print surface (satin, smooth, or textured steel-sheet) is clean. You can find information on how to clean it in PEI print surface preparation. There are some small differences between how it should look on the textured and smooth steel sheet. We will, therefore, present pictures and guidelines for both, starting with the smooth sheet.

Turn the knob counter-clockwise to bring the nozzle closer to the bed.

Smooth sheet

Too high

You want the line flattened, but not squished. On the square at the end of the test line, you do not want any **gaps between the lines (left picture), which means it is too high.** In that case, the value will be too close to zero

Too low

If the nozzle is set too low (right picture) you will see the line squished completely flat and the end square will have **ridges between the lines, which is a clear sign it is set too low** and the value will be too far away from zero. When it is too low, the edges of the square can also start curling upwards. In the extreme, the

filament will be spread so thin you will be able to see through the printed filament, leading to clogging of your hotend.

Just right

A correct adjustment will show you an even surface (center picture), with no gaps between lines, nor ridges. As stated, the numeric value depends on the exact position of the P.I.N.D.A./SuperPINDA sensor, which will be unique to each machine and means nothing without a visual reference. **However, a common range is from -0.400 to -1.500.**

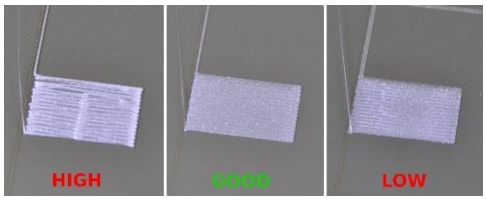


Figure 112 Calibration

Adjusting it closer can in some cases improve adhesion. However, if you are having problems with adhesion, but your first layer calibration looks like the 'good' picture (center picture), your problem lies somewhere else, like a dirty/greasy sheet, print-settings, bed leveling/XYZ calibration, or under-extrusion.

Figure 113 Calibration

You can not use the same first layer calibration if you swap between the Smooth and the textured sheet! For more information, please see Steel sheet profiles.

Textured sheet

The textured sheets are thinner than the sheets with smooth PEI, therefore you need to move the nozzle bit closer, but you are seeking the same results as with the smooth sheet. Again, if **it is set too low** (right picture) the filament can start curling up **around the edges like it is not adhering. The numeric value will be too far from zero and must be adjusted back.**

If set too high, you will see the line being round, and have gaps between the lines of the end-square. In this case, the value is too close to zero.

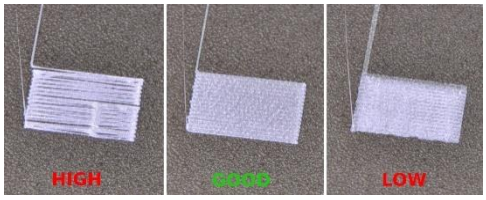


Figure 114 Calibration

Have a look at the nozzle

A single layer is about 0.2 mm / 0.00787402 inch. Having a look at the nozzle and its distance to the sheet can also be helpful. However, measuring the printed layer with calipers is not a recommended method to calibrate the first layer.

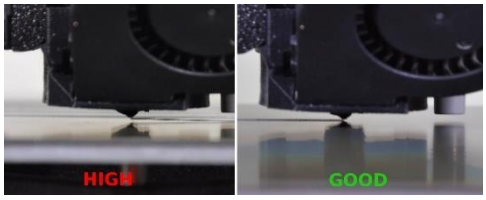


Figure 115 Calibration

When to run the First layer calibration

Generally, the **first layer calibration** should be performed every time there is a **major change in the assembly.** This includes changing the nozzle, extruder upgrades, or other updates to any axis. You should also run all calibrations if you move the printer to a different location.

For First Layer Calibrations with other nozzle diameters than 0.4 mm, please see this article

Other issues

- If the width of the line varies across its length, you may have to do some Bed Level Correction.
- If the nozzle comes in contact with the bed, the SuperPINDA/P.I.N.D.A. leveling sensor is not being triggered by the flexible steel sheet and must be physically moved lower in its holder. This will bring it closer to the level of the nozzle tip. You should make sure it is adjusted as instructed in the Preflight check in the Assembly manual. **If you move the leveling sensor you must redo the First layer calibration.**

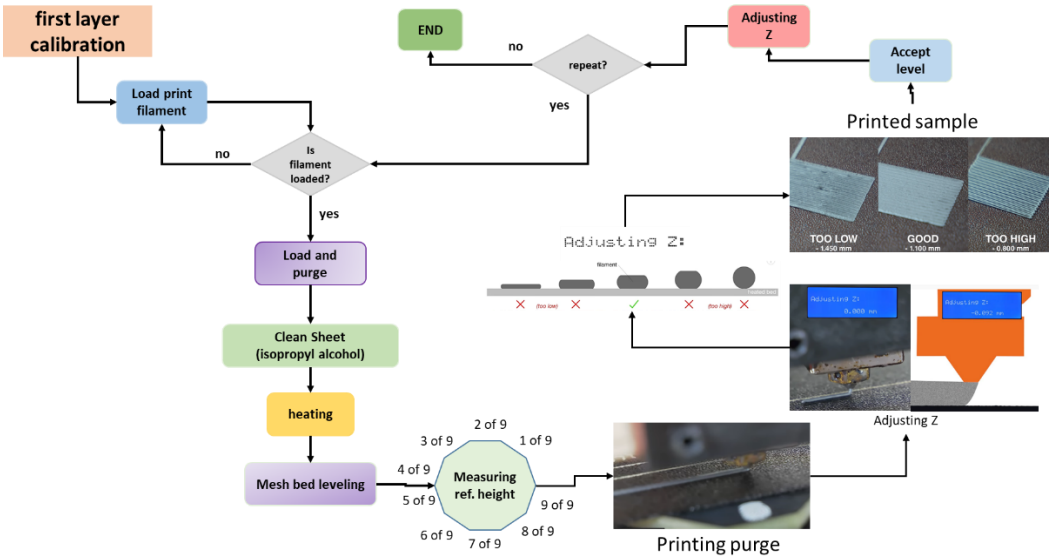


Figure 116 Scheme of Calibration