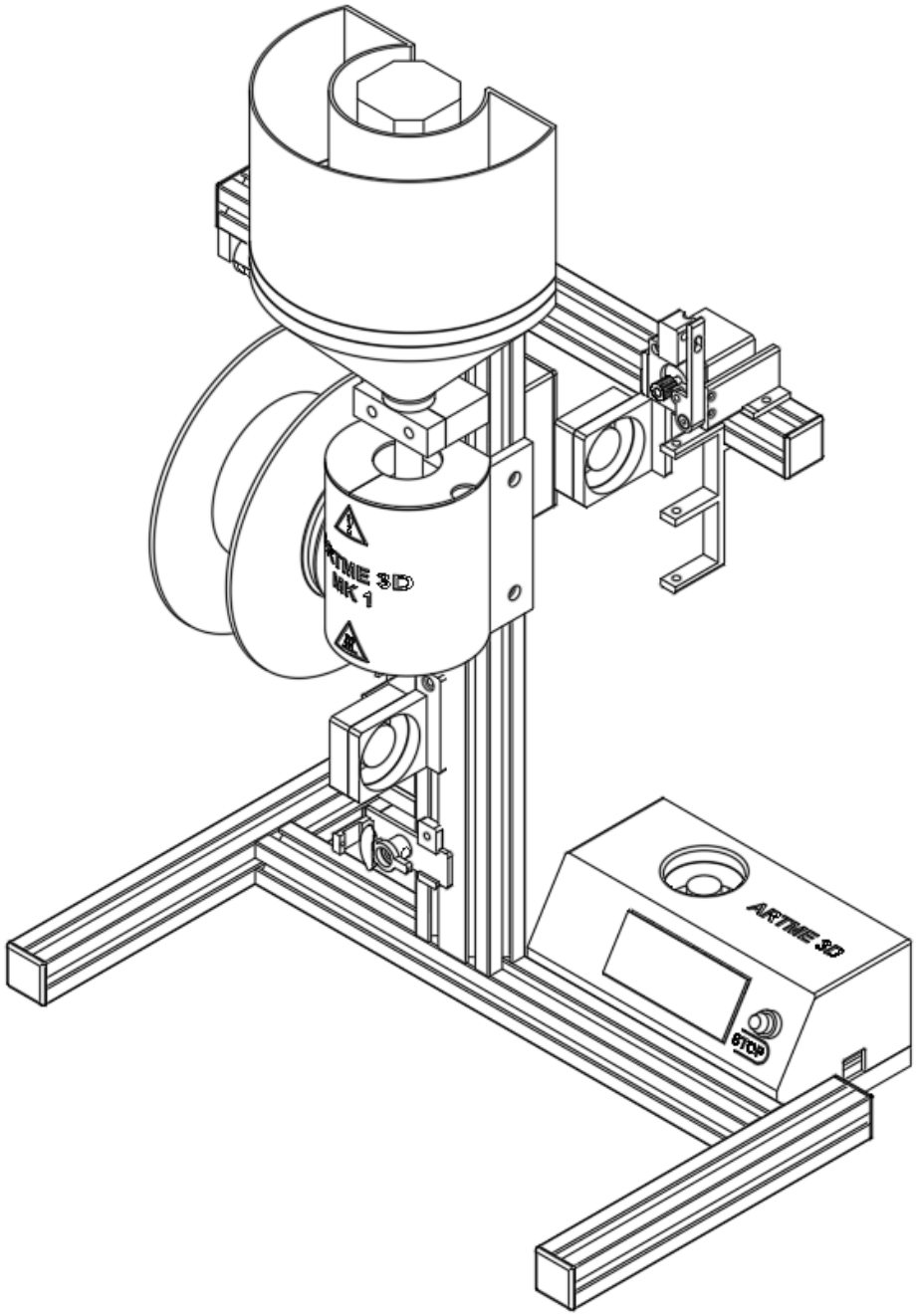
Instruction manual

Original Desktop Filament Extruder MK1 by ARTME 3D

Version 19.06.2022



Please read these operating instructions carefully and thoroughly to ensure safe and proper operation.

Thank you for purchasing the kit for my original Desktop Filament Extruder MK1! Your purchase supports me in the further development of this kind of projects and the quality assurance of the parts.

The effort to publish such a project is big. The development and the creation of the documentations have now required more than 1200 working hours. All this to make the knowledge of the project available to all interested users for free, to live the open source idea. I cannot earn these services by selling the kits. The rent for workshop, office and warehouse, as well as personnel costs and material costs are too high for that. If you would like to support me in developing and publishing projects of this kind, I would appreciate a small donation. This can be done in several ways:

- Buy a donation in my webshop: artme-3.de/shop
- Support me on Patreon: https://www.patreon.com/artme3d
- Send me a donation amount via Paypal to paypal@artme.de or by clicking on the yellow "Donate" button.

You can follow my developments via various sources:

- On the web at www.artme-3d.de
- On Instagram at instagram.com/artme3d
- On Youtube at https://www.youtube.com/c/ARTME3D

If you have any questions or problems with the project, please first read the FAQ`s at www.artme-3d.de/support or send an email to kontakt@artme-3d.de. Try to describe your problem as detailed as possible.

Have fun building and running the extruder,

David from ARTME 3D

Table of contents

1. Usage license and acknowledgement

1.1 License

The Original Desktop Filament Extruder MK1 by ARTME 3D is an open source project used under a CC BY-SA license (https://creativecommons.org/licenses/by-sa/4.0/):

You may:
-Use, modify and share any content.

Under the following condition:
-Mention my name: David Pfeifer of ARTME 3D
-Link my project: www.artme-3d.de
-State what has been changed
-Publish under the same license

1.2 Acknowledgement

A big thank you goes to Filip Mulier. He wrote the firmware "Marlin-Mackerel" which made this project possible.

You can find his original data at https://github.com/filipmu/Marlin-Mackerel.

The following was edited for the Desktop Filament Extruder MK1:

- User interface changed
- Device parameters changed
- Safety functions (thermal runaway and killswitch) integrated

2. Important notes for the user of the extruder

2.1 Disclaimer

Failure to follow the safety instructions, documentation and operating instructions may result in injury to users, inferior results or damage to components. Always make sure that everyone who operates the extruder knows and understands the contents of these operating instructions. Always make sure that you have the latest version of firmware installed on your extruder. We cannot control the conditions under which you assemble and operate the Original Desktop Filament Extruder Mk1. For this and other reasons, we assume no responsibility and expressly disclaim all liability for any loss, injury, damage or expense resulting from the assembly, handling, storage, use or disposal of the product. The information in this documentation is provided without any express or implied warranty as to its accuracy.

You purchase a set of hardware to build your own version of the extruder. There is no obligation to build the device according to my specifications, you can combine the components as you like. Your action is necessary to operate the system as safe as possible. Therefore, please be sure to read chapter 1 in the instruction manual completely.

2.2 Safety instructions

1. Please be very careful during any interaction with the extruder. This extruder is an electrical device with moving parts and high-temperature high temperature ranges.
2. The device is intended for indoor use only.
3. Do not expose the extruder to rain or snow.
4. Always keep the extruder in a dry environment at a minimum distance of 30 cm from other objects.
5. During extrusion, plastic is melted, which causes odor. The inhaling these fumes is harmful to health. Always place the extruder in a well ventilated area. Do not use it in living rooms or bedrooms. Wear suitable respirators.
6. Some plastics can decompose thermally if heated for a long time or even if overheated. thermal decomposition, resulting in potentially toxic fumes.
7. It is recommended to install a carbon monoxide detector.
8. Before processing a plastic material, always check its properties and processing temperatures. and processing temperatures. Check the material safety data sheet. In case of questions contact the manufacturer of the material.
9. Always switch off the extruder heating immediately when you are not extruding material.
10. If dangerous situations occur during operation of the extruder, you can immediately switch off all dangerous operations by pressing the STOP button on the display.
11. Always place the extruder in a stable place where it cannot fall or tip over.

topple over. Make sure that the extruder is on a firm footing.
12. Never leave the extruder unattended while it is switched on and heated up.
13. Use monitoring systems for fire detection.
14. Protect the extruder from direct sunlight.
15. The extruder is powered by 12VDC safety extra-low voltage at a maximum input current of 12.5A. An external power supply for operation on mains voltage is not included. Use safe, enclosed desktop power supplies for this purpose. Never connect the unit to a power source with other current or voltage ratings, as this may cause malfunction or damage to the extruder.
16. Route the power cord to the power source so that you cannot trip over it, step on it, or otherwise cause damage. Make sure that the power cord is not mechanically or otherwise damaged. Do not use damaged cords and replace them.
17. Do not touch the heating element or heated barrel when the extruder is operating or heating up. operation or is heating up. Note that the temperature of the die and the
heating elements can be up to 300 °C (572 °F). Temperatures above 40 °C (104 °F) can damage the human body.
18. Beware of rotating parts and self-starting movements! Do not reach into the interior of the extruder while it is in operation. An injury can be caused by the rotating parts. Fingers can be crushed. Loose parts, clothing, long hair, jewelry or other objects can be pulled in by rotating parts.
19. Prevent children from accessing the extruder unsupervised, even when the unit is not in operation.

2.3 Intended use

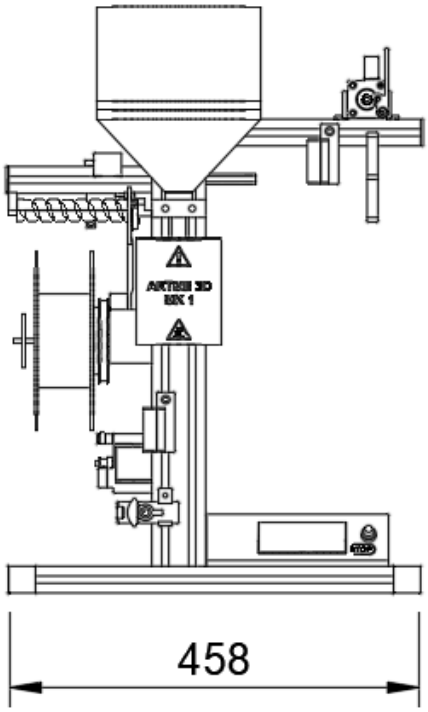
The unit is only suitable for extruding thermoplastics with a processing temperature below 260°C. Any other use is not in accordance with the intended purpose.

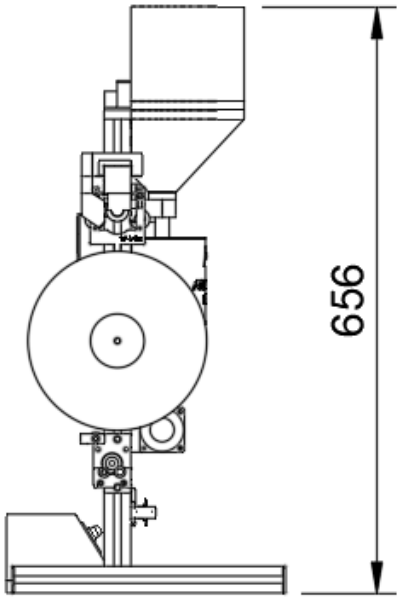
3. Technical data

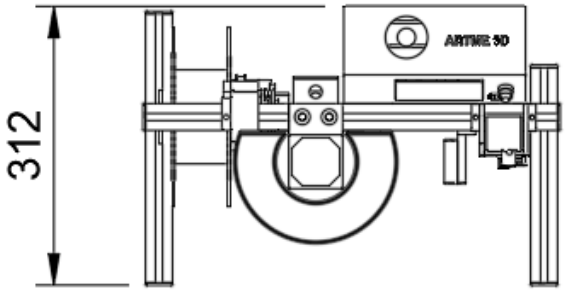
3.1 Kit data

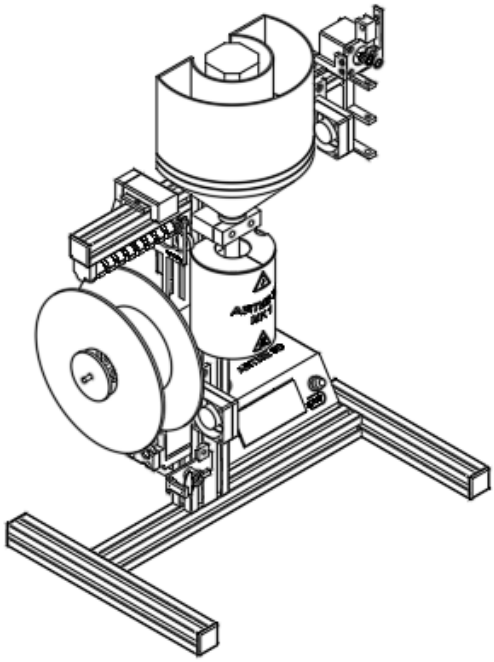
Name: Original Desktop Filament Extruder MK1 by ARTME 3D (Kit)
Filament: 1,75 mm or 2,85mm
Manufacturer: Artme GmbH, Wormser Straße 44, 67346 Speyer, Germany
Device usage: indoor use only
Power supply: 12V DC safety extra-low voltage at maximum 140W input power
Operating temperature range: 18 °C to 30 °C
Humidity: 70% or less
Kit weight (gross / net): 8.4 kg / 6.9 kg
The serial number of the kit is located on the extruder frame (aluminum profile)
Maximum temperature: 260°C
Maximum speed: 25 rpm at 7NM
Extruder screw: ⌀12mm, 3 zones. Compression ratio approx. 3:1. L/D ratio: 10:1.
Maximum extrusion rate: 0.4kg/h (At PLA, 210°C, 25RPM)

3.2 Dimensions and drawing









4. Overview controls

4.1 Switch on, switch off

The extruder is switched on by connecting the 12V DC supply voltage. It is recommended to use a safe table power supply (12V, 140W) in closed design (not included in the scope of delivery). The extruder is switched off by removing the supply voltage. Ensure that there is no voltage after switching off.

4.2 Display and operating elements

After the extruder is turned on, you will see the Info Screen. This shows the following data:

1: Temperature: Actual temperature / Target temperature in degrees Celsius.

2: E: Extruder motor speed in revolutions per minute (rpm) (Only visible if extruder is heated up and extruder motor started, otherwise COLD rpm).

3: S: Measured value of the sensor

4: Av: average, Mx: maximum value, Mn: minimum value, of the sensor measured value

5: L: Filament length in cm

6: Puller: speed of the pulling motor in revolutions per minute (rpm).

7: Info line.

8: STOP: When this button is pressed, the extruder switches off all motors and heaters. In order to turn the extruder on again, it is necessary to turn the power supply off and on again.

9: Rotary knob: The rotary knob next to the display can be pressed and turned to the left and right. To enter the main menu, press the knob. To scroll down in the main menu, turn the rotary knob to the right. To scroll up, turn it to the left. To make a selection, press the rotary knob in the corresponding position. In the main menu you will find some direct functions but also more detailed submenus with the following content:

4.3 Menu structure

Main menu (when extruder motor is off):
Info Screen: Back to the information screen
START Extruder (Starts the extruder motor, attention the extruder temperature must be above 90°C to avoid damage).
Prepare (submenu for presetting the most important parameters, see below)
Preheat (preheat to 175°C)
Cooldown (switch off heating)
Control (submenu for setting controls, see below)
Clear Statistics (Sets the filament length counter reading and the min/max sensor reading to zero)
Enable Statistics (not yet required in this operating state)

Main menu (when extruder motor is on):
Info Screen: Back to the information screen
Automatic pulling / Manual pulling (Starts or stops the automatic puller-motor speed control)
puller motor speed)
STOP Extruder (Stops the extruder motor and the winder motor)
Tune (submenu to change current values, see below)
Preheat (Preheat to 175°C)
Cooldown (turn off heating)
Control (submenu to set controls, see below)
Clear Statistics (Sets counter reading of filament length and min/max sensor reading to zero)
Pause statistics (Pauses filament length counter reading and min/max sensor reading, then "Enable Statistics" to resume)

Prepare (Only visible when extruder motor is off):
Main (Back to the main menu)
Extruder RPM (Setting the extruder speed in revolutions per minute)
Extruder Temp (setting of extruder temperature in °C and heat up)
Fan speed (speed of the filament fan from 0 to 99 %)
L cutoff (setting of the filament length at which to cut off, here specified in millimeters)
Preheat (preheating to 175°C)

Tune (Only visible when extruder motor is on):
Main (Back to the main menu)
Extruder RPM (Setting the extruder speed in revolutions per minute)
Extruder Temp (setting of extruder temperature in °C)
Fan speed (speed of the filament fan from 0 to 99 %)
L cutoff (setting of the filament length at which to cut off, specified here in millimeters)

Control submenu:
Main (Back to the main menu)
Temperature (submenu for setting the extruder temperature, see below)
Motion (submenu to adjust the motor settings)
Puller PID (submenu for setting the automatic rewinder)
Store memory (Stores the current speed values and settings)
Load memory (Loads the last stored speed values and setting values)
Restore failsafe (Loads the original default settings of the firmware)

Temperature:
Control (Return to Control menu)
Extruder Temp (Setting of extruder temperature in °C and heating up)
PID-P (Setting value P of the control behavior of the PID temperature control)
PID-I (Setting value I of the control behavior of the PID temperature control)

PID-D (Setting D of the PID temperature control behavior)
PID-C (Setting value C of the control behavior of the PID temperature control)
Preheat config (submenu for setting the preheat temperature)
PID Autotune (Starts several heating phases to determine the PID values for the heating, see chapter 5.4)

Preheat config:
Extruder Temp (Set target temperature to be heated to by the "Preheat" function.
Store memory (Stores the temperature setting).

Puller PID:
Control (Back to the Control menu)
Sensor Pos (factor for the height of the desired sensor arm position)
L cutoff (setting of the filament length at which to cut off, here specified in millimeters)
PID-P (Adjustment value P of the control behavior of the rewind)
PID-I (Setting value I of the control behavior of the rewind)
PID-D (Setting value D of the control behavior of the rewinding)
Factor 1 (Factor for the sensor value display. When using a Hall sensor for diameter detection of the filament).
Factor 2 (Factor for sensor value display. When using a Hall sensor for diameter detection of the filament).
P circ (circumference in mm of the puller wheel on the puller motor, see chapter 5.2)

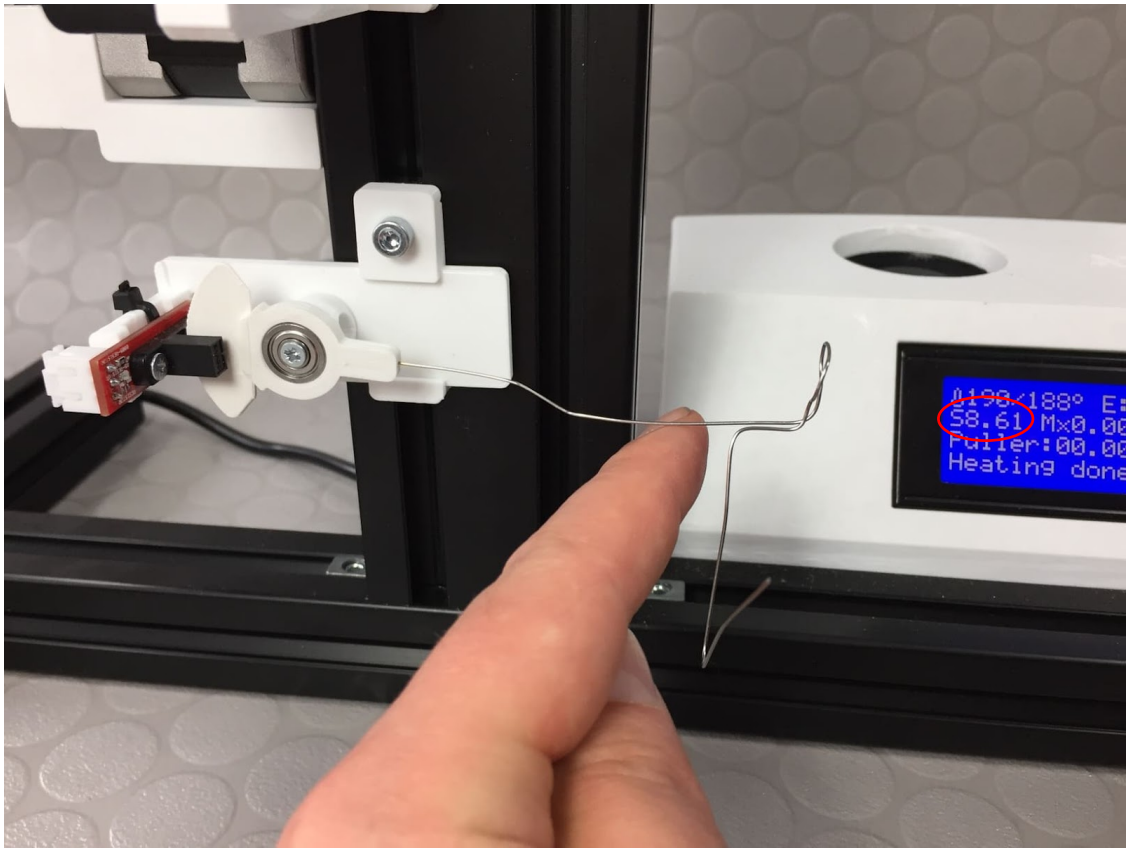
Motion:
Control (Back to the Control menu)
Esteps/rev (number of steps per revolution of the extruder motor)
P steps/mm (number of steps per revolution of the pull motor)
Motor Acc (acceleration value)
Ve-jerk (Jerk setting)
Vmax e: (V setting)

5. Setting and calibrating the device

5.1 Calibrate sensor

The sensor of the extruder is responsible for automatically controlling the pulling speed of the filament so that the pulling force on the filament always remains the same. The sensor consists of an optical light barrier (optical limit switch) and a 3D printed sensor arm with an aperture. This aperture is illuminated by the light barrier and should be printed in a white material. The material thickness of the aperture may need to be changed after printing so that the sensor functions properly. To do this, proceed as follows:

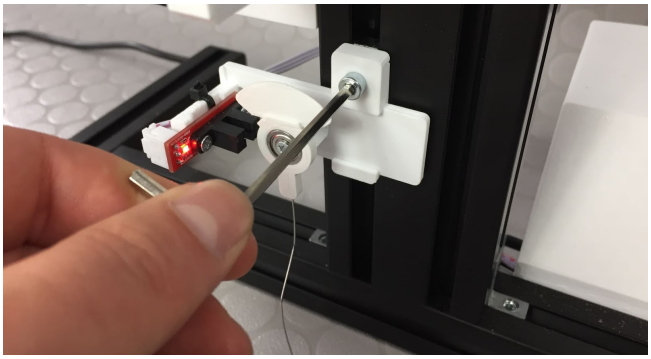
1. On the information view of the display, you can see the sensor value under "S", which changes when the sensor moves. Hold the sensor arm horizontally and read the value. Now set this value under Main menu-Control-Puller PID-Sensor Pos. Save the entry under Main menu-Control-Store memory.



2. If the value is outside the adjustable range or fluctuates when the sensor arm is moved instead of rising or falling evenly, the sensor orifice must be mechanically reworked. To do this, remove the sensor arm by loosening the small screw on the ball bearing. The surface of the sensor aperture, which is located between the light barrier, can now be ground a little thinner with a file. Sand the aperture from both sides so that the transilluminated surfaces are clean and matte. Make sure that the surface is thinned evenly and that there are no dents. The wedge shape of the transilluminated surface must be maintained. Then reinstall the sensor arm and read the value again. Repeat the process if necessary.

3. Adjust the distance of the sensor to the extruder nozzle by loosening the small screw on the sensor holder, sliding the sensor up or down, and reattaching it. The distance to the nozzle is

measured at the point where the filament touches the sensor when it is horizontal. The distance can be between 40 and 120mm depending on the material.



4. The sensor can now be removed by pulling it out to the left. If necessary, the screw must be loosened again slightly. Put it to one side. This has the advantage that the sensor will not be damaged if hot, soft plastic comes out of the nozzle when the extruder is started up.

5. Make sure that the sensor is never exposed to direct sunlight during operation. This would change the measured value and interfere with filament calibration and winding. Especially if the extruder is located near a window and runs for several hours, it may happen that the sun hits the extruder after some time. This should be prevented.

5.2 Calibrate puller motor wheel

The toothed wheel on the puller motor can have a different diameter than specified in the data sheet or order text of the wheel due to production reasons. To obtain a correct display of the filament length, the circumference of the wheel must therefore be adjusted in the control:

1. To do this, measure the diameter of the wheel with a caliper gauge.

2. In order to be able to enter a value into the control, the circumference of the wheel must first be calculated from the measured diameter. You can use an online circle calculator for this and enter the diameter there and get the value of the circumference. Or you can calculate it with the following equation (The sign * means multiply.)

   U=2*π*r

   So you calculate 2 * 3.14 * half of the measured diameter.

   Example:

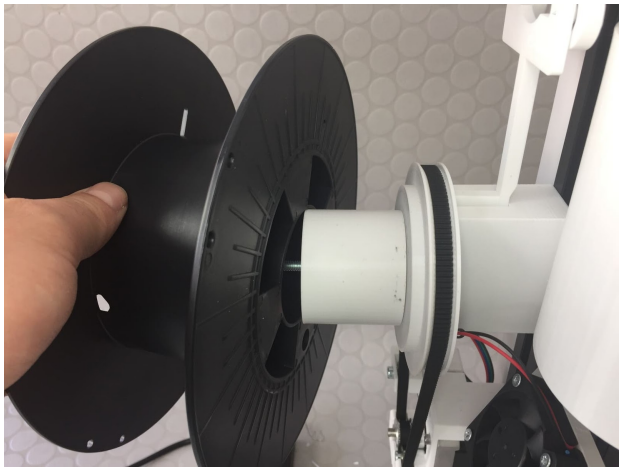
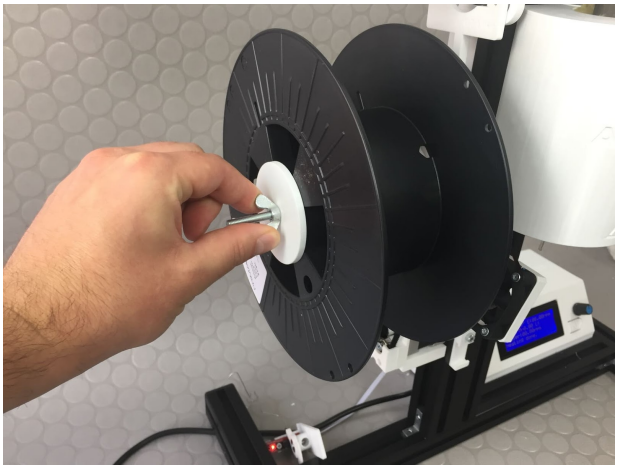
   If you measure a diameter of 12mm on the puller wheel, calculate 2 * 3.14 * 6. This gives a circumference of 37.68mm.

   Enter this value under Main Menu - Control-Puller PID - P circ. The value must be entered in millimeters. Then save the setting (Main menu - Control - Store memory).

5.3 Prepare and adjust spool

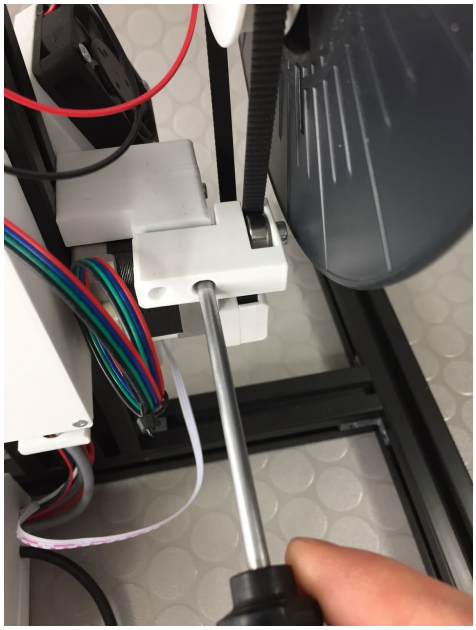
The toothed belt on the spool drive serves to keep the filament under tension while it is being wound up. It therefore rotates slightly during operation, similar to a slipping clutch. If the tensile force is too low, this can have a negative effect on winding. If the tensile force is too large, the spool motor can be blocked. The belt tension must therefore be adjusted:

1. Place an empty filament spool on the spool holder disk. Use a suitable adapter (3D print part SD08) so that the spool is centered. Place the corresponding washer on the mounting screw and tighten the wing nut. The wing nut may be turned so tightly that the washer bends slightly inwards. It is important that this screw does not loosen during operation.

2. Now start the extruder (in cold state). To do this, select START extruder in the main menu. The spool will now rotate. Hold the spool with your hand and check approximately how strong the pulling force is. If you hardly feel any pulling force, the belt must be tightened. If it pulls quite strongly or the motor stalls, the belt must be loosened.

3. The belt tensioner is located on the back of the extruder. This has two holes in which there are Phillips screws (see picture): The right screw tightens the belt when turned in clockwise and loosens the belt when turned counterclockwise. The left screw straightens the belt tensioner.



4. If the tensioning force is still not sufficient, even when the belt tensioner is fully tightened, the entire holder with stepper motor and belt tensioner must be loosened and moved down slightly. To do this, the filament spool must be removed once again and the cylinder screws of the motor bracket loosened with a 3 mm Allen key.

5.4 Calibrate temperature control

It is necessary that the temperature remains very uniform during operation and does not fluctuate. Even a temperature change of 1 - 2°C can have an influence on the quality of the extrusion. Calibration has already been performed when testing the components before shipping the kit. Therefore, you should not need to perform this step. However, if you still notice too much variation in your temperature control during operation, you can calibrate the temperature controller. To do this, run the Autotune function. This can be found under Main Menu - Control - Temperature - Autotune PID. Start the function in cold condition. Once you have started the function, the process will take a few minutes. Do not operate the unit during this time. When the process is complete, the control will begin to beep. Press the rotary knob to turn off the signal. Now the values for the PID control are determined and must still be stored (Main menu - Control - Store memory). The extruder cools down again automatically.

6. Granules Requirements

The condition and quality of the material to be processed is decisive for the success of the extrusion. Therefore, please be sure to read the material guide in the documentation (09-Material Guide). You will always find the documentation in up-to-date form at www.artme-3d.de/support.

7. Extrude plastic

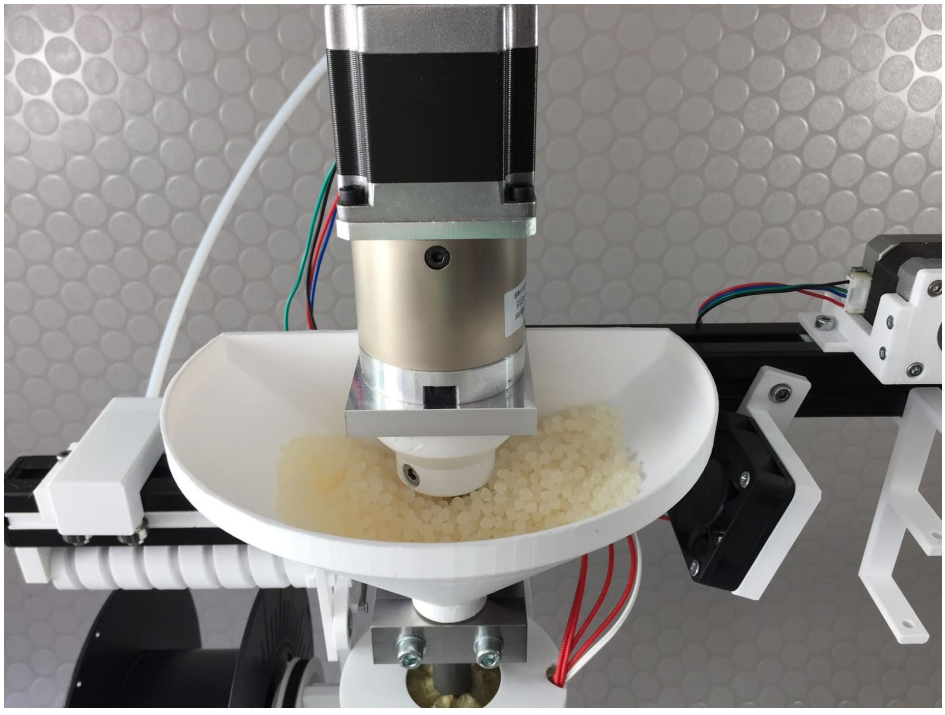
CAUTION Danger of burns! The nozzle and the metal parts on the extruder become very hot. When the filament comes out of the nozzle in the form of a soft plastic filament, it is very hot (150°C to 260°C). To get the take-up going, you must handle the filament while it is soft. Therefore, use protective gloves or tools such as tweezers to touch the filament in this area. The filament cools down considerably after a few centimeters on the surface, but inside it still remains very hot for a long distance. Therefore, be very careful when handling the filament.

7.1 Heating up

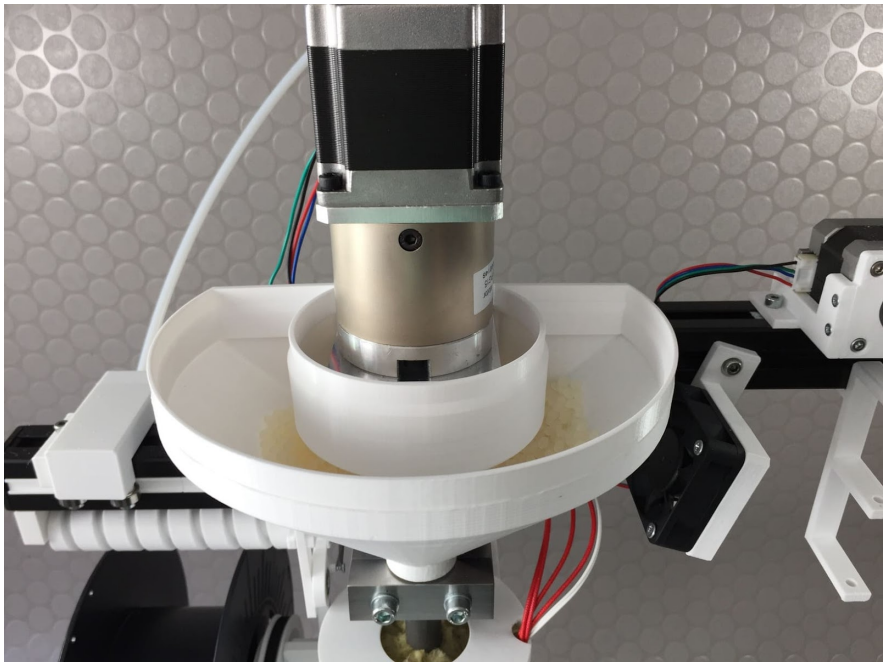
Heat up the extruder by selecting - Preheat in the main menu. The extruder will now heat up to a preset 180°C. This temperature is an approximate starting value for PLA. If you would like to set a different preheat temperature, you can do so under Main Menu - Control - Temperature - preheat config. Independently, you can change the temperature at any time under Main Menu - Prepare/Tune - Temperature. For a list of empirical values for different types of plastic, see the "empirical values" at www.artme-3d.de/support. When the extruder is heated, the controller will beep twice. This is to ensure that you do not forget that the unit is in operation.

7.2 Fill hopper

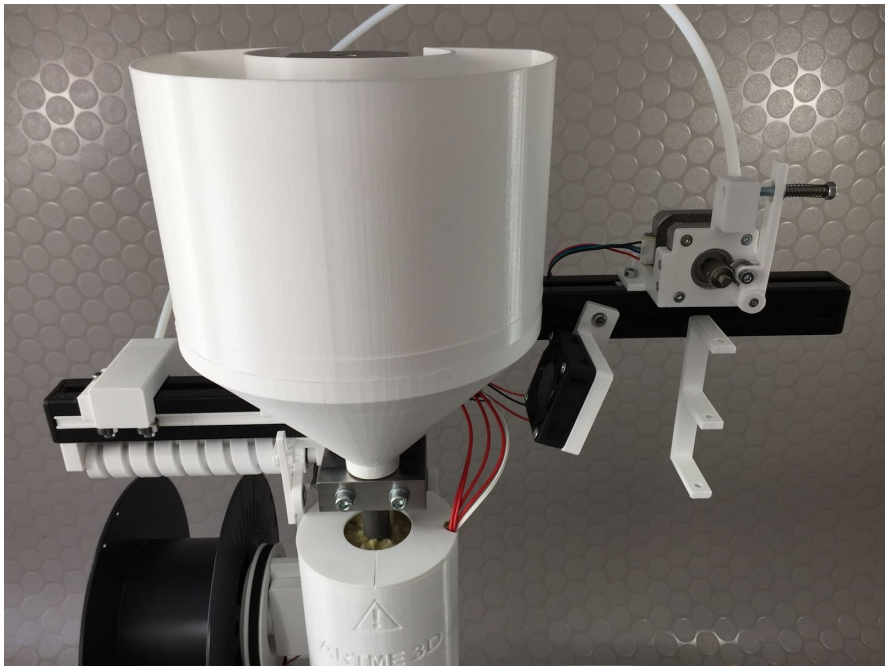
1. Fill the hopper with plastic granules. The hopper part 1 is permanently installed on the extruder and should always be at least filled to obtain consistent extrusion results:



2. The hopper part 2 has a kind of orifice plate so that the granulate flows to the feed zone in a controlled manner when pellets (industrial granulate) are processed. When processing shredded 3D printing waste, the hopper part 2 should be removed to prevent bridging in the material.

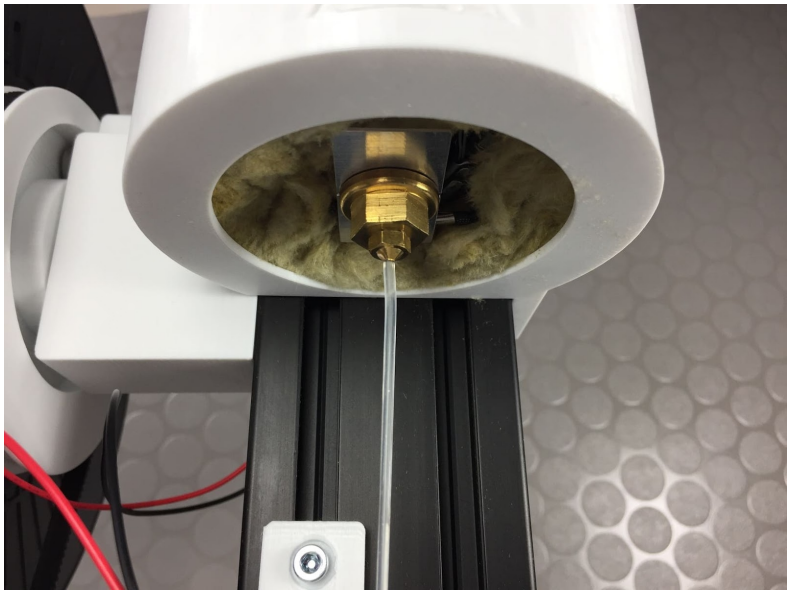


3. The hopper part 3 enlarges the hopper and enables a longer runtime. This part is stackable, so you can put another hopper part 3 on top.

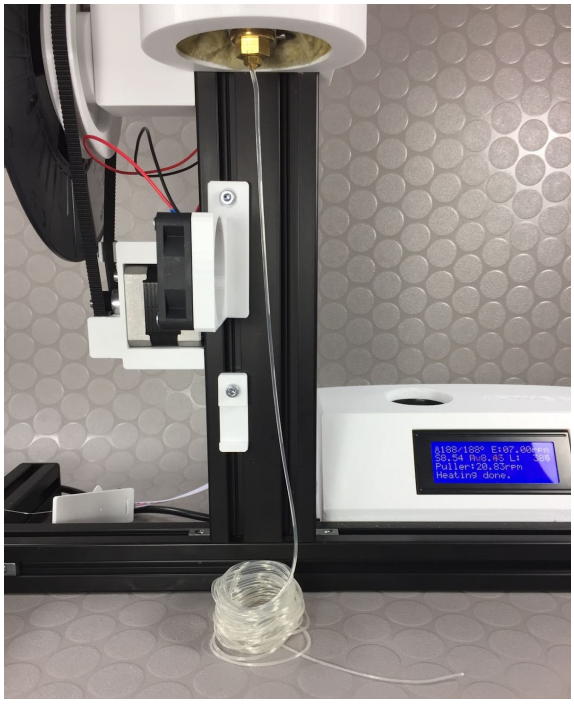


7.3 Start extruder

Start the extruder motor (Main Menu - START Extruder). In the factory setting, the motor starts with 7 revolutions per minute (RPM). This is a relatively slow initial value to get used to. The pull motor and spool motor will also start, so the filament spool will also spin. You can change the extruder RPM at any time (Main Menu - Prepare/Tune - Extruder RPM). When the extruder is running for the first time, or when the extruder screw is free of plastic, it may take a few minutes for material to come out of the die.



When plastic comes out of the die, the extruder still needs a moment until the pressure and temperature curve along the extruder screw are even. Therefore, let it run for another 2 to 4 minutes. The sensor should be removed and put aside to avoid damage. It is best to place a pad on your work surface so that it cannot be damaged by the hot plastic.



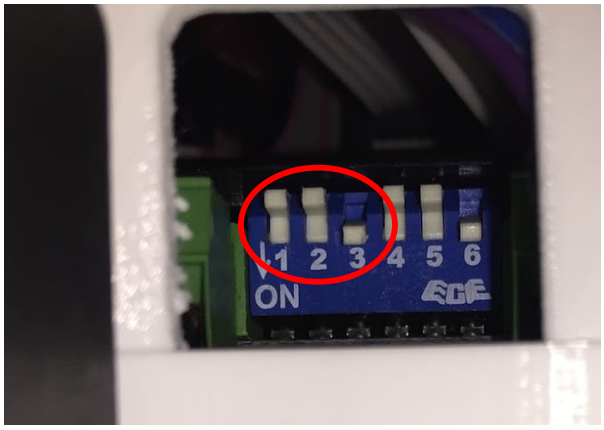
7.4 Set motor current

The presetting of the motor current is set so that the power of the motor is sufficient for processing common materials and little heat is generated in the motor. It may be necessary to increase the motor current if you are processing tough or semi-flexible materials such as PETG pellets. If the motor current is not sufficient, the stepper motor will lose steps. This manifests itself in a disturbing noise and stalling of the motor speed. The motor current setting can be adjusted on the dip switches on the stepper motor driver in the electronics housing. These are accessible through an opening on the right side of the housing. The corresponding dip switch positions are printed on the stepper motor driver and can be found in the documentation. The following settings have proven to be effective:

For processing PLA, ABS, ASA, PP and TPE:
Peak Current 1.63A: Dip switch 1: on. Dipswitch 2: off. Dip switch 3: on.

For processing PETG:
Peak Current 1.94A: Dip switch 1: off. Dipswitch 2: off. Dipswitch 3: on.

A dip switch is on when it points down and off when it points up. If you set the motor current above 2 A (peak), it may be necessary to cool the motor.



8. Filament Production Prepare

8.1 Prepare speeds and fan setting

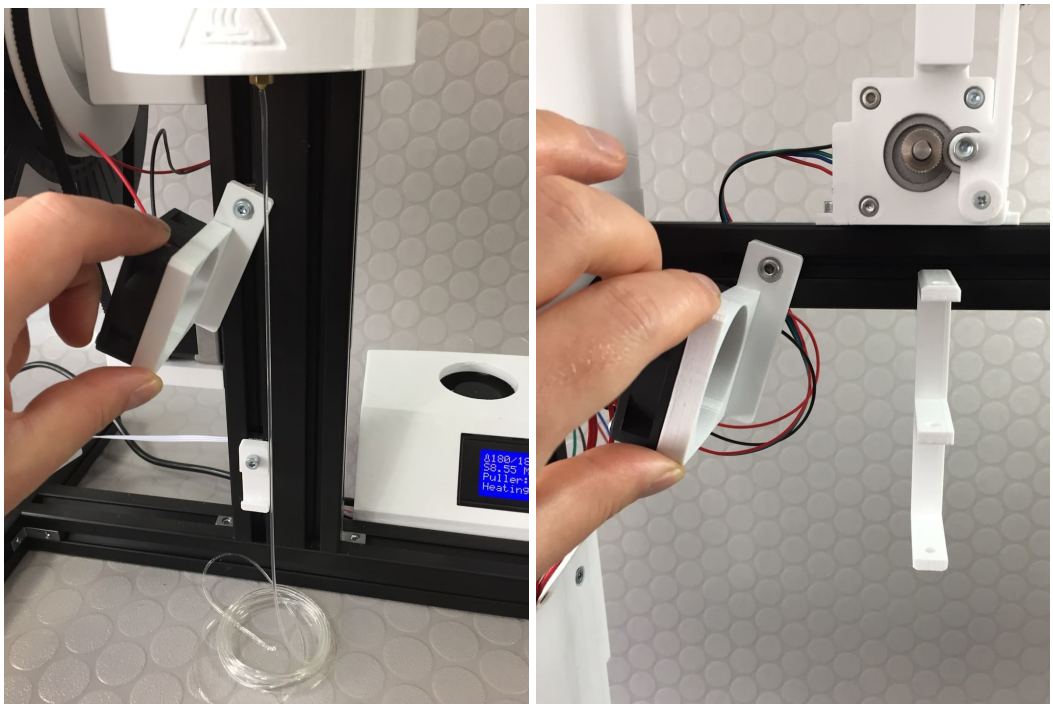
To start the winding you need both hands and don't have much time to concentrate on other things. Therefore, there are a few things that can be preset:

1. Roughly set the speed of the extruder motor and the pull motor depending on the material. A list with empirical values depending on the type of plastic can be found in the "empirical values" at www.artme-3d.de/support. The extruder speed is set via Main Menu-Tune-Extruder RPM. Avoid higher speeds (above 15 RPM) if the values for the material settings are not known. Excessive RPM can cause damage to the extruder screw and tube if the settings are inappropriate. High speeds (above 20 RPM) should only be used with low processing temperature materials such as PLA.

2. The puller motor speed is set by turning the rotary knob on the display while the information view is visible. You can read the corresponding speed on the display at "Puller". You can again use the empirical values in the documentation at www.artme-3d.de/support as a guide.

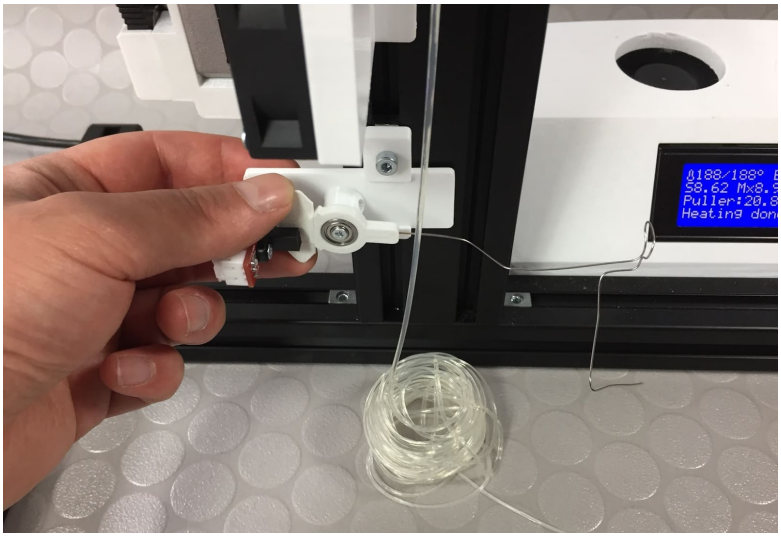
3. Roughly adjust the fan speed of the fan under the extruder nozzle. Main menu - Prepare/Tune - Fan speed. For a list of empirical values depending on the type of plastic, see the "empirical values" at www.artme-3d.de/support. There are two reasons for cooling the filament on its way to the winder. First, it generally cools the filament so that it is cold enough to be wound up well. Second, it cools the surface of the filament in the area of the sensor enough to prevent the sensor arm from sticking to the soft filament. In this case, increase the speed of the fan. If cooling takes place too quickly, the filament will twist on its way to the puller motor and can disrupt the functional sequence. In this case, reduce the speed.

4. Roughly adjust the alignment of the two fans. It is sometimes advantageous to tilt the fan under the nozzle slightly downward. This ensures that the function of the sensor is not disturbed by the filament sticking to it. The fan next to the pull motor can also be tilted down. This extends the cooling zone somewhat. However, there are materials that solidify very quickly. In this case, too much cooling can interfere with the take-up because the filament will twist. In this case, set the fans straight or change the speed.

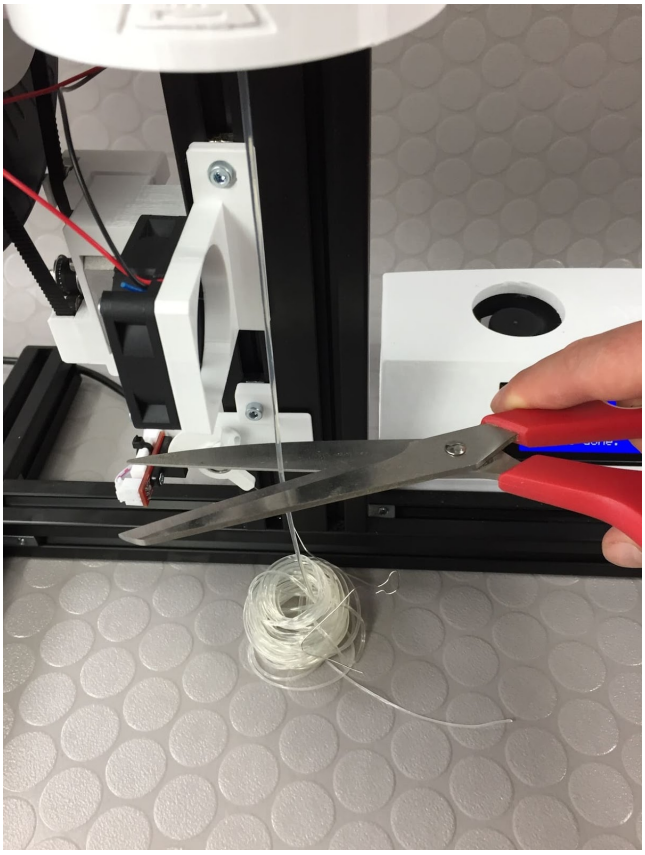


8.2 Prepare filament calibration

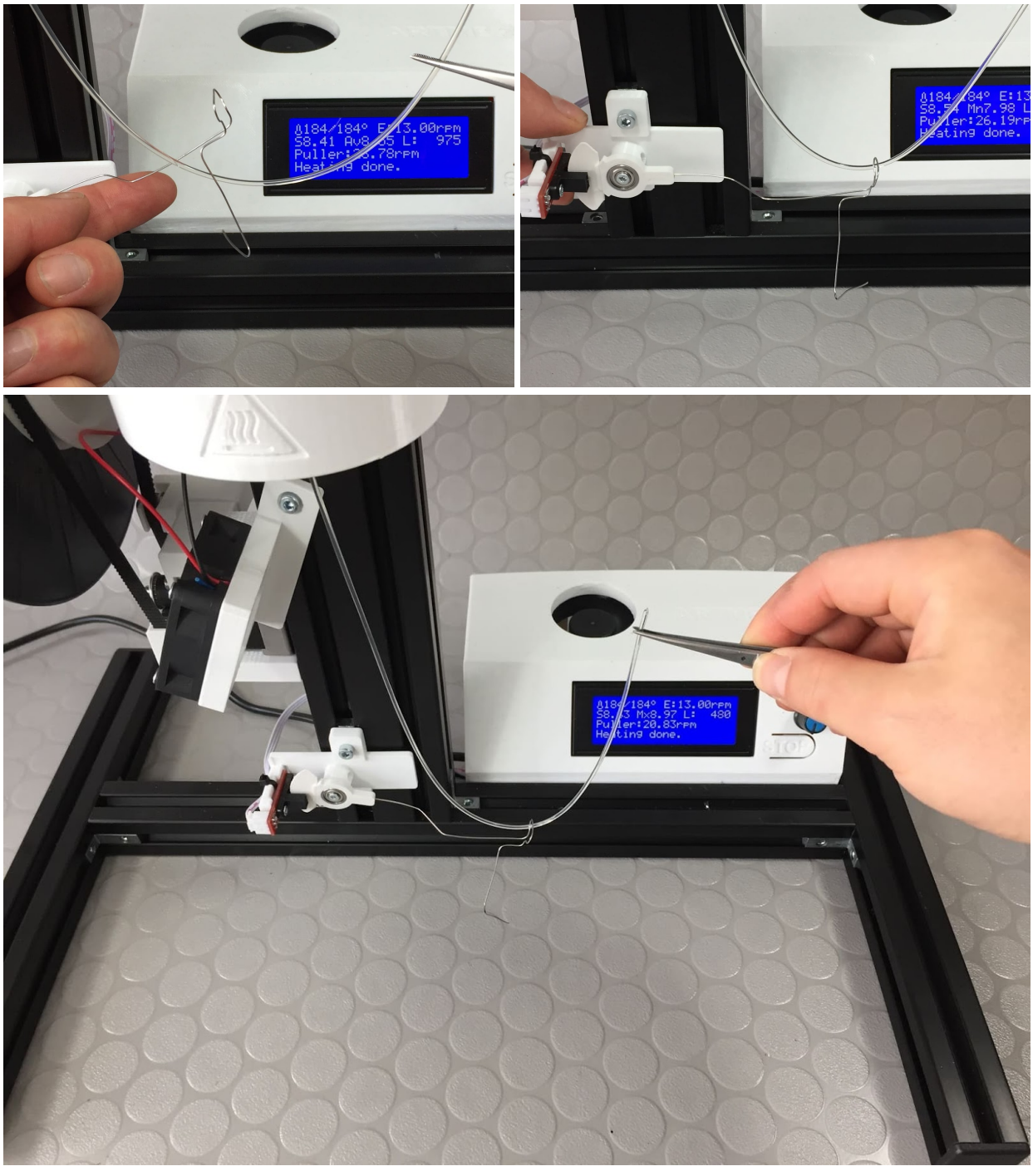
1. Reinsert the sensor into the holder by pushing it into the holder from the left. It may be necessary to loosen the screw on the holder briefly.



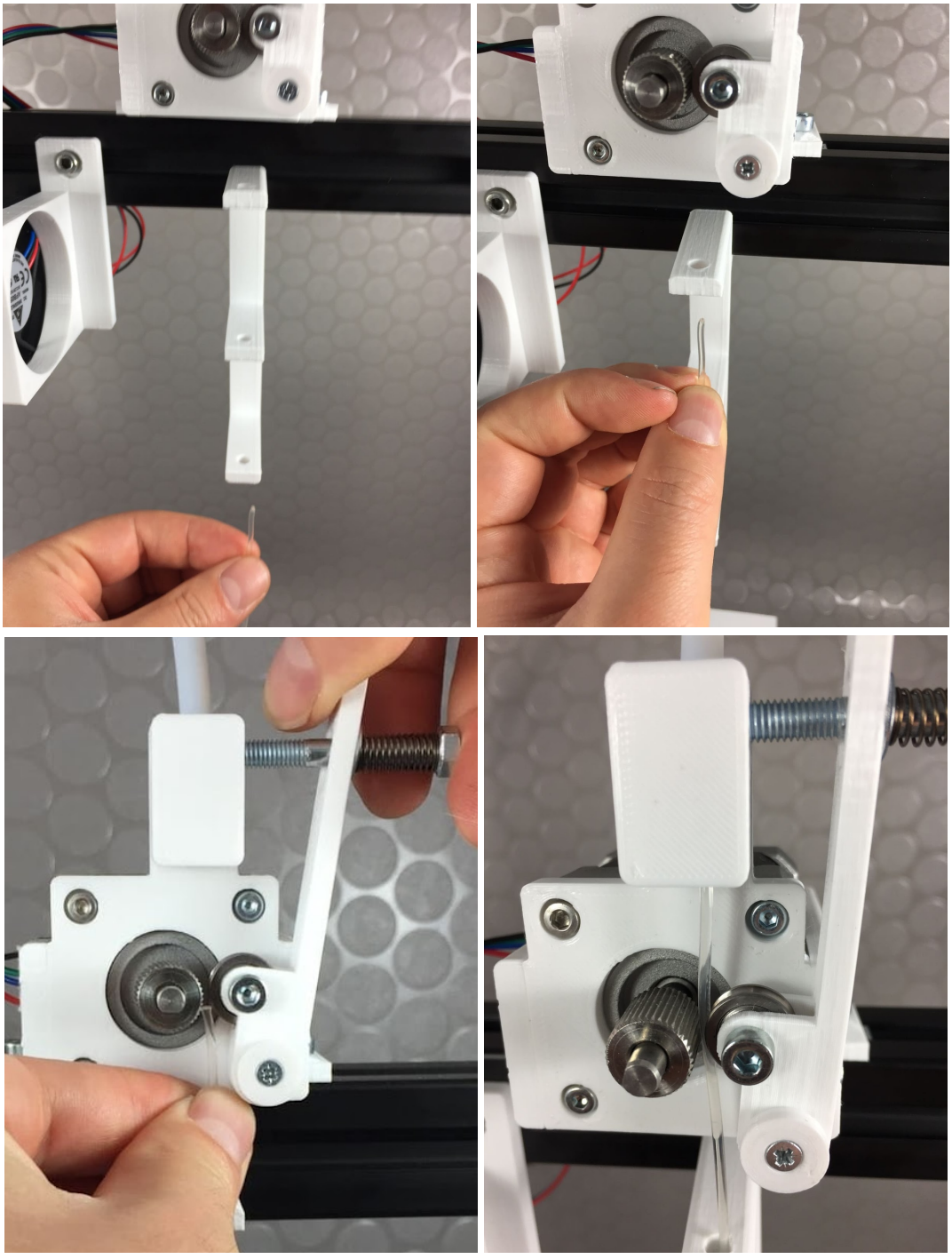
2. Cut the still soft filament about 7 to 10 centimeters after the nozzle with scissors or side cutters.



3. Guide the filament in an arc in the direction of the puller motor and place the sensor on the filament. Make sure that the sensor rests on the filament with the eyelet-shaped piece. Pull the filament at approximately the same speed as it comes out of the nozzle, keeping the sensor approximately horizontal. If the cooling by the fan is too fast or the extrusion speed is too low, the filament may twist. In this case, reduce the fan speed or increase the extruder motor speed. If you don't get it right the first time, just try again by depositing the filament. After a little practice, this will go very quickly by hand.

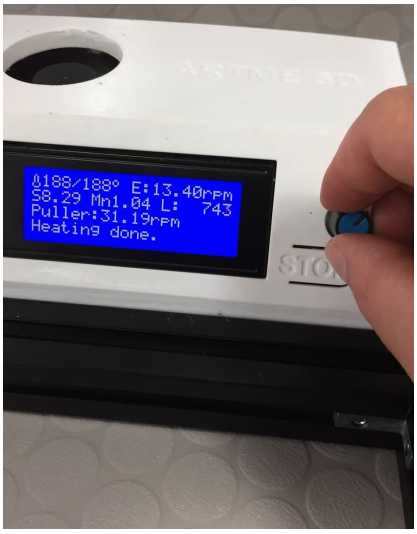


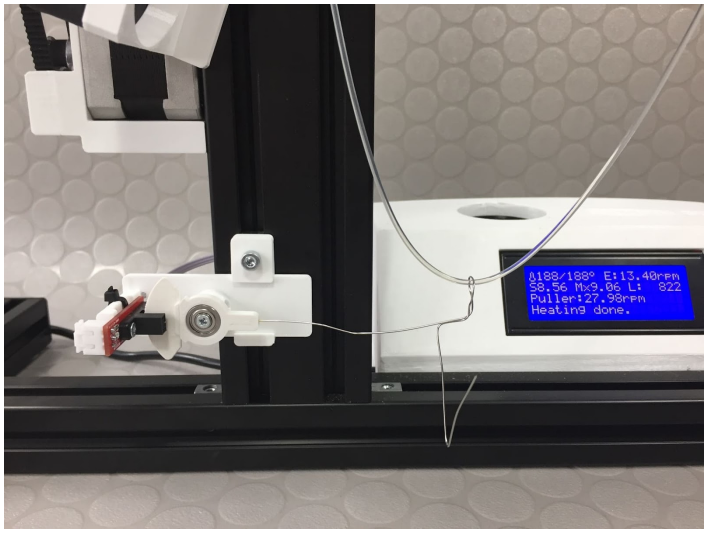
4. Push the filament through the holes in the guide under the pull motor. Then push the filament into the pull motor and between the toothed wheel and the pinch wheel. Once the motor pulls the filament by itself, make sure it hits the guide to the PTFE tube.



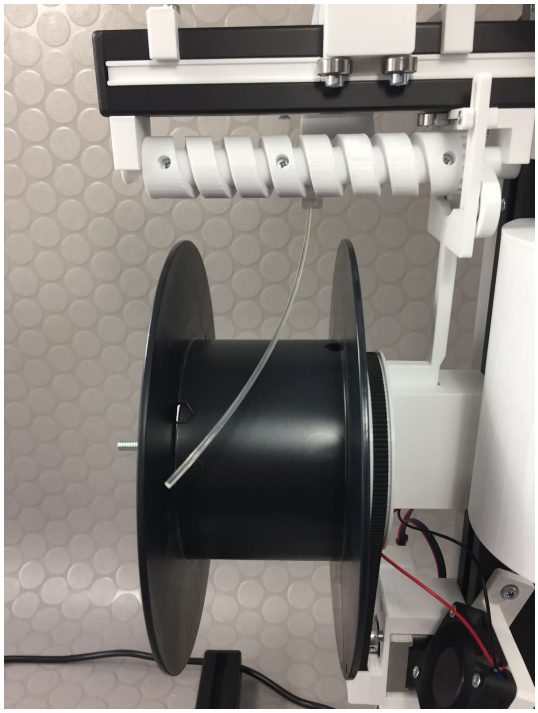
5. The speed of the puller motor can now be changed by turning the rotary knob on the display. (Info view must be visible). Set the speed so that the sensor remains approximately horizontal. If you increase the speed, the sensor moves slowly upwards. If you decrease the speed, the sensor moves slowly downwards. When the sensor is reasonably stable horizontally, start the automatic (main menu - automatic pulling). Now the speed of the pulling motor is controlled depending on the height of the sensor. If the sensor lowers, the speed is increased and vice versa. This ensures that the soft filament, which runs in an arc to the pulling motor, always hangs at the same height. This keeps the dead weight and thus the diameter of the filament uniform. With a little practice and the empirical values from the "empirical values", this can be done quite quickly.

The sensor can be moved a little to the right or left in its holder so that the wire on the sensor touches the filament sheet at the lowest point.





6. Now the filament runs through the PTFE tube and comes out above the spool. Let it run to the bottom first to have time to make the next adjustments to calibrate the exact diameter.

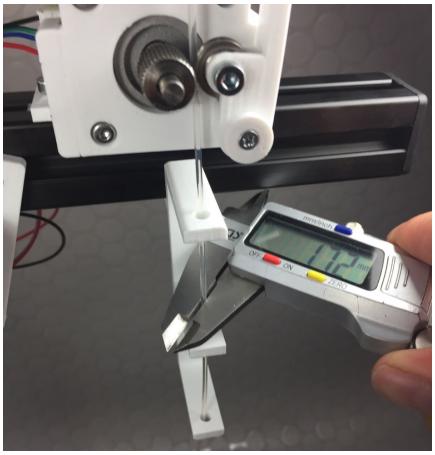


7. You can interrupt the automatic speed control at any time (Main menus -/ Manually pulling) and control it again via the rotary knob in the Information view. This is especially necessary if you make large changes in the settings. Do not restart the automatic speed control until the sensor is approximately horizontal.

9. Calibrate filament diameter

9.1 Measure filament diameter

It is best to check the diameter with a digital caliper gauge. Measure just before the puller motor between the guides. Use a high-quality caliper gauge or micrometer for this purpose. Inferior measuring devices can lead you astray.



9.2 Define usable filament

If, for example, you set a diameter of the filament that is between 1.6 and 1.8mm (for 1.75mm filament system), this can be processed well with common 3D printers. If in doubt, you can increase the flow rate of the printer, for example, if the diameter is smaller than 1.75mm. Or you can enter the diameter of the filament in the slicer. However, if the diameter of the filament varies greatly during production, even though the rewinder is running automatically, something is wrong in the system (granule quality, speed too high, melt filter dirty, material unsuitable, etc.). A filament diameter larger than 1.85mm may cause clogging in most 3D printers. If in doubt, stay slightly below the target diameter of 1.75mm. With a little practice, however, it is quite possible to achieve this diameter. See next step.

9.3 Calibrate filament diameter

If you are processing a new material without any experience, this process may take some time, as the system reacts quite sluggishly. So if you change the temperature, for example, to optimize the filament diameter, wait a moment until the temperature has equalized throughout the system. The same applies to all the possibilities listed below.

Important to know: Plastics expand at different rates as they leave the nozzle. Therefore, the hole in the nozzle only roughly specifies the filament diameter:

1. Hole sizes for 1.75mm filament:
   PLA and PETG: 1.7mm hole (experience, may vary)
   ABS: 1.5mm hole (experience, may vary)
   PP: 1mm hole (experience, may vary)

2. Hole sizes for 2.85mm filament:
   PLA and ABS: 2.5mm hole (experience, may vary)

The following options are available to influence the filament diameter:

1. The size of the hole in the nozzle
2. The pressure in the system depending on the speed, material and temperature.
3. The filling level of the hopper. (At least hopper part 1 should always be filled to ensure uniform pressure in the system).
4. The distance between the nozzle and the sensor. (greater distance increases the dead weight of the filament).
5. The property of the material depending on the temperature (tough or soft).
6. The weight of the sensor.
7. The distance from the fan to the nozzle. The closer the fan to the nozzle the cooler the nozzle and the earlier the filament cools.
8. Plastic is damaged during each melting process (degradation due to the frequency and duration of the melting processes). This can change the properties of the plastic. PLA, for example, appears to become thinner and does not expand as much exiting the nozzle the more times it is melted. This reduces the diameter of the filament and requires new adjustments.
9. Even plastics of the same grade can have different properties. This depends, for example, on the manufacturer's recipe or the age of the material.
10. Avoid drafts in the room.
11. Always dry the material before processing. (See material guide at www.artme-3d.de/support).

Therefore, it is recommended to use the empirical values (download www.artme-3d.de/support) and then proceed as follows for fine adjustment:

1. The bore of the nozzle can be different depending on the material to be processed. Only change the nozzle diameter with the aim of changing the diameter of the filament if you do NOT achieve your goal with the help of the following setting options.

2. If the filament diameter is too large, you can:
    a. Increase the distance of the sensor to the nozzle. Increase the filament's own weight so that the filament draws slightly thinner.
    b. Slightly increase the temperature. This softens the plastic and causes it to draw thinner. If the plastic still arrives at the sensor too hot, the sensor arm may brake or bounce. In this case, increase the speed of the filament fan.
    c. Attach an additional small weight (e.g. washer M5) to the sensor, this will pull the filament a bit.
    d. Slow down the speed of the extruder motor. This will lower the pressure in the system and the filament will expand less when it leaves the nozzle.
    e. Reduce the fan speed. Then the filament cools down a little later and has more time to be pulled by its own weight.
    f. Increase the distance from the fan to the nozzle slightly. This way the filament is softer shortly after the nozzle and stretches a bit more.

3. Accordingly, if the filament diameter is too small, you can:
    a. Reduce the distance to the nozzle
    b. Reduce the temperature slightly
    c. Reduce the weight on the sensor
    d. Increase the speed if necessary.
    e. Increase fan speed.
    f. Reduce distance between fan and nozzle.

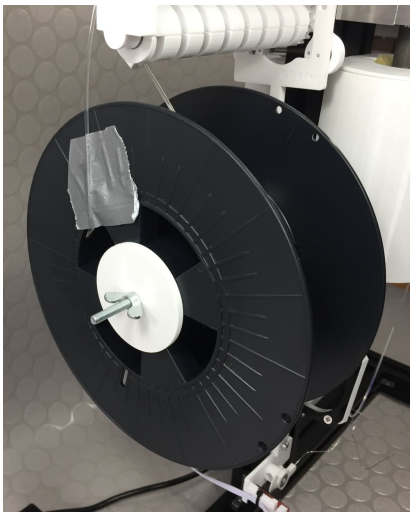
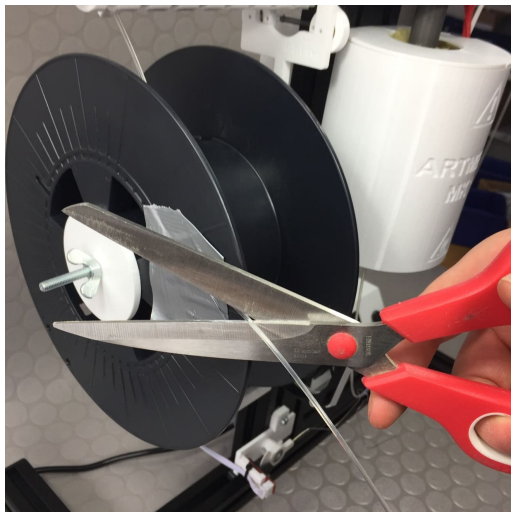
4. Remember to give the system time after each change until the effect is stable.

5. Make a note of the setting values and store the settings if necessary. (Main menu - Control - Store memory)

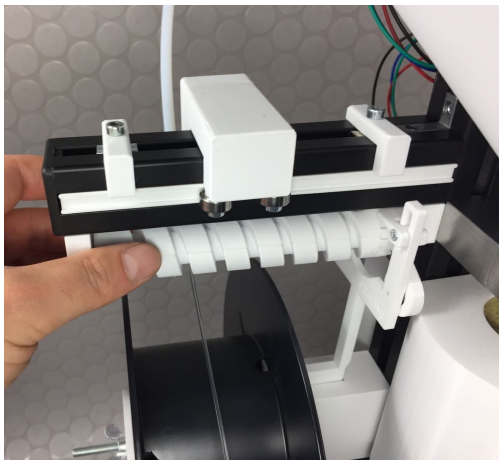
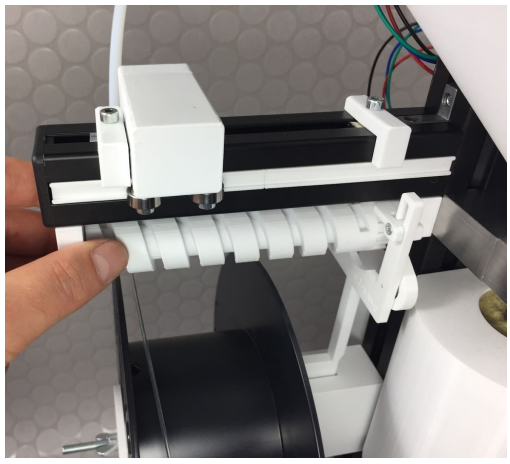
10. Filament spooling

1. Cut the filament above the spool. The filament is then threaded into the opening at the bottom of the spool. To do this, turn the empty spool by hand to a position where you can see the opening.push the filament through.

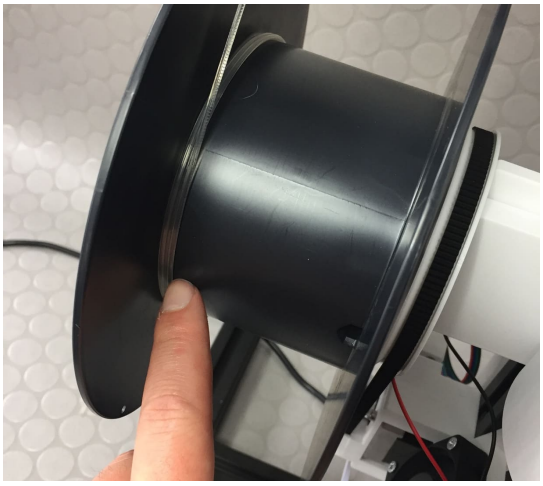

2. The filament is bent around the outside of the spool and secured with an adhesive strip. Make sure that the filament remains reasonably taut. The protruding end of the filament should be cut off.

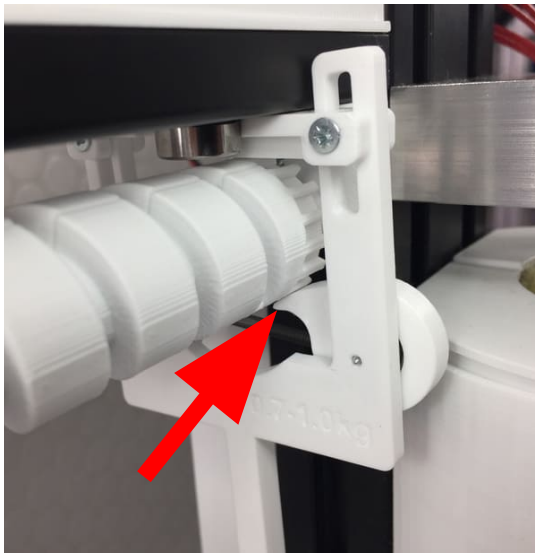
3. Move the carriage on the filament guide to the left side by turning the spiral axis.

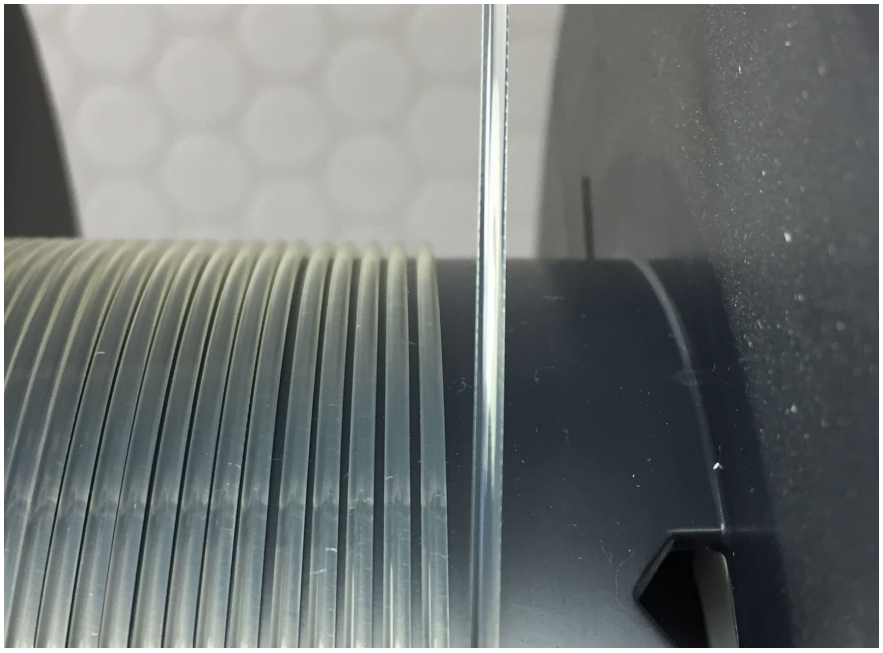
4. Slide the first windings to the left side.



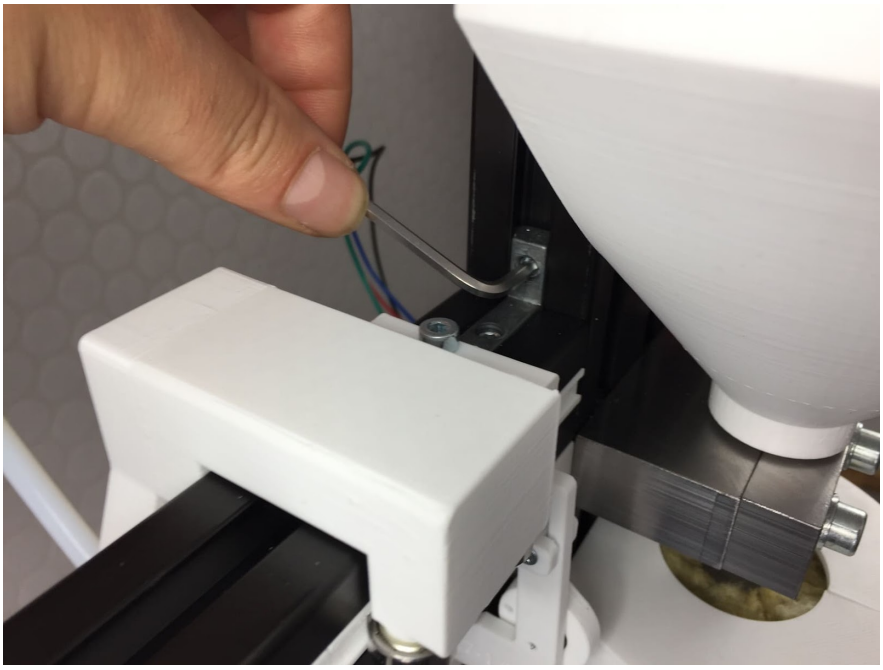
5. It can happen that one or both hooks on the swing arm is twisted downwards. It is important that the hooks straighten up again. To do this, you can push the rocker arm into both detent positions and/or turn the spiral axis slightly. Switch the rocker to the position shown, then the filament guide moves to the right bit by bit.




6. Observe how the winding looks. If, for example, the winding on the spool is too loose (See picture: too much space between the windings), then this can be adjusted. See next step.

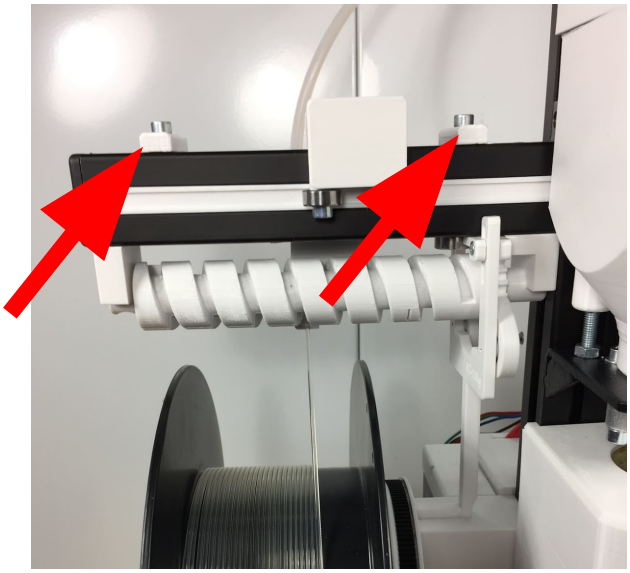


7. The distance between the windings can be adjusted by loosening the aluminum profile (to which the filament guide is attached) and fixing it higher or lower in very small steps (less than 0.5mm). If you raise the aluminum profile, the distances between the windings become smaller. If you lower the aluminum profile, the distances between the windings become larger.



8. Depending on the spool width, it is necessary to set the stops for the carriage of the filament guide to the correct position in order to obtain a clean take-up. By loosening the cap screw, the position of the stops can be changed. When the carriage presses against a stop, the swing arm will snap to the other position, reversing the direction of rotation of the spiral axis. Adjust the stops so that the direction changes when the filament is almost at the outer edges of the spool. It

takes some experience and can be readjusted as you go.



9. If the filament guide switches the direction of movement even though it has not yet reached the end, there are the following possibilities:
    a. Increase the spring tension of the latching mechanism. See assembly instructions 06-Filament guide assembly - step 14.
    b. If the spiral axis turns out of round or sluggishly or hooks at one or the other point, it can be reworked. See assembly instructions 06-Filament guide assembly - step 9 and step 21.
    c. The tension of the spool drive can be set a little lower if necessary. If it is too high, the guide will have more resistance to movement.

10. If the filament guide does NOT switch the direction of movement even though it has reached the end, there are the following possibilities:
    a. The spiral axle does not touch the plow over the entire length. This means that there is too little frictional resistance and the spiral axle can rotate backwards. To do this, realign the holder for the spiral axle on the left and right. See assembly instructions 06-Filament guide assembly - step 25.
    b. Set the spring tension of the latching mechanism lower. See Assembly Instructions 06-Filament Guide Assembly - Step 14.
    c. The tension of the spool drive can be set a little higher if necessary. If this is higher, the guide also gets more resistance to movement, so that the spiral axis can no longer rotate backwards.

11. When the winding has started successfully, you can reset the filament length counter. (Main menu-Clear Statistics) The extruder switches off automatically after reaching a preset filament length. Before it can be started again, the unit should be switched off once and switched on again. The default setting is 200000 mm (200m), which corresponds to approximately 570g (for 1.75mm filament). You can set the preset for shutdown. (Main menu - Prepare/Tune - L cutoff). The cutoff length value is displayed in millimeters (mm). You can read the produced filament length on the information view of the display under "L:". This value is displayed in centimeters (cm). (e.g. 20000cm = 200m) You can reset or pause the display (Main menu - Clear Statistics or Pause statistics).

11. Switch off and cool down

1. Stop the extruder motor (Main menu - STOP Extruder).
2. Switch off the heating (Main menu - Cooldown).
3. Cooling down will take some time, because quite little heat is lost due to the insulation of the extruder and no more cold pellets are heated up.
4. Disconnect the extruder from the power supply. Make sure that no one can burn themselves on the hot parts of the extruder.

12. Recommissioning

Heat the extruder to the desired temperature. Once the temperature has been reached, you can start the extruder motor. The system does not yet run stably, as the heat distribution in the system is not yet uniform. Let the extruder run until the extruder screw is filled with new plastic and the extrusion proceeds evenly. This may take 3 to 10 minutes. The old plastic may have changed its properties (degradation) due to the slow cooling process after switching off and may be somewhat thinner or burnt than the new plastic then flowing in.

13. Material change

Es gibt mehrere Optionen, um die zu verarbeitende Kunststoffsorte zu wechseln:

1. While the extruder is running, add new material and run the extruder until the screw, extruder barrel, and die have cleaned themselves. This can take 10 to 40 minutes depending on the material and the temperature requirements of the material. This is only possible if the materials have a processing temperature that overlaps, such as PLA, PETG and ABS.

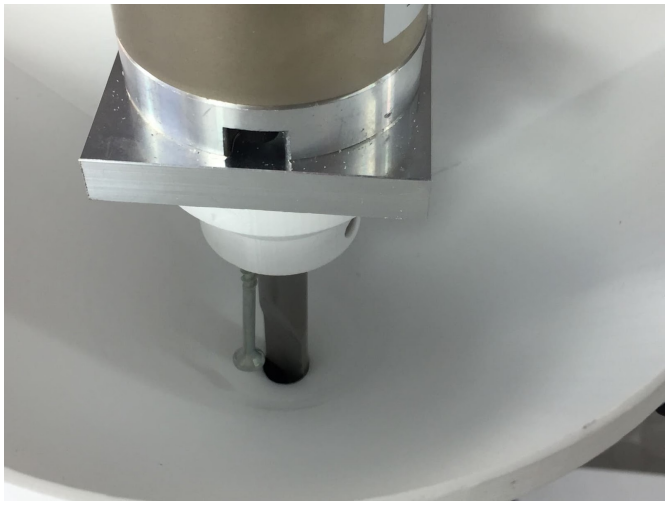
2. If you change from a plastic with a high processing temperature to a plastic with a low processing temperature, it is possible that buildup of the old plastic remains at various points in the system. This is mainly the case in the narrowing area of the nozzle. It may therefore be necessary to clean the area of the nozzle. See chapter 16.1. Also clean the area of the thread in the extruder barrel, see 16.2.

3. However, buildup can also occur in the feed area of the extruder screw. In this case, the extruder screw should be removed and cleaned. See next step.

4. If the processing temperatures of the plastics to be changed are far apart, it is also possible to work with cleaning granules. This makes it possible to change materials without removing the extruder screw. However, these are very expensive and are only adapted to certain types of plastic.

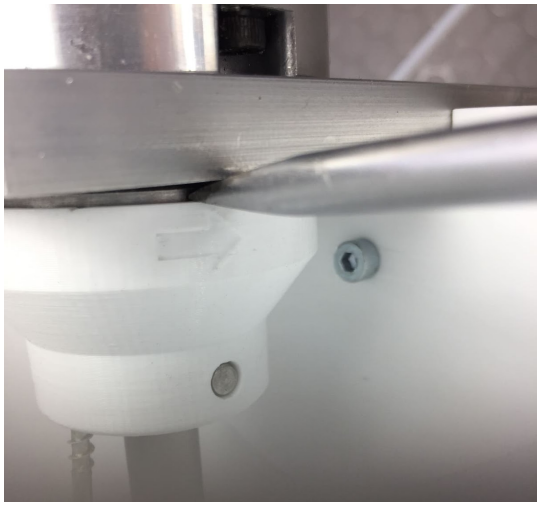
14. remove and clean extruder screw

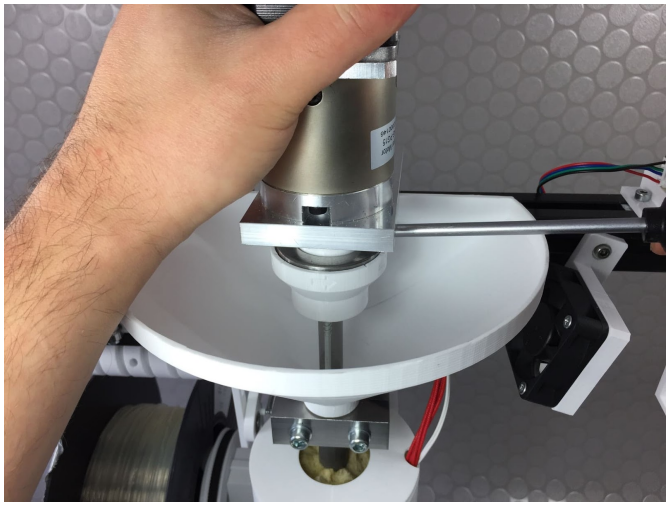
1. If there are deposits on the extruder screw, it may be necessary to remove and clean the extruder screw while it is hot. First allow the extruder to run empty as far as possible in the heated state so that as little plastic as possible remains in the extruder screw.

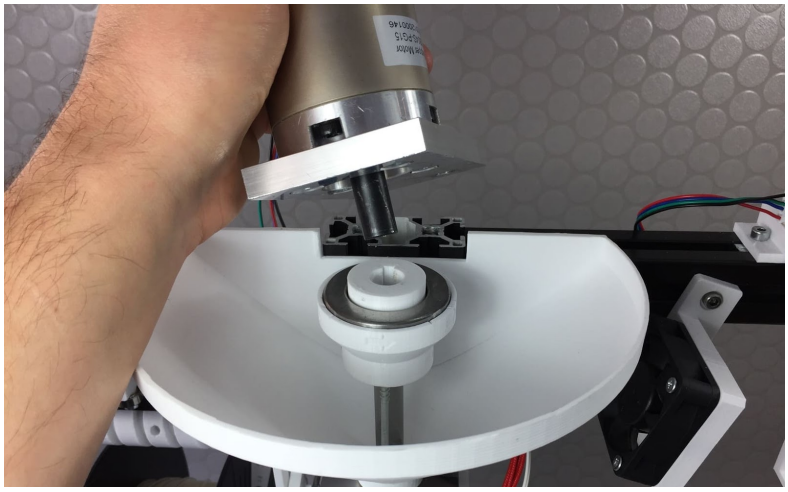


2. Then loosen and remove the two countersunk screws on the motor bracket.

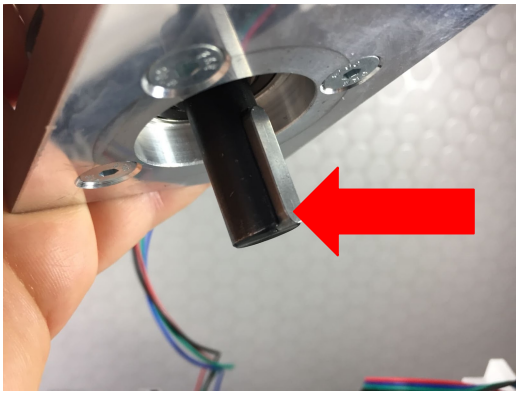
3. The small wood screw that is screwed into the side of the coupling holds the coupling onto the motor drive shaft.Therefore, you can loosen the motor from the coupling and pull it away upward by inserting a flathead screwdriver into the thrust bearing area and levering/turning.



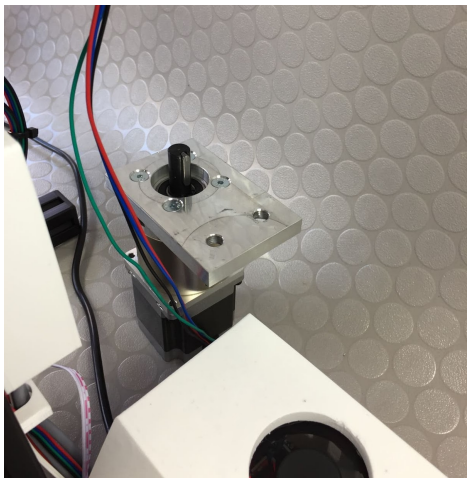




4. Be careful not to lose the key on the motor drive shaft. Sometimes the key also gets stuck in the coupling.



5. Place the motor to the rear.

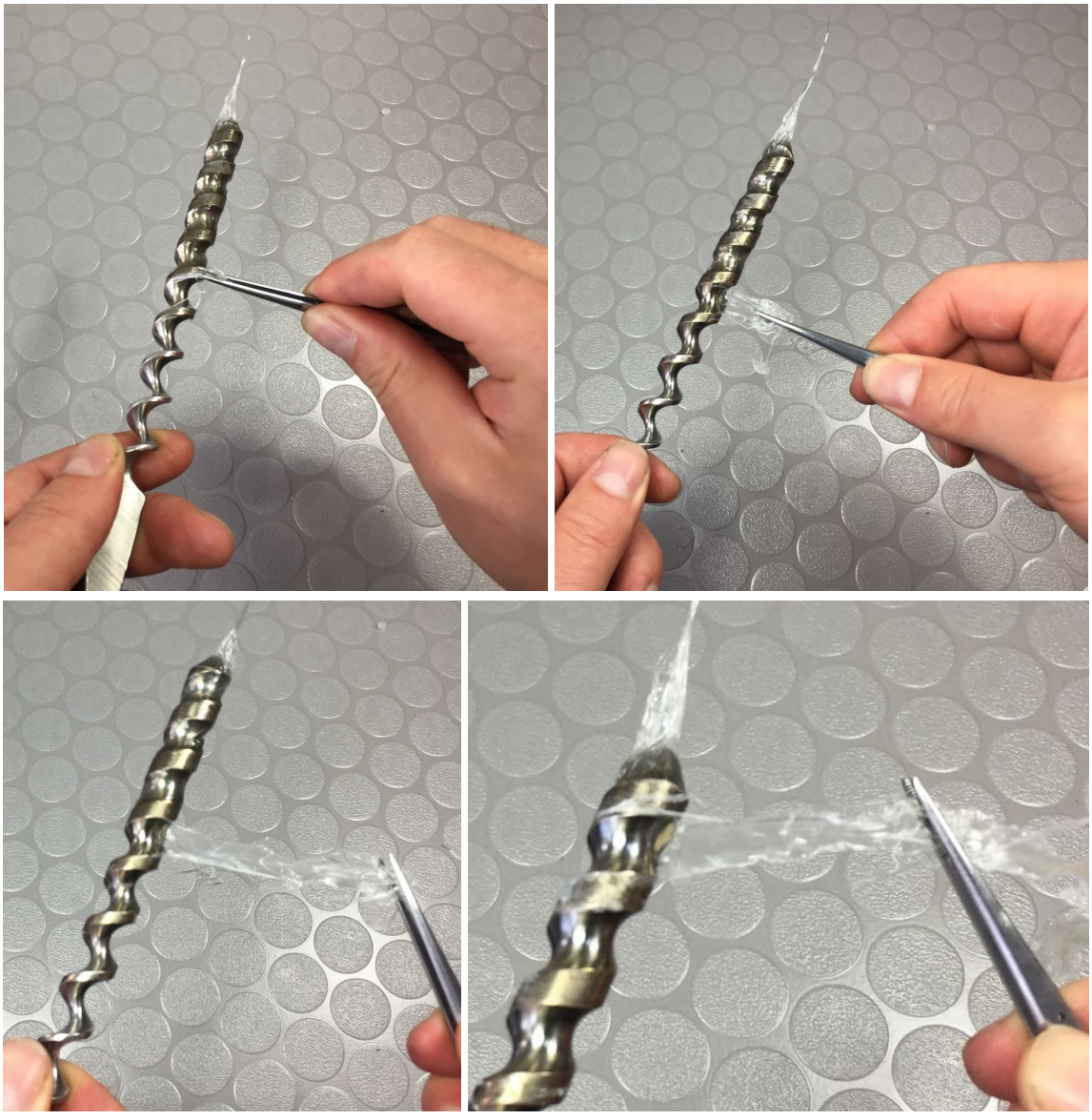


6. Now the extruder screw can be gripped at the coupling and pulled / turned out upwards. In case of problems, some force may be necessary. If in doubt, heat the extruder further so that the plastic becomes softer. Caution: There is a great risk of burns during the entire process. Wear protective gloves or touch the parts only at the non-heated areas.

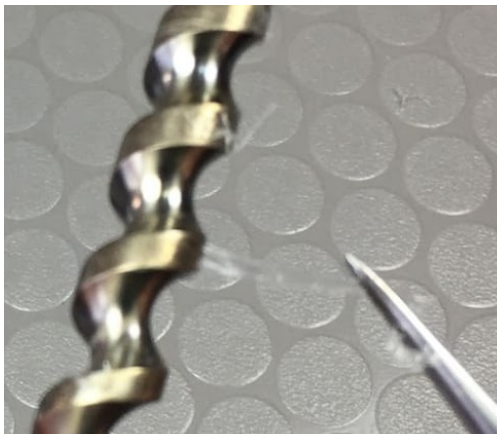
7. Rotate the coupling so that the thrust bearing can be removed. Lay it on its side. Make sure that no dirt or dust gets into the bearing.

8. Disconnect the coupling from the extruder screw by removing the side cap screw.

9. Hold the extruder screw at the cold end. Now the plastic can be pulled off with tweezers or pliers. To do this, wait a short time until the screw cools down somewhat so that the plastic becomes tough. Then you can pull off the plastic. Start at the cold shaft. At the tip of the screw, it cools down last. It can be helpful to blow a little air on the plastic with your mouth, then it will toughen faster in the desired places. See also the pictures on the next page.

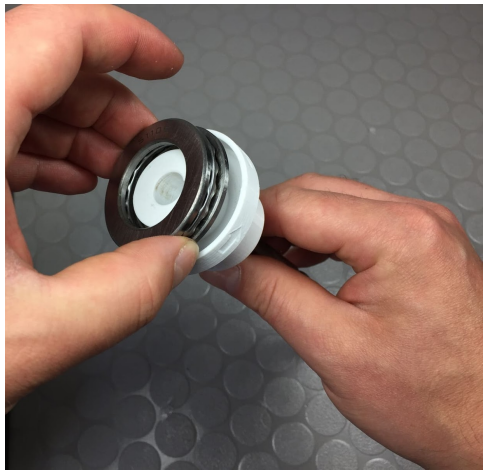


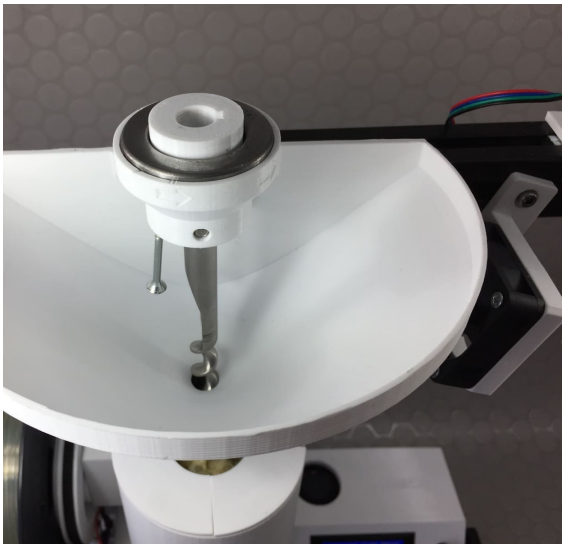
10. Do not forget to clean the edges of the flanks.

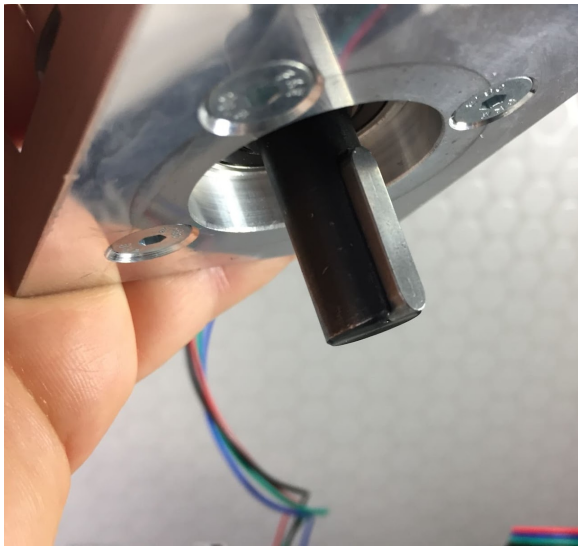


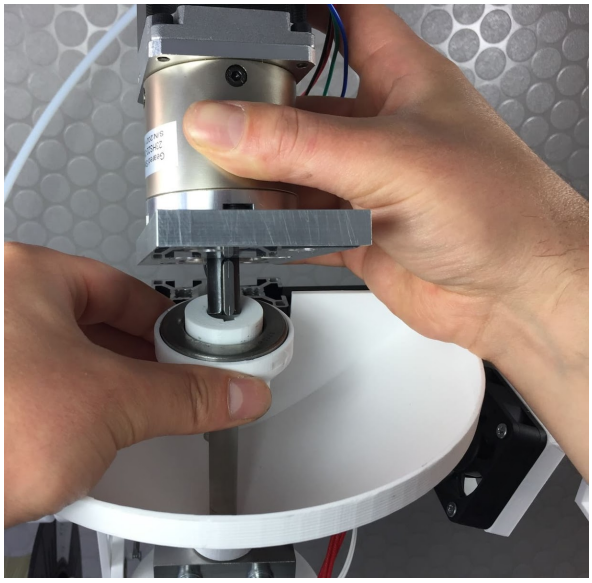
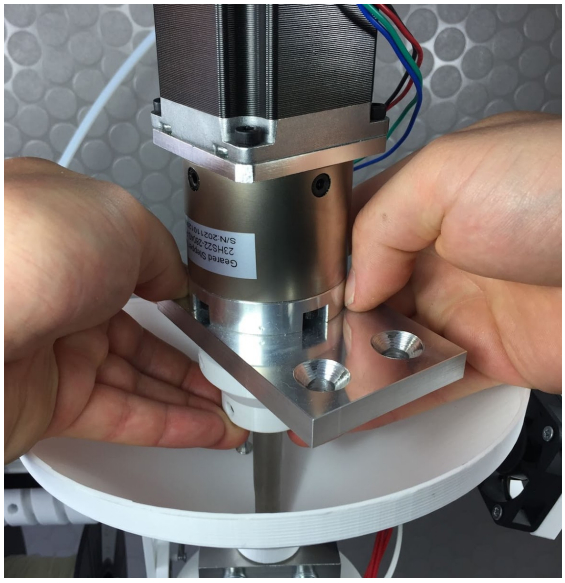
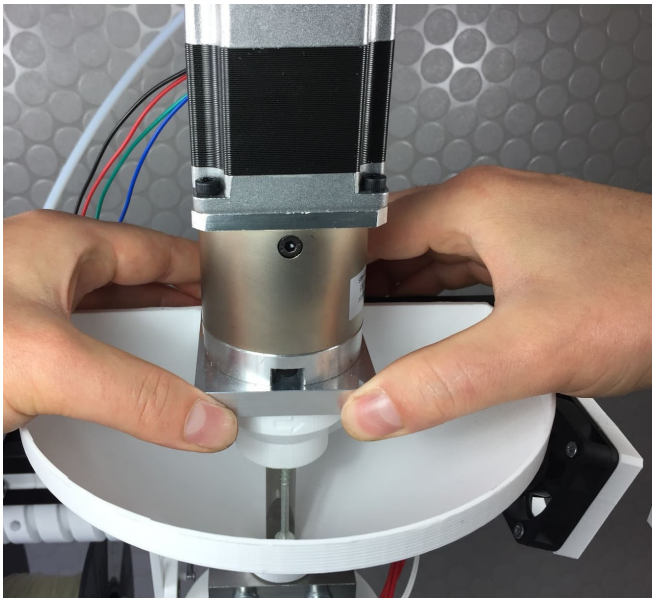
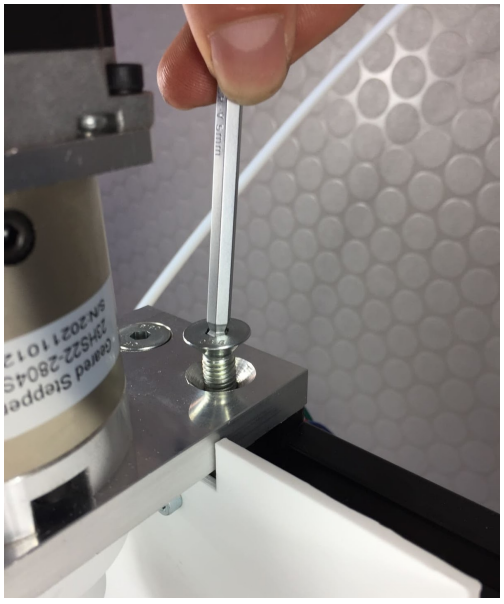
11. If there are charred areas or other buildup, it may be necessary to grind and re-polish the screw.

12. The extruder screw is installed in reverse order. If the coupling slips off again due to its own weight when the motor is mounted on the coupling, the small wood screw on the side of the coupling may have to be slightly tightened again. See also the pictures on the next page.







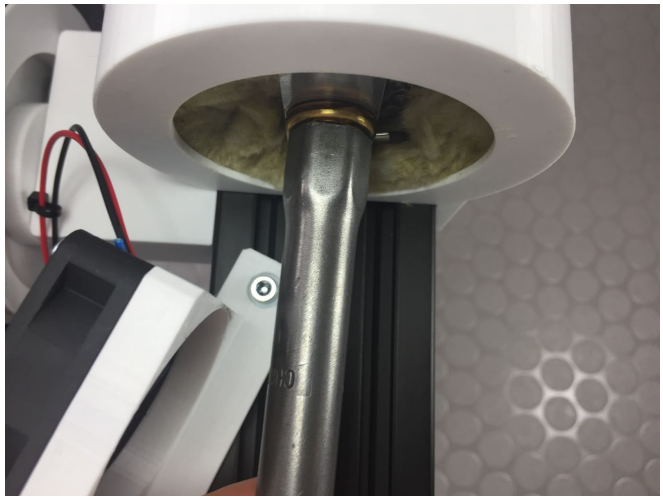





15. Clean / renew melt filter

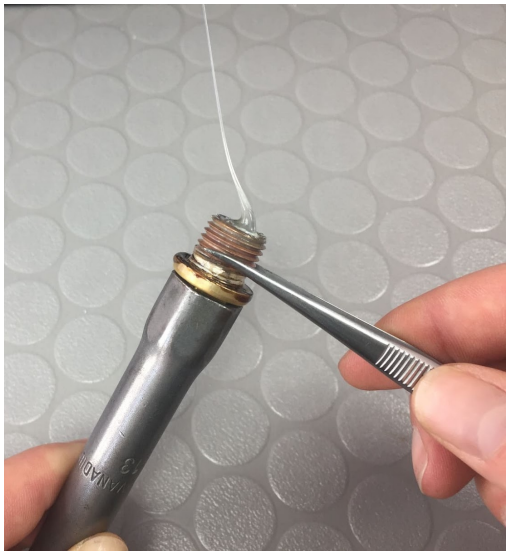
15.1 Clean melt filter

The melt filter has a relatively small surface area, so you should clean the filter regularly. Regrind from 3D printing waste often contains much more dust and particles, which can clog the filter quite quickly. Therefore, it is very important that you pay close attention to cleanliness when collecting 3D printing waste. See the material guide in the documentation. When processing pellets, the load on the filter is often much smaller. When cleaning the filter there is a risk of burns, use gloves and/or tools so that you do not touch the hot parts. To clean the filter, proceed as follows:

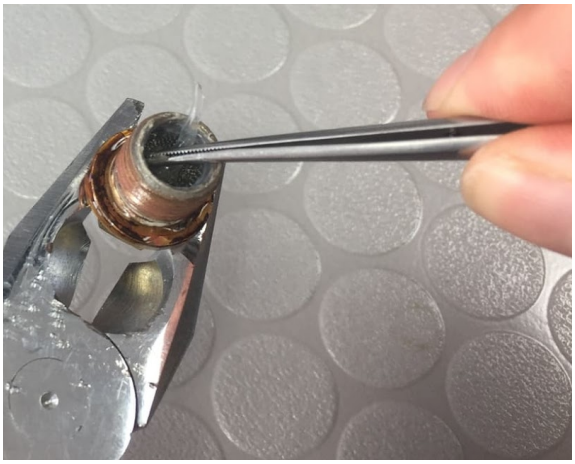
1. Heat up the extruder. Then unscrew the nozzle. The corresponding 13 mm socket wrench is included in the kit.



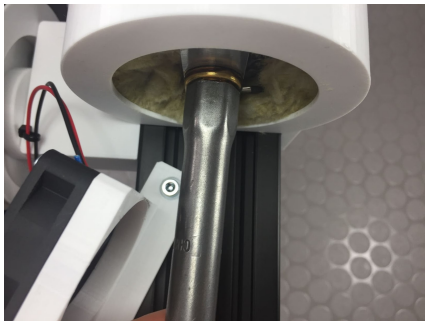
2. Use tweezers to remove the nozzle from the socket wrench and place it in a pair of combination pliers.



3. Then use the tweezers to pull the plastic off the melt filter. Dirt particles usually detach from the filter in this way and are removed with the plastic. Make sure that the melt filter does not come loose.

4. Turn the nozzle back into the extruder barrel. Wait 1 minute before restarting the extruder so that the melt filter can heat up again.

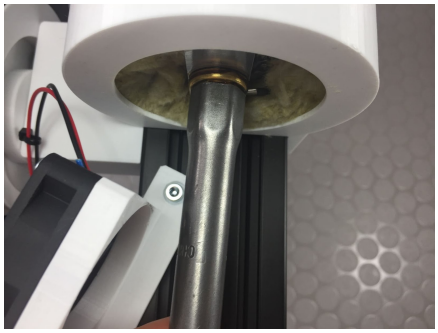


15.2 Renew melt filter

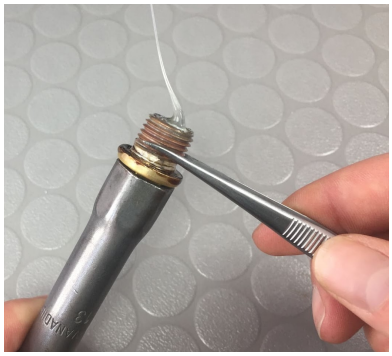
The melt filter consists of a stainless steel wire mesh with a mesh size of 0.3mm (Mesh 50). The wire mesh can be purchased on the Internet if required.

If the filter is damaged or removed during a material change, it may be necessary to replace it. When replacing the filter there is a risk of burns, use gloves and/or tools so that you do not touch the hot parts. Proceed as follows:

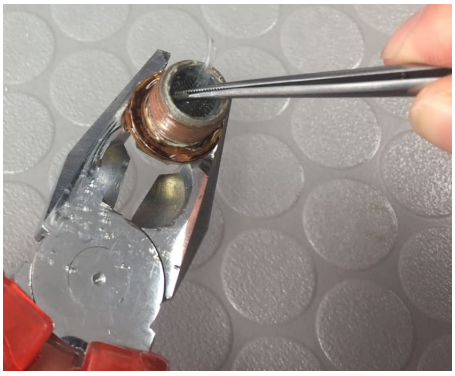
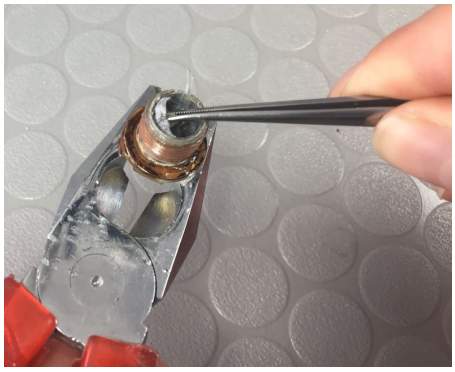
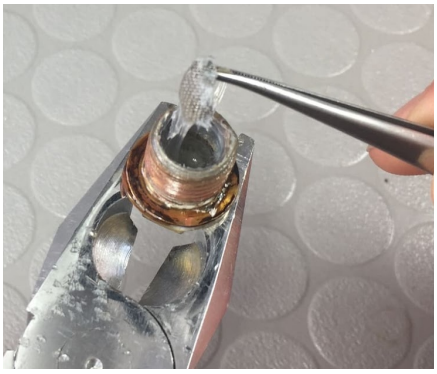
1. Heat up the extruder. Then unscrew the nozzle. The corresponding 13 mm socket wrench is included in the kit.



5. Use tweezers to remove the nozzle from the socket wrench and place it in a pair of combination pliers.




2. Now the filter insert can be removed. To do this, use tweezers or a thicker needle and pry out the wire mesh.

3. Then allow the nozzle to cool for a few seconds until the plastic inside becomes tough. Then you can use, for example, needle-nose pliers to pull out the plastic. When the plastic is at the right temperature, you can get almost all of it out in one piece. However, it is mainly important that the upper edge is free of plastic so that you can insert a new filter.


4. Now you can insert a new filter. The installation is shown in the assembly instructions 08 Nozzle with melt filter. When you turn the nozzle back into the heated barrel, please wait approx. 1 minute before starting the extruder motor. If the nozzle is still too cold, the melt filter inside the nozzle may be deformed.

16. Clean nozzle and thread

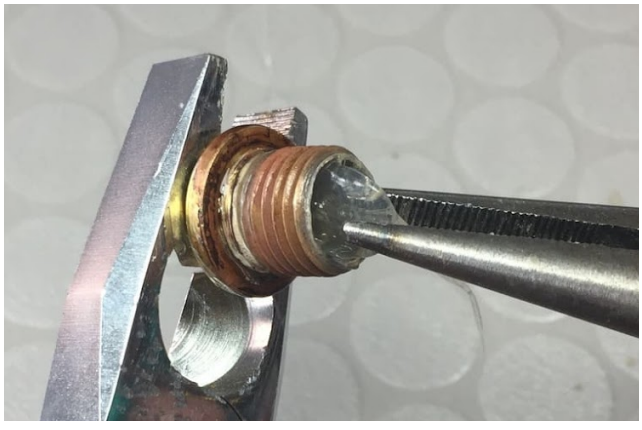
16.1 Clean nozzle

As mentioned in chapter 13, deposits may occur in the area of the nozzle when changing materials. This is especially the case when you change from a material with a higher processing temperature to a material with a lower processing temperature. E.g. from PETG to PLA. Since the plastic with a higher processing temperature flows more slowly than the plastic with a lower processing temperature, deposits occur.

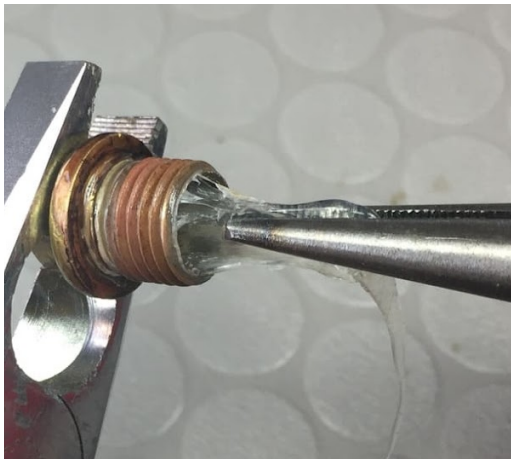
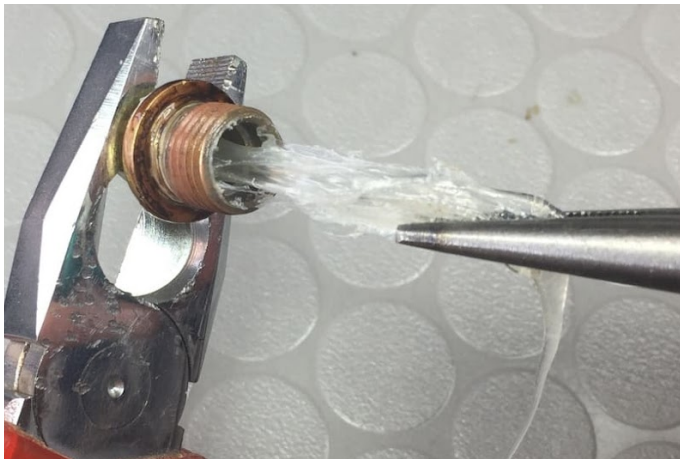
To clean the nozzle, proceed as follows. Using the example of the change from PETG to PLA:

1. Remove the melt filter. See chapter 15.2. Then reinstall the die and run the extruder at the processing temperature of PETG (or slightly higher, about 215°C) while PLA is in the hopper. Select a high speed of the extruder about 20 to 23 RPM.... This will create pressure in the die and push out the debris. Let the extruder run like this for a few minutes.

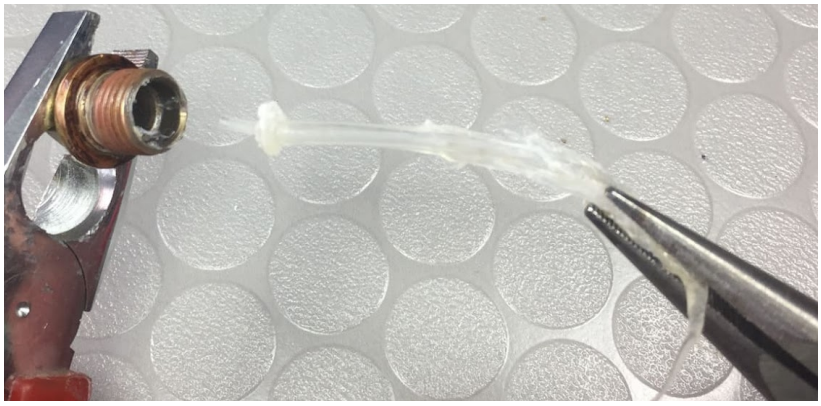
2. Stop the extruder and set it to a fairly low temperature. For the example of PLA to approx. 155°C (in preparation for the next chapter). Then remove the nozzle again. See again chapter 15.2. With a pair of needle-nose pliers or similar, squeeze the soft plastic a bit and let the nozzle cool down briefly. At this point, you can then apply the pliers well when the plastic becomes colder and tougher.



3. Use the pliers to slowly pull out the plastic while it cools. Make sure that it does not tear off and remains in one piece. With a little practice, you can get it all out in one piece this way. You need to hit the right temperature and some force may be needed when pulling. Sometimes it helps if you blow a little air on the plastic with your mouth. Then it becomes harder in the places that help pull it out.

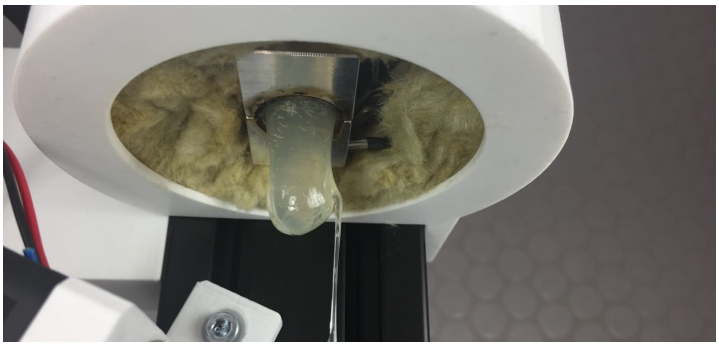



4. Now the nozzle should be clean. If not, you can repeat the procedure. However, the nozzle is not yet installed. Now continue with chapter 16.2.



16.2 Clean thread in barrel

1. Set the extruder to a fairly low temperature. For PLA, for example, to approx. 155°C. When this temperature is reached, start the extruder again at a rather slow speed (approx. 7 RPM).



2. If the area of the thread has filled you with plastic, you can, for example, insert a small screwdriver into the hot barrel and rub along the thread in circular motions to pull out the plastic inside. The temperature should not be too high when doing this. The plastic should be tough rather than liquid. Caution, when the extruder screw is rotating, a tool inserted into the barrel can become jammed and damage the extruder screw and the barrel. Therefore, do not push the tool too deep into the barrel, but only stay in the area of the thread. This will cause the debris in the thread to stick to the plastic. Then stop the extruder again.

3. Now the die can be fitted with a new melt filter and reinstalled. (see assembly instructions 08-Die with melt filter). When turning the nozzle back into the heated barrel, please wait approx. 1 minute before starting the extruder motor. If the nozzle is still too cold, the melt filter inside the nozzle may be deformed.

17. Maintenance

17.1 Clean melt filter

Clean the melt filter regularly, especially if you process regrind from 3D printing waste. See chapter 15.1.

17.1 Check components

Check the components for proper function at regular intervals. 3D-printed components can warp over time due to aging or the effects of heat and may impair their function.

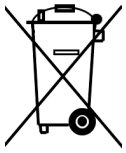
17.2 Retighten screws

Check at regular intervals whether screws are loosening and retighten them if necessary.

17.3 Lubricate ball bearing

The small ball bearings on the unit are maintenance-free. The open axial bearing on the coupling of the extruder screw should be checked for sufficient lubrication at regular intervals. If you use grease, it should not be too firm in consistency, rather soft. If you use oil, it should not be too thin, rather thick.

18. Disposal of the device



Defective devices or electronic parts can be returned to us. You can find the current address at www.artme.de. Never throw defective devices in the trash. Electronic waste can also be handed in free of charge at suitable collection points in your region. Furthermore, all components of the extruder are suitable for other various tasks and can be installed in other projects or devices.