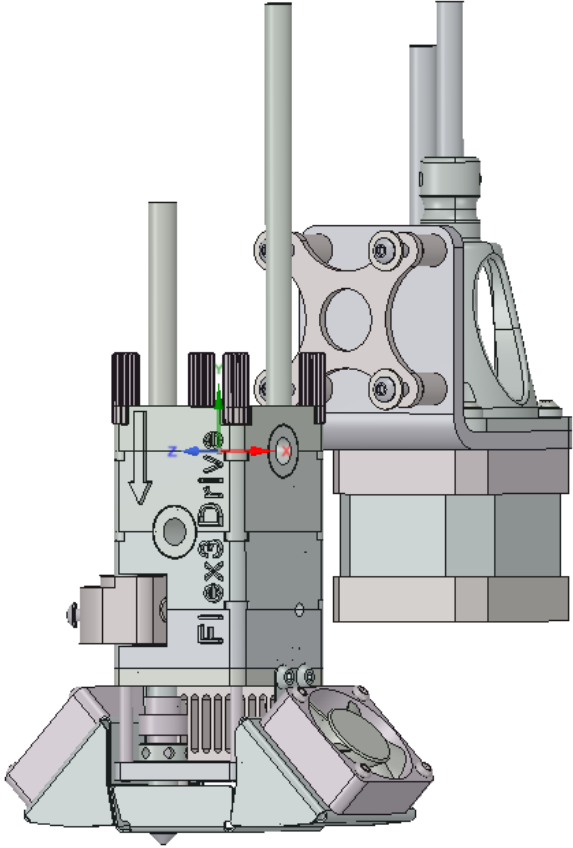


Ultimaker 2 Flex3Drive Installation Manual



Contents

- Getting Started 3
 - In the box..... 3
 - Printable Components..... 4
 - Tools required 5
 - Optional Components 5
- Taking your Ultimaker 2 apart..... 6
 - Removing the covers 6
 - Removing your original Feeder 7
- Installing the Flex3Drive 8
 - Preparing the Chassis 8
 - Assembling the Head..... 9
 - Assembling the Bearing Arm 10
 - Disassembling the head..... 10
 - Installing the Flex3Drive Head..... 13
 - Installing the Flex3Drive software 16
- Tips and Tricks 17

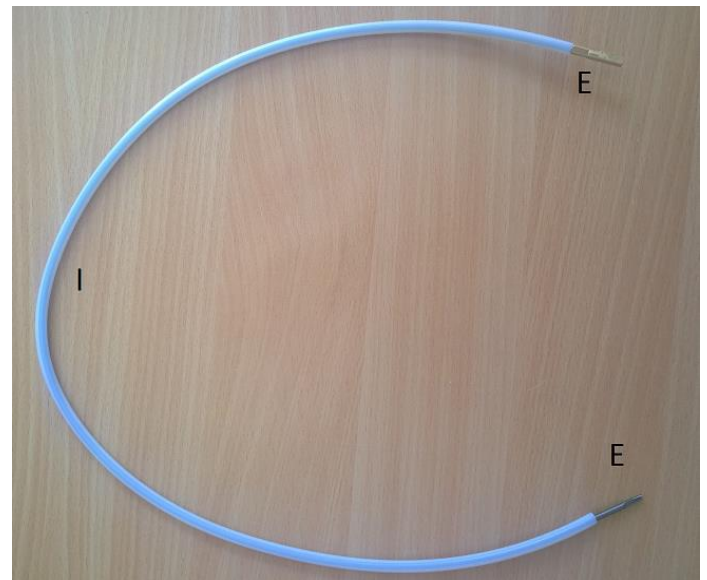
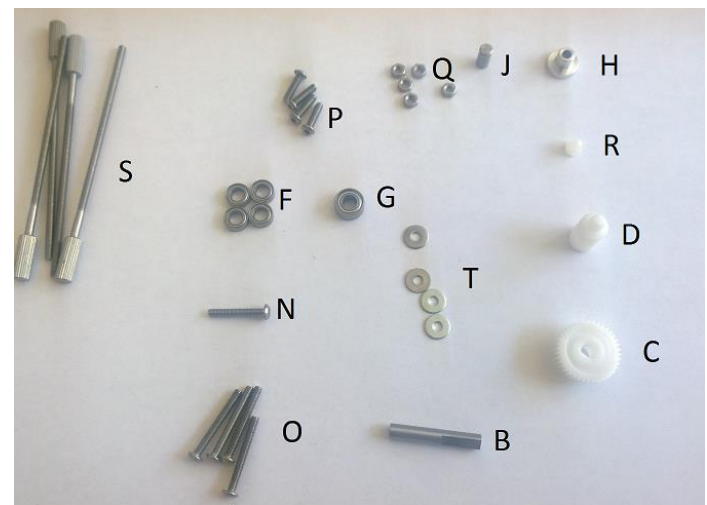
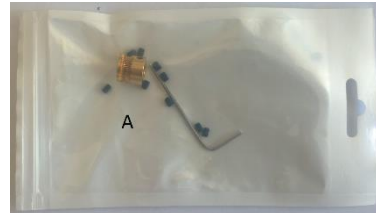
Getting Started

Congratulations on buying the Ultimaker 2 Flex3drive! In this chapter we will walk through the parts and steps required to begin assembling your Flex3Drive

In the box

The following should be supplied in your kit. Please use the following list to verify you have received all required components. They will be referenced by their reference letter from here on on;

Ref.	Name	Qt	Check
A	grip wheel, hobbled + tools ISO 4029 M3 x 4mm	1 5+	
B	grip wheel shaft	1	
C	wheel gear	1	
D	worm gear	1	
E	flexible shaft with D-ferrule	1	
F	5 x 9 x 3mm bearing	4	
G	5 x 11 x 5mm bearing	1	
H	teflon insulator spacer	1	
I	flex shaft outer tube	1	
J	idler axis	1	
K	motor bracket	1	
L	feeder motor 200 steps/rev	1	
M	lubricant	1	
N	ISO 7380 M3 x 20mm	1	
O	ISO 7380 M3 x 25mm	4	
P	ISO 7380 M3 x 12mm	4	
Q	ISO 4032 M3	5	
R	DIN 1587 M3	1	
S	print head thumb screw 80mm	4	
T	DIN 9021 M3	4	



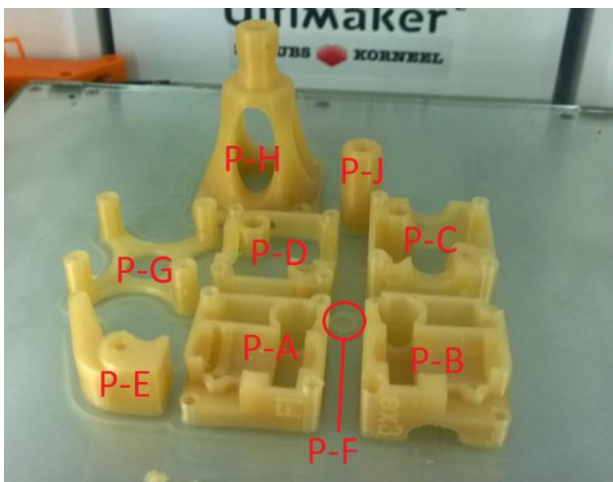
Printable Components

Before you start assembling, the following steps have to be completed;

- 1) print a complete Flex3drive head and additional parts by using the supplied STL file
 - a. Print using PLA, 40mm/sec, 50 percent fill and other standard settings. Print without support, brim is optional.
 - b. Perform normal after-print cleanups like cutting away “Elephant Feet” and cleaning up the print
 - c. Remove the support cylinders below printable piece
 - d. If you print with a different material than PLA keep in mind that different materials shrink differently. Different printers also print differently. Verify a good fit before proceeding
- 2) After cleaning up, perform the following to verify a correct print
 - a. Assemble the printed head to ensure the print was done correctly. It should fit snugly
 - b. Verify the tension arm fits in the print head and the print head thumb screws (S) fit through the head.
- 3) Should the fit not be snug additional cleaning up needs to be performed
- 4) It is recommended to print all components twice. During the assembly you will not be able to print spare parts if needed.

Printable Parts:

Reference	Name	Quantity	Check
P-A	print head casing part A	1	
P-B	print head casing part B	1	
P-C	print head casing part C	1	
P-D	print head casing part D	1	
P-E	tensioner arm	1	
P-F	bearing spacer	1	
P-G	motor spacer	1	
P-H	motor coupler	1	
P-J	flex shaft coupler	1	



Note – P-F (bearing spacer) is a very small part!

Tools required

The following tools are required to assemble the Flex3Drive

- Inbus 2,0X75 screwdriver (all screws except hot-end)
- Hobby knife (to cleanup the print)
- Inbus 1,0X75 screwdriver (hot-end tension screw)
- A small printable tool called "Bearing Pusher"

Optional Components

While replacing the hot-end the chances are that you will damage either the Temperature Sensor or the Heater. It is also the ideal opportunity to replace the Teflon Coupler and possibly even the Hot End Block to ensure a fresh start.

Please note that the Temperature Sensor and the Heater should only be replaced if damaged, there is actual value in replacing the Heater Block and the Teflon Coupler since they directly impact print quality.

Original Ultimaker Components can be found in the store;

- Temperature Sensor
 - <https://shop.ultimaker.com/product/62/PT100-B-sensor>
- Heater
 - <https://shop.ultimaker.com/product/58/Heater-Cartridge>
- Heater Block
 - <https://shop.ultimaker.com/product/485/Ultimaker2Nozzleheaterblock>
- Teflon Coupler
 - <https://shop.ultimaker.com/product/57/PTFE-coupler>
- Optional : Hot End Pack
 - Contains Heater, Heater Bock, Teflon Coupler and additional components
 - <https://shop.ultimaker.com/product/61/Hot-end-pack>

Taking your Ultimaker 2 apart

To prepare for the installation of the Flex3Drive, you will have to perform the following steps. Before taking any of the steps make sure your Ultimaker 2 is powered off, the filament is removed and the bed is all the way down.

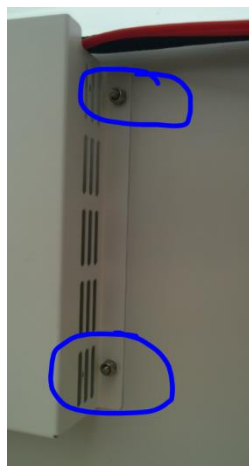
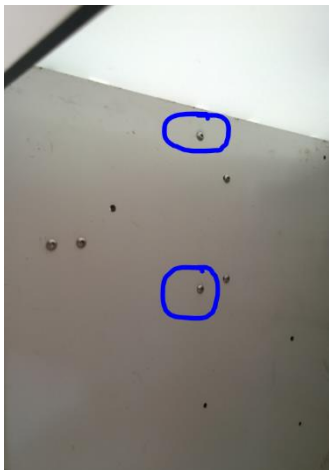
Removing the covers

to access the inner components, we first need to remove the covers. Start by removing the motor cover in the back left (the one covering the Feeder Motor) by removing the 2 screws the hold it in place with the Inbus Screwdriver. After removing the screws you can take out the inner motor cover.



The second cover we need to remove is the Main Electronics Cover down below. for this you will need to both the Inbus Screwdriver as well as a size 5.5MM socket wrench (or a set of small pliers).

Start by placing your Ultimaker 2 gently on it's right side and slowly push the bed up. There should be minimal resistance. After putting the Ultimaker 2 on it's side, there are 2 bolts that need removal and you need to hold the nut in place while unscrewing.



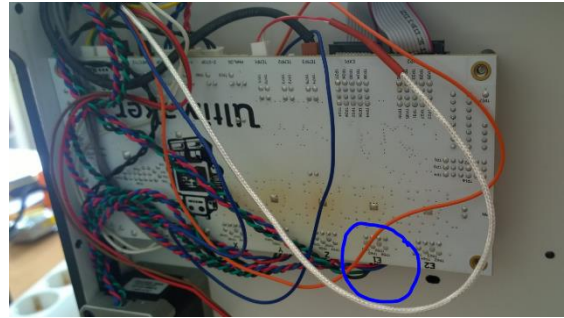
After unscrewing the 2 bolts you can remove the bottom cover.

You now have access to your electronic board.

Removing your original Feeder

On the original electronics board, which is now accessible, remove the plug that is connected to the E1 connector. This is for your Extruder Motor.

After removing the plug, you can push the cable through the bottom of the chassis into the main printing area. You are now ready to remove your original Extruder motor and feeder.



Start by placing your hand on the back of the Extruder Motor while unscrewing the 4 screws of the original feeder with the Inbus screwdriver. Make sure you hold the feeder motor so it does not drop down. If possible move the building plate up so you cannot drop anything on the glass plate.



Keep holding the feeder while unscrewing to make sure it does not come apart. After all 4 screws have been removed you can take out the Extruder Motor and place it somewhere for safekeeping. Once the feeder is separate from the machine you can gently open it up and remove the Bowden Tube. The Bowden tube will still have the white collar and the blue clasp attached. Remove them since we will need them later. The original feeder motor and the 4 bolts and washers you removed can be stored for safekeeping;



Installing the Flex3Drive

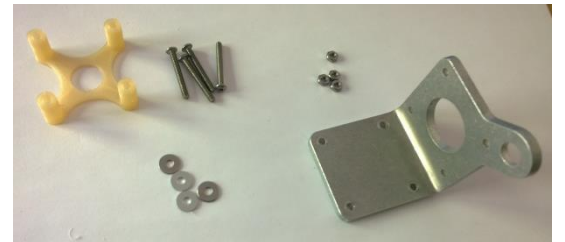
We are now ready to start installing the Flex3Drive

Preparing the Chassis

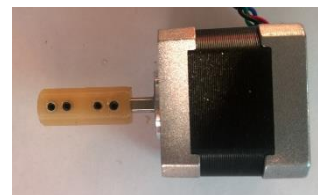
Now the old feeder motor is removed, it is time to install the new feeder motor.

As the first step take the following components;

- Feeder motor L
- Motor Bracket K
- 6 M3 ISO 4029 M3 bolts A
- The Motor Spacer P-G
- The motor coupler P-H
- The Flex Shaft Coupler P-J
- 4 M3 X 25mm bolts O
- 4 M3 X 12 MM bolts P
- 4 DIN 9021 M3 rings T
- 4 ISO 4032 M3 Nuts
- The white collar and blue clasp from the original feeder motor



Start by insert the 4 M3 bolts A in the Flex Shaft Coupler P-J. insert the feeder motor L into the shaft coupler P-J and tighten the 2 M3 bolts A. leave the 2 M3 bolts A that will attach to the shaft loosely inserted. Loosely insert 2 M3 bolts A into the Motor Coupler P-H as well.



Take the rings T and insert bolts O into them. Slide them into the holes of the original feeder motor from inside the chassis facing outside. Slide the motor Spacer P-G over the bolts sticking out, then the Motor Bracket K and finish with the bolts O. secure the connection but do not overtighten.

Once the external bracket is secured, take Feeder Motor L, the prepared Motor Coupler P-H and the 4 bolts P. secure the feeder motor L below the bracket and the motor coupler P-H on top of the bracket. Make sure the 2 bolts A that are secured on the side of the motor coupler P-H are aligned to the sides of the chassis so they can be secured afterwards. Insert the 4 12mm bolts P through the motor coupler P-H and secure the coupler to the feeder motor L. tighten the connection so there is no gap between the parts;



After finishing the assembly take the white collar and insert it into the motor bracket. Take the connector cable from feeder motor L and insert it into the opening in the chassis that has the cables for the head coming out of it. Inside the chassis feed it through the same hole as the old feeder motor cable and insert it into the E1 connection where you removed the old feeder motor connection. Refer to the pictures in the start of the manual if you are unsure about the direction of the connector.

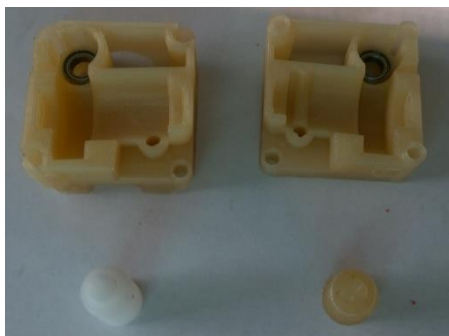
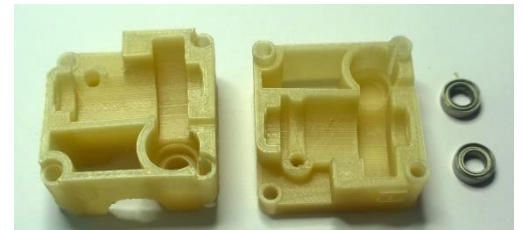
Assembling the Head

Once the motor assembly is connected you are ready to build the Flex3drive Head. You will need the following parts;

- Grip Wheel, hobbled A
- Iso 4029 M3 bolt A
- Grip Wheel Shaft B
- Wheel Gear C
- Worm Gear D
- 4 X 3MM bearing F
- Print Head Casing A P-A
- Print head casing B P-B
- Print Head Casing C P-C
- Print Head Casing D P-D
- Bearing Spacer P-F

Start by assembling the Head. For this we need the print head casing A and B , the worm gear D and 2 of the 3MM bearings F.

There is a small tool that you can print, it's called the bearing pusher and you can use this to insert the bearings into the head. The recommendation is to use this to make sure the bearings are inserted correctly and not damaged during insertion. You can



easily slip the bearing on top of the bearing pusher and use that to insert the bearings into the head. Some force will be required! Make sure the bearings are aligned nicely with the bottom. After insertion take the worm gear D and insert it with the opening facing up (in the print head casing B P-B) and assembly the head with the pieces P-A and P-B. pieces should connect nicely and the worm gear D should be inserted deeply enough to allow for a seamless assembly. Should there be a seam or even a gap, the bearings where not inserted deeply enough.

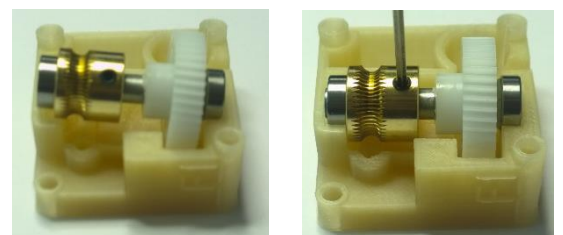
After the bearings have been inserted we will create the hobbled wheel assembly. Start by taking the wheel gear C and slide it over the grip wheel shaft B from the right. follow it up with printed



bearing spacer P-F and finish with the bearing F. insert the bolt screw A into the hobbled wheel A but don't tighten it. Slide it from the left with the bolt facing the wheel gear C. finish with the bearing F.



Take the hobbled wheel assembly and insert it into the printed head A P-A. move the hobbled wheel to the right together with bearing F so that there is a tight fit and the hobbled wheel aligns with the hole for the filament. Use the M3 bolt A to tighten the hobbled wheel. The fit should be tight and unable to move from left to right while moving freely back and forth over the axis.



Note: the bearing F has to align with the grip wheel shaft on the right. This will require forcing the gear wheel and spacer down on the grip wheel shaft.

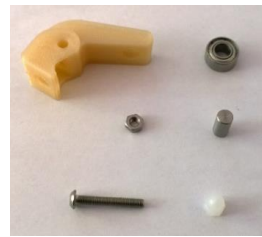
Once the assembly is complete start building the head from from the 4 printable pieces P-A, P-B, P-C and P-D. the word Flex3Drive should be in the front and D to A should be visible on the back. The fit should be nice and snug, no room between the parts. If the fit is not correct try cleaning up the print more.



Assembling the Bearing Arm

The Tensioning arm creates the pressure on the filament to ensure a proper travel through the hobbled wheel. Start with the following components;

- Printable Tensioning Arm P-E
- Bearing G
- M3 nut Q
- Idler Axis J
- 20 MM M3 N
- Din M3 R



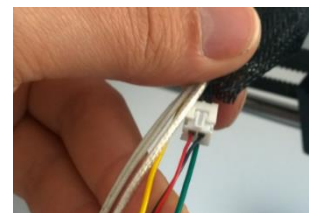
Insert the bearing G into the hole in the front of the tensioning arm P-E. secure the bearing with Idler Axis J. make sure the idler axis is fully inserted until it aligns with the side of the tensioning arm. Note: this might require some significant force.

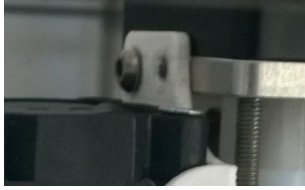
Take nut M3 Q and insert it in the open space in the tensioning arm. Insert the bolt N from the other side and tighten it just enough so it sticks out around 5 mm. Finish the tensioning arm with the addition of the M3 endstop R on top of bolt N.



Disassembling the head

Now your new Flex3Drive head is ready to install, it is time to dismantle the old head. It is very important to perform a complete "Atomic Pull" before disassembling to make sure the hot end is clean. The recommendation is to use Nylon (like Taulman 645) to remove any filament from the inside. If there is still molten filament inside it will be very hard to take apart and reassemble the heater block. After this, make sure the head is cool and the machine is still turned off! Start by disconnecting the rear fan and the 2 side fans. The connectors are inside the black cable mesh. Do not pull on the cables itself but use small pliers or your nails to remove the connectors from the socket. If you apply too much pressure on the wires they will come loose. Should a cable break you can resolder it or contact Ultimaker for a replacement.





Once the 3 fans connectors are disconnected start by removing the fan shroud. The fan shroud is connected by 2 screws on each side. Note that these are small screws so keep them close you will need them to reconnect the fan shroud. The fan shroud should now just “hang” by the fan wires. Remove the Bowden tube and the blue clip.

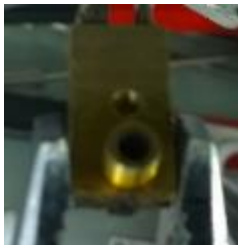
The next step is to remove the 4 thumb screws. Once the thumb screws are removed the hot end will be separate from the head. You can use this opportunity to remove the fan shroud with the fans from the head and put it on the side. We will use this to rebuild the head later.



Now remove the top of the hot end and the spring. Put the spring with the old thumb screws since we will not need it anymore. Gently remove the teflon insulator and the hot end isolator. Should the hot end isolator be “stuck” you can turn on the Ultimaker 2 and using the advanced options on the Ultimaker 2 to heat up the heater block and nozzle to around 150 degrees. This will allow you to gently remove the hot end isolator. Be gently since the hot end isolator is very prone to breaking.

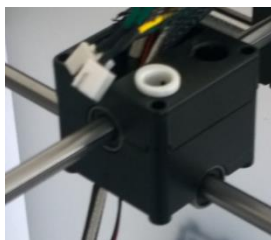
NOTE : if the hot end isolator is difficult to remove this is most likely caused by earlier filament leakage. Most likely this will make assembly very difficult. Should the hot end isolator be damaged this would be a good opportunity to replace it. If the heater block and nozzle is damaged by this leakage this would be a good time to replace it. While the teflon insulator is removed it is good to check it for damage. If there is an indentation on the bottom inside of the teflon insulator, it is time to replace it.

Now that the heater block is separated from the hot-end, remove the set screw so the heater and the temperature sensor can be removed. Place the set screw on the side.



Once the set screw is removed gently tug on the sensor and the heater to remove them from the heater block. You can try to use some small pliers or heat up the block to help the removal should the heater and sensor be stuck in the heater block.

Note: this is the point where a lot of people break the temp sensor or heater by forcibly removing it from the heater block. should your temperature sensor or heater break you can remove the connector from the electronics board on the bottom of the Ultimaker 2. There are many guides available on how to do this. It is easier to cut off the connector of the old heater or temp sensor then use some tape to attach the new one to the old wire and use it to pull it through the cable mesh.



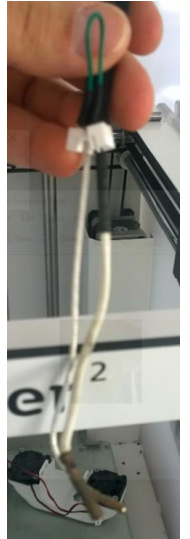
The next step in the process is to remove the 3 plastic portions of the original head. You can slide the bottom piece over the now separate heater and temp sensor. The other 2 portions can be removed by removing the X rod from it’s plastic holders. Gently click the rod out of the left and right holder. This will give you enough room to take out the final 2 pieces of the old head. Place the rod on the side since we will need it later.





Now that the heater and sensor are removed from the block you can take out the cable assembly from the top of the head.

You are now ready to start installing the new Flex3Drive head.



Installing the Flex3Drive Head

To start assembly you will need to gather the following components;

- The previously assembled Head
- the previously assembled Tensioning Arm
- 4 thumb screws S
- Lubricant M
- Flexible Shaft E
- Flex Shaft outer tube I
- Teflon insulator spacer H

From the disassembly of the original head;

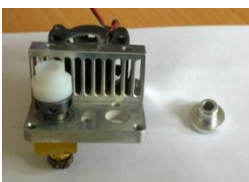
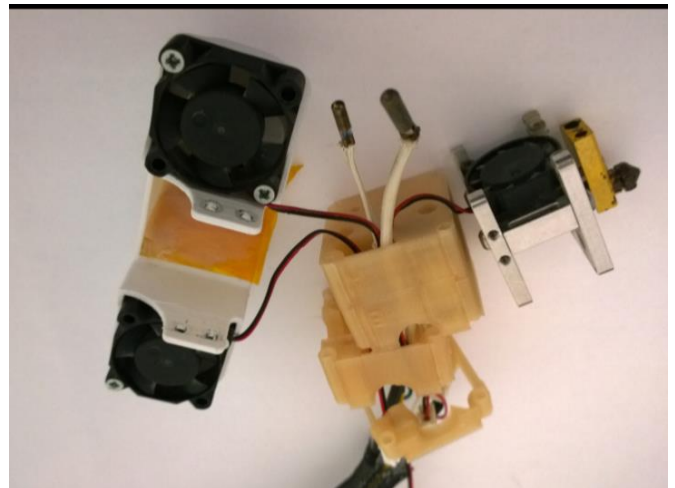
- The original Bowden tube
- The complete hot end assembly
- The fan shroud

Note : some pictures might not show original components or not show the components inside the machine. This is done to make sure the steps that need to be taken are clear. Please follow the instructions and use the pictures for clarity.

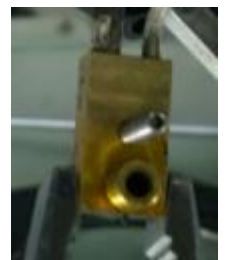
Take the printed head and disassemble this into the pieces P-D, P-C while keeping P-A and P-B together with the hobbed wheel assembly inside.

Take the hot end and insert the hot end fan cable through the printed head. **Make sure you pay close attention to keep the printed head in the right order when feeding the cables through!**

Take the fan shroud (you can remove the fans from the fan shroud if this is easier for you) and insert those cables through the printed head as well. Once these 3 cables are through reconnect them into the fan connectors. Take the heater and temperature sensor and guide them through the printed head as well.



Insert the heater and temperature sensor into the heater block and nozzle and retighten the set screw. Make sure the screw top of the heater block and nozzle is clean. There should be no residue to ensure a proper connection with the Teflon insulator.

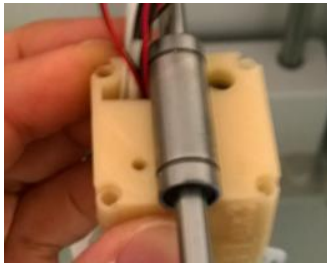


Insert the heater block and nozzle through the bottom of the hot end assembly and screw on the hot end isolator. Do not screw all the way down! Insert the (new) Teflon insulator and place the Teflon insulator spacer H on top.

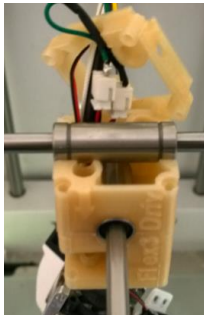
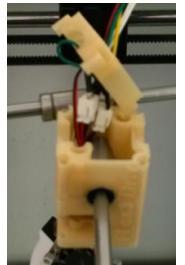


Add the top of the hot end assembly on top and put the 2 screws back in. Now gently screw the hot end isolator all the way down so the Teflon insulator and the Teflon insulator spacer H are snug. The hot end isolator should be screwed down smoothly and the heater block and nozzle should not be able to move anymore. Note: if you need to apply force to screw down the hot end isolator you run the risk of overtightening it. Overtightening will reduce the lifespan of the Teflon insulator.





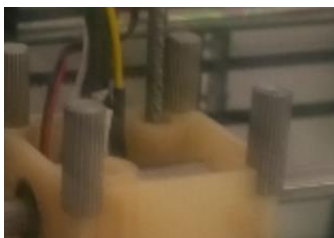
Take the complete head and separate printed parts P-A and P-B from P-C (while keeping P-A and P-B together!) and press it below the Y axis bearing. Make sure the cables are all on the left of the bearing. Take printed piece P-C and slide it down the cables so it connects on top of P-A and P-B. Snap it together so it is a tight fit. Depending on the amount of cleaning up you have done this will stay together or you might have to hold it.



Take the X axis and place the X axis bearing on top of printed piece P-C, effectively "Squeezing" it in between the axis. Pay close attention to the alignment of the different printed piece, they should show the work Flex3Drive on the front and the letters A to D should align on the back. Click the X axis back into the holders on the side. Make sure to leave enough room on the sides of the rod so the rod hits the X endstop while still not hitting the sides of the chassis.



Place the final piece of the printed head, P-D on top of the head.



The next portion is tricky. Gently take the printed parts P-A and P-B apart, exposing the hobbed wheel assembly. Take the flexible shaft with D-ferrule with the ferrule facing forward and feed this through printed parts P-D to P-B from the top right corner and through the bearing in part P-B. Note, the bearing might come loose. If this is the case, make sure you feed the flexible shaft with D ferrule through the bearing so you can place it back during reassembly. Take the worm gear D and insert the ferrule all the way down into the worm gear.

Wrong:

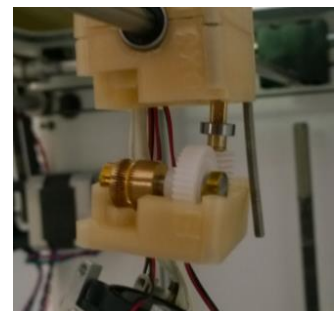


Right:



Gently feed back the flexible shaft back into the head by pulling the shaft from the top so that the flexible shaft with D ferrule together with the bearing and the worm gear are almost back in printed head P-B. Insert the worm gear inside the bearing of printed head P-A so it aligns with the hobbed wheel.

Note : you can see one of the (bended) thumb screws sticking out of the head. I did this to keep the head together so I could take a picture.



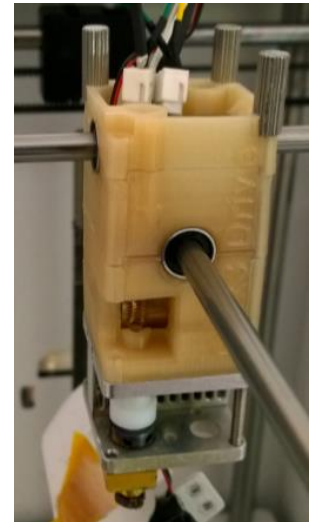
Take the lubricant M and gently apply some of it on the worm wheel and the gear wheel. Do not apply it to the hobbed wheel!

Note : I applied more than needed so the picture would be clearer

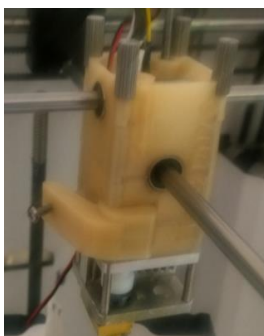


Push printed head P-A back into the head. All printed parts should align properly and the fit should be nice and snug. Check that the assembly has gone well by turning the Flexible Shaft. This movement should be smooth and you should see the hobbed wheel assembly move back and forth.

Take the hot end and align it below the printed head. Make sure the cables align on the backside so they do not get stuck in the thumb screws. Insert the 3 thumb screws (leaving out the one in the left front) and gently press them down until they reach the threaded part of the hot end. Tighten them so the head is now secure. When tightening them down it is recommended to start with the one on the back left, then the one on the right front, then the one on the back right. Tighten them so any gaps between the printed parts disappear but don't overtighten them.



Hold the hot end and feel if there is any movement in the head. The head should clamp down on the X and Y axis bearings. Any movement here means that you did not print the head correctly or you did not perform enough cleaning. This check is extremely important! If the head is loose on the bearings your prints will suffer greatly in print quality.



Try to move the flexible axis again to make sure the movement of the worm wheel and the hobbed wheel assembly is without obstruction.

Take the tensioning arm and insert it into the head. This might take some force. Once the tension arm is in, insert the last thumb screw all the way down and tighten it.

Note: you can always remove the tensioning arm if you need to do troubleshooting on the print head.

Take the fan shroud and reconnect it to the hot end.

Take the flex shaft outer tube and insert the flexible axis into it. Slide the flex shaft outer tube all the way down into the print head so you have about 2 or 3 cm's of the flex shaft sticking out of the end of the flex shaft outer tube.



Take the flex shaft and insert it into the motor coupler and flex shaft coupler as far as it will go. Tighten the set screws to fix this into place.

Note : depending on your print quality and filament you used this might or might not go smoothly. As an alternative, you can disassemble the motor coupler and shaft coupler and insert the flex shaft and flex shaft outer tube into the motor coupler first, then insert the flex shaft into the flex shaft coupler. Tighten the M3 set screws then place the shaft coupler back over the stepper



motor (make sure to align the set screws with the flattened part) and place the motor coupler back. This might be easier in some occasions.

It is very important that the connection between the stepper motor and the flex shaft is smooth and secure since slippage here will impact the functionality of the Flex3Drive.

NOTE: do not skip the next step! Running the Flex3Drive with the default software can damage your machine!

Installing the Flex3Drive software

Now the mechanical installation is done, it is time to update the software. Connect your Ultimaker 2 with the USB cable to your pc and turn it on. Open cura and under machine select install custom firmware. Select the Hex file as supplied to you for the Flex3Drive and upload it to the machine.

Wait until the firmware has successfully been flashed and disconnect the USB cable.

Return to your machine and it will take you through the first setup wizard. Quickly run through this wizard and you can ignore the steps for now.

In the menu under advanced, select heatup nozzle. Verify that the nozzle is heating up. If this is successful, put the temperature back to 0 degrees.

Remove the thumb screw for the tensioning arm and remove the tensioning arm. In the menu under advanced select move material. Use the jog dial to move the material, this will make the hobbed wheel move forward and backward. The movement should be smooth. If this works correctly reassembly the tensioning arm.

In the menu, go to advanced and select a factory reset. **Note : skipping the factory reset might lead to residual settings still being applied!**

Once the factory reset has been performed the first start wizard should be displayed again. Run through this wizard to make sure the bed is aligned again.

If all steps have been succesfull you have succesfully installed the Flex3drive. You can now take the final plates and place them back into and under the machine. While placing them back make sure you do not squeeze and cables in between the plates and the chassis.

Once this is done you are ready to start printing with your Flex3Drive!

Tips and Tricks

- How tight should the tensioning arm be?
 - Very. The bolt should be screwed down almost all the way. You can untighten it to assist during material change but it should be screwed down with perhaps 1 or 2 MM left.
- How should I change material?
 - Use the change material option in the machine.