

Hot end assembly

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The airflow system

Component	Type	Quantity
heatsink duct	Printed	1
fan duct	Printed	1
Fan	Hot end	1
Heatsink	Hot end	1
M3 x 40mm cap screws	Fastener	2
Aluminium cooling block	Hot end	1



The wires on the fan in this picture are too long. They will be shorter, and each terminated with a crimp pin. Place the heatsink with its fins inwards and its flat face outwards in the cavity in the [heatsink duct](#). The screw holes are at the bottom in the picture above.



Turn the device over, and add the [fan duct](#) then the fan, with its wires coming out the top, and its face with the fan-axis support inwards. Use the two screws into the cooling block to hold all five major pieces together. If you have it you can put a little heatsink compound between the cooling block and the heatsink.



The plastic filament Bowden tube

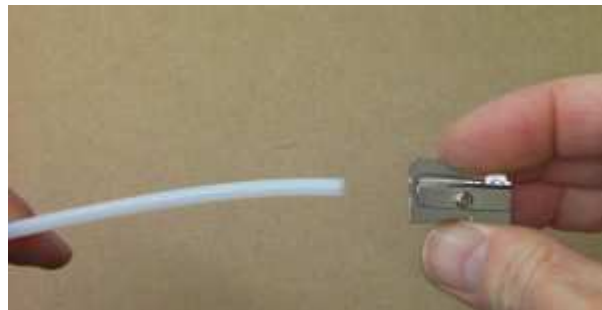
Component	Type	Quantity
PTFE tube	Hot end	1
Threaded brass union	Hot end	1
Notched brass union	Hot end	1



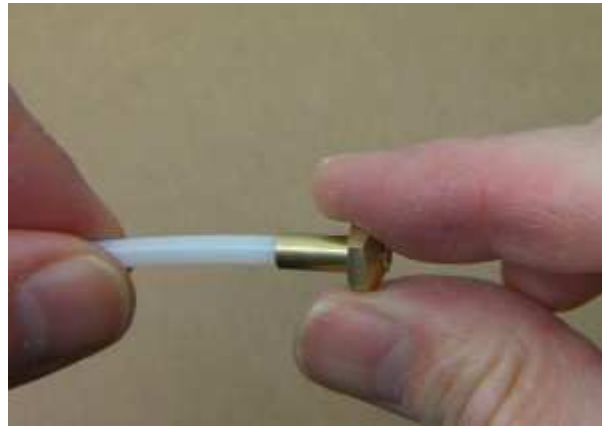
Start by trimming a couple of millimetres off each end of the PTFE tube with a very sharp blade to get the ends clean and square.



Next use a pencil sharpener to cut the ends of the PTFE tube to a cone. Be very gentle. PTFE is a soft material and it is easy to remove too much. You just want a frustum of a cone at each end that doesn't quite reach the inner hole in the tube.



Put the conical brass nut that you will use below on the threaded brass union. This is not its final resting place, but it will make it easier to screw the internal thread on the union over the PTFE tube, by giving you something to grip. Screw the union over one end of the tube. It will cut its own thread. Take care to keep the two parts axially in line. You don't want the brass screwed on at an angle.



Do the brass up until you can see the cone you cut by looking down the free end of the brass. Then, unscrew the brass union, and repeat the thread cutting process at the other end of the tube. The threaded part of the PTFE tube should be about 10mm long, and it will be easier to screw each brass union on, once threaded.

Screw the slotted brass union onto the free end of the PTFE tube.

Remove the nut from the other union by gently gripping the brass union (not the PTFE) with a pair of pliers and use a small spanner to remove the nut. Take care not to crush the brass with the pliers – it is quite thin.

Screwing the brass onto the PTFE will have compressed its inner hole. You need to open it out again so that the plastic filament that your Ormerod will print with will run freely in the tube. Use a 2mm drill bit in a small hand chuck. Gently, and twisting clockwise all the time – never anti-clockwise, whether going in or coming out – use the drill bit to enlarge the inner hole in the PTFE where it passes through the brass. Take several goes at it, going a couple of millimeters deeper each time and drawing the PTFE swarf out by keeping twisting clockwise



and pulling. Stop when the tip of the drill is about 5mm into the clear transparent PTFE.

The finished Bowden tube



IMPORTANT: Push a length of printing filament through from the other end of the tube to clear out any remaining PTFE swarf; otherwise, this will end up in the nozzle the first time you try and print, blocking it! Blow down the tube, from both ends, as well.

The nozzle and heater block

Component	Type	Quantity
Stainless steel nozzle	Hot end	1
Aluminium heater block	Hot end	1
Small-diameter PTFE tube	Hot end	1
Conical brass M5 nut	Hot end	1



Screw the stainless steel nozzle into the aluminium block. The small nozzle hole should protrude from the face of the block nearest the small (2mm) diameter hole through the block.

Screw the nut onto the nozzle. The cone on the nut points away from the block, and the nut is at the small-hole end of the nozzle.

Adjust the three so that the cone of the nozzle continues the cone of the nut. There shouldn't be a shoulder between the two, nor should the nozzle be down inside

the nut.

Hold the aluminium block between folded pieces of paper in the jaws of a vice. (The paper is to stop the jaws damaging the aluminium.)

Tighten the nut against the block with a spanner. It needs to be reasonably tight, but don't force it so hard that you damage anything.

Cut a few millimetres off the end of the small tube with a very sharp blade to get it square and to clean it up, just as you did with both ends of the larger tube above.

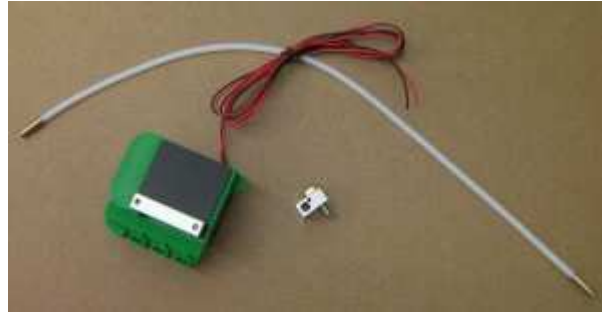
Push the end you have cut all the way into the large hole in the longer end of the nozzle sticking out from the block. It may be quite stiff. You may have to put the free end of the tube on the bench and push against that. Be careful – you don't want to buckle the tube.

Use the sharp blade to trim the end of the PTFE tube flush with the nozzle.



Assembling the cooling system, the heater block and the Bowden tube

Take the cooling system, heater block and Bowden tube

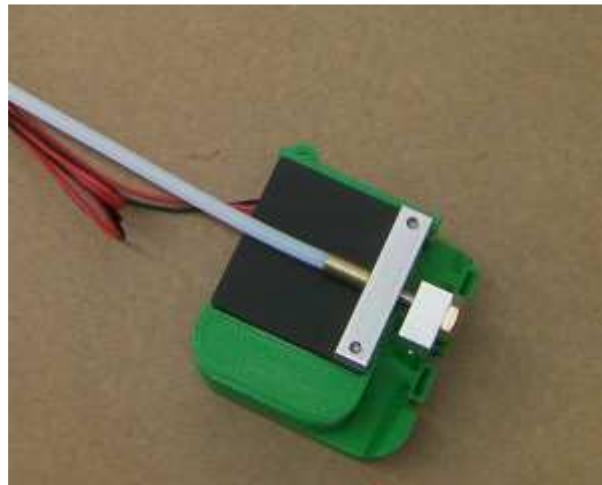


Screw the threaded brass union on the Bowden tube into the cooling block on the cooling system. Screw it in all the way, then back it off half a turn

Screw the nozzle and heater block assembly into the other side of the cooling block. If the small PTFE lining tube in the nozzle is loose, take care not to drop it – make sure it is in there or the hot end won't work.

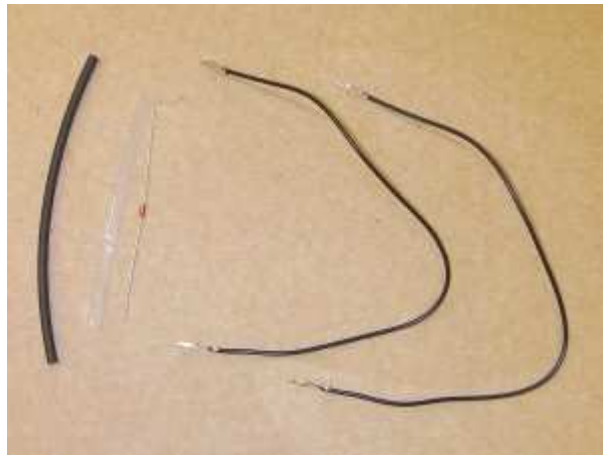
Get the heater block square with the rest of the assembly, with its longer protruding side pointing away from you in the picture above.

Using pliers, tighten the threaded brass union against the top of the stainless steel nozzle. Again, take care not to grip the brass too tight and damage it, but do the two up as tight as you can.



Adding the temperature-measuring thermistor

Component	Type	Quantity
Transparent PTFE heatshrink	Hot end	about 50mm
100K thermistor	Hot end	1
Thermistor wiring – 160mm	Hot end	2
Cartridge heater (not shown)	Hot end	1



NOTE: We now supply the thermistor wiring with a crimp housing, or with heatshrink already on it. The black heatshrink shown in the picture is not supplied. The thermistor wiring may be another colour, usually blue and/or green. Also, the cartridge heater is not shown in the picture, but it is in the last picture in this section below. The picture will be updated soon...

Cut the transparent PTFE heatshrink about 10mm shorter than the thermistor with its axial connecting wires. Put the thermistor in it so that 5mm of wire protrudes from each end.



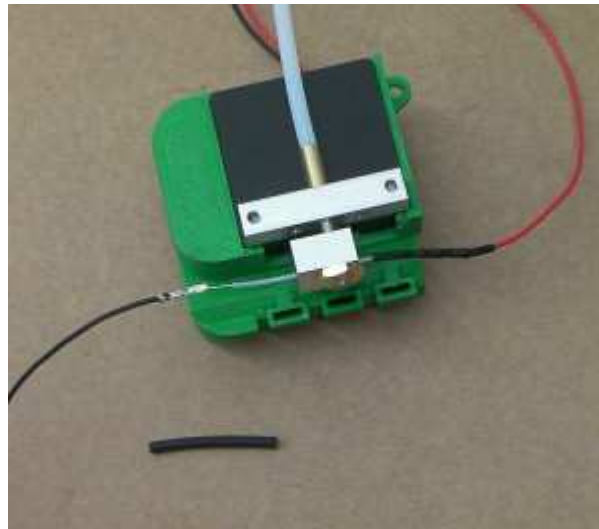
Using a flame (a cigarette lighter, blowtorch, gas hob, or hot air gun work well; a hair dryer does not), shrink the heatshrink over the thermistor. Just waft the thermistor and heatshrink through the flame. You don't want the heatshrink to overheat and burn.



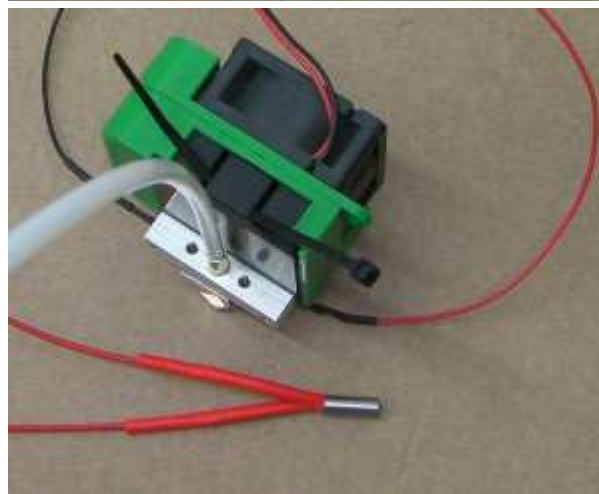
This is how the thermistor should look with the PTFE shrunk onto it. It may even look neater than this!



Pull the thermistor through the small hole in the heater block so that it is about half way through. If you pull it with pliers, be gentle, and grip on the PTFE heatshrink, not the bare wire. Attach the thermistor wiring to each side of the thermistor – it is pre-crimped, and should just push onto the bare ends of the thermistor wire.

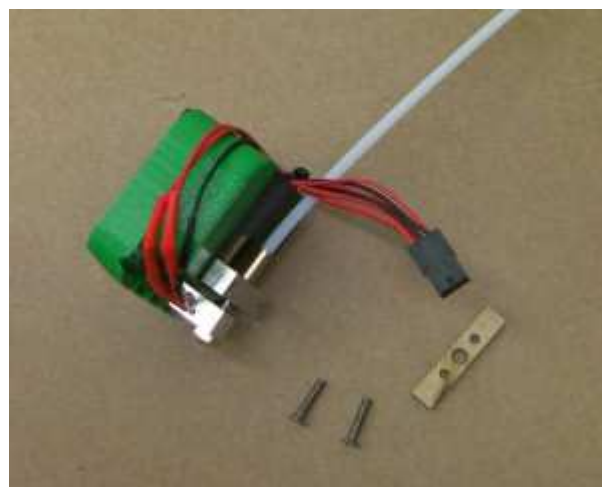


Slacken the two screws that hold the air duct assembly together by a few millimeters, and loop a cable tie through the top two gaps in the heatsink, as shown. Re-tighten the screws. Push the heater cartridge (with the red leads) into the heater block.



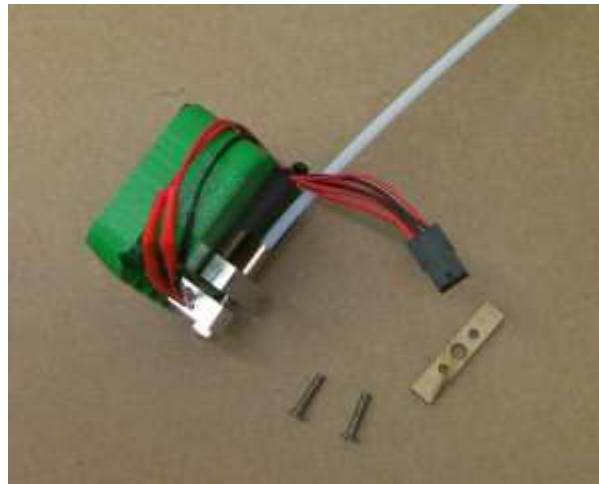
Final assembly

Component	Type	Quantity
2×3 female black crimp socket	Hot end	1
M3x16mm cap head screws	Fastener	2
MDF heat insulator	Hot end	1

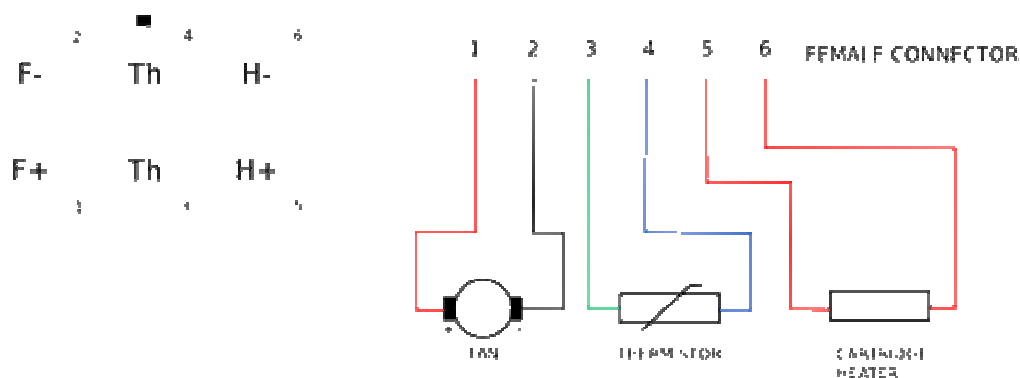


Note: picture shows countersunk screws; use M3x16mm cap head screws

Run all six leads (fan, heater cartridge, and thermistor) up and through the cable tie. Pull the cable tie closed, but not too tight. It doesn't need to squash anything.



CAUTION! The next step describes wiring up the hot end connector. However, **GREAT CARE** should be taken doing this. The heater cartridge and the fan wires have 12V running through them **ALL THE TIME**. The thermistor wires are 3.3V, and connect directly to the Arduino chip on the Duet. If you incorrectly wire the plug, a short circuit between the thermistor wires and any of the other wires **MAY DESTROY YOUR DUET!**



Put the the pins on the ends of the wires into the six-way female socket. The diagram, above left, is looking into the back of the socket, where you insert the crimps. The little black rectangle is the locking tab on its side, and the housing has a small embossed '1' and '6' number on it, so you can orientate it as the diagram.

The pins are crimped on one side, and smooth on the other. The smooth sides go downwards in the diagram. Neither the thermistor nor the heater cartridge has a polarity so it doesn't matter which way round their wires go. (Though the H+ and H- are the way that the machine will apply power – hence the labels.) Make sure to get the polarity of the fan right.

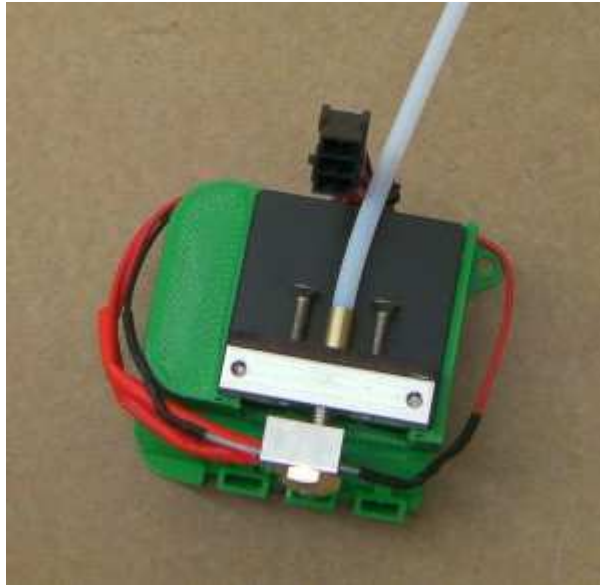
The pins are very difficult to remove without damaging them, so check twice, plug in once!

You can check the wire order by comparing it to the end of the hot end loom, which the hot end plugs into.

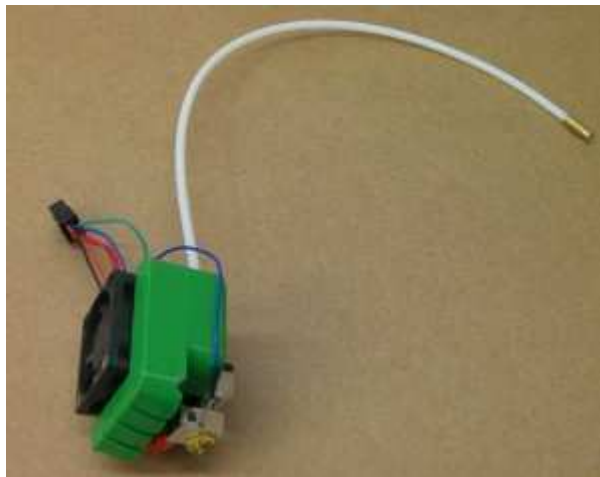
Wiring loom	Hot end wires
Red	Red FAN wire (+12V)
Black	Black FAN wire (ground)
Green	Thermistor wire (green/blue)

Blue	Thermistor wire (green/blue)
Double yellow	Thick red heater wire
Double brown	Thick red heater wire

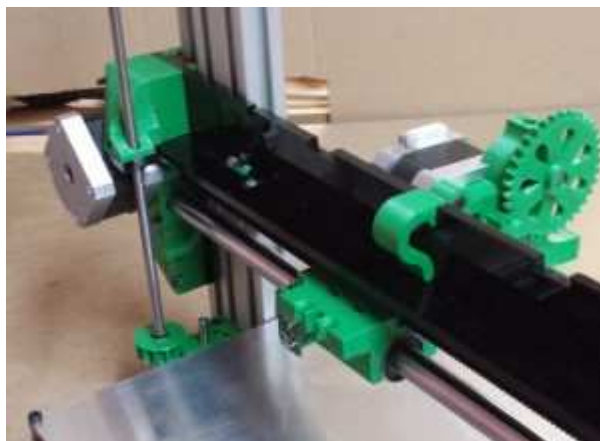
Thread the MDF insulator onto the Bowden tube, and slide it down the tube until sits on top of the aluminium cooling block. Thread the two screws through the MDF insulator and into the aluminium cooling block, as shown. Just put the screw in a couple of turns. (Picture shows countersunk screws; use M3x16mm cap head screws.)



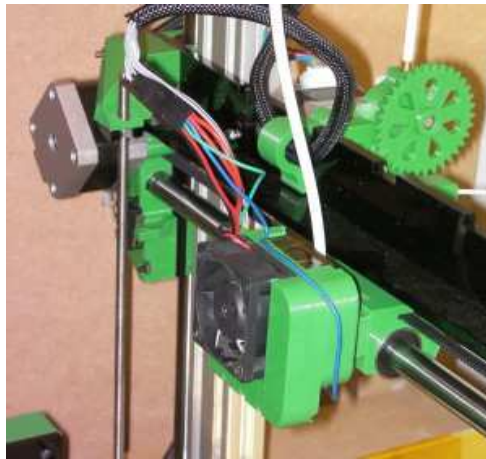
The hot end is now finished, and may be attached to your Ormerod.



The hot end mounts onto the [x-carriage](#) via the [nozzle-mount](#).



It should push on sideways, and you can then fix it into place using the two screws. The MDF insulator should sit UNDER the nozzle mount, but on top of the aluminium cooling block, so it is sandwiched between them.

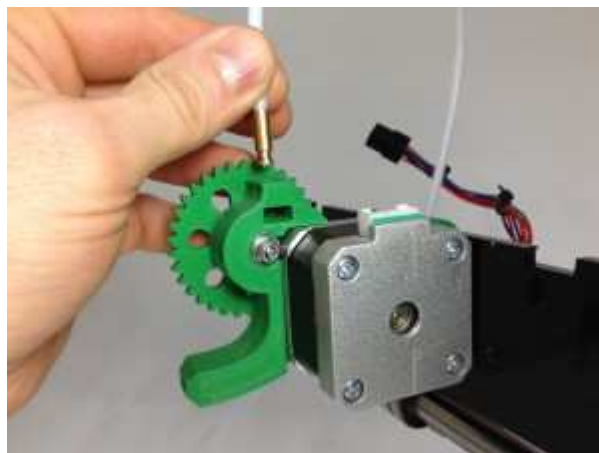


The tongue

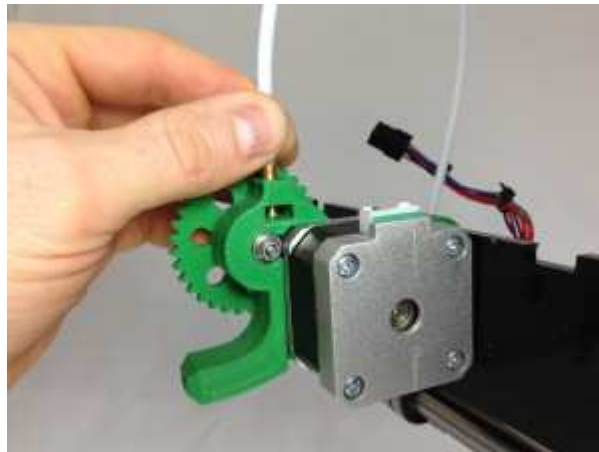
Now find the [retaining tongue](#).



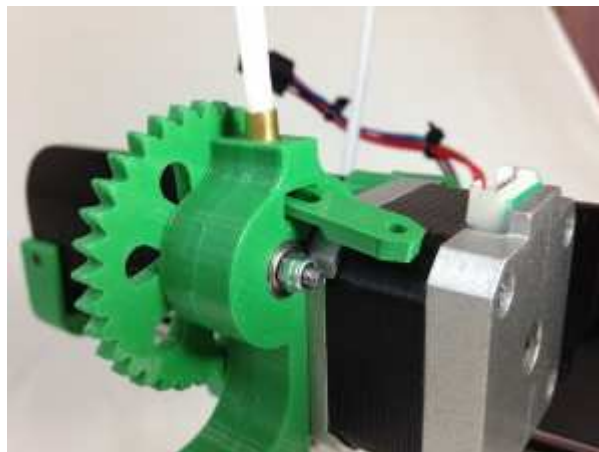
Push the free end of the Bowden tube, with the slotted brass connector, into the hole in the top of the extruder drive.



The slot in the brass connector should be visible in the slot in the printed part; ensure the brass connector is pushed all the way in.



The retaining tongue fits in the printed slot as shown, with the flat side of the tongue going upwards.



Push the retaining tongue in, until it is firmly engaged with the slotted brass connector. The hole in the end will help you remove it, if you need to.

