E3D-v6 Assembly

From E3D-Online

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Assembly of the E3D-v6 HotEnd should be an easy process that takes no more than half an hour. Please follow the instructions on this page carefully to ensure that you assemble the HotEnd correctly.

Contents

What's in the box

Metal Parts

1 x Aluminium Heatsink (Contains embedded fitting for tubing in 1.75mm Universal and 3mm Bowden versions)
1 x Stainless Steel Heatbreak
1 x Aluminium Heater Block
1 x Brass Nozzle (0.4mm)

Electronics

1 x 100K Semitec 104GT2 NTC thermistor with
100mm x Silicone Fibreglass Sleeving
1 x 12v or 24v 30W Heater Cartridge
1 x 12v or 24v 30x30x10mm fan
1 x High Temperature Fiberglass Wire - for Thermistor (150mm) OR
1m of Thermistor wire (with 0.1" connector when available)
4 x 0.75mm Ferrules - for Solder-Free Wire Joins

Fixings

4 x Plastfast30 3.0 x 16 screws to attach the fan to the fan duct
1 x M3x3 grub screw to clamp thermistor
1 x M3x10 socket dome screw and washer to clamp the heater block around the heater cartridge
1 x Fan Duct (Injection Moulded PC)

Bowden Versions also Include

800mm of appropriately sized PTFE tubing.
1 x Screw in Coupler for extruder end of tubing.

What you need

- 16mm Spanner
- 7mm Spanner
- Pozi-Drive Screwdriver
- M2.5 Hex Wrench - we supply these in the kit when possible

Warnings - Please Read!

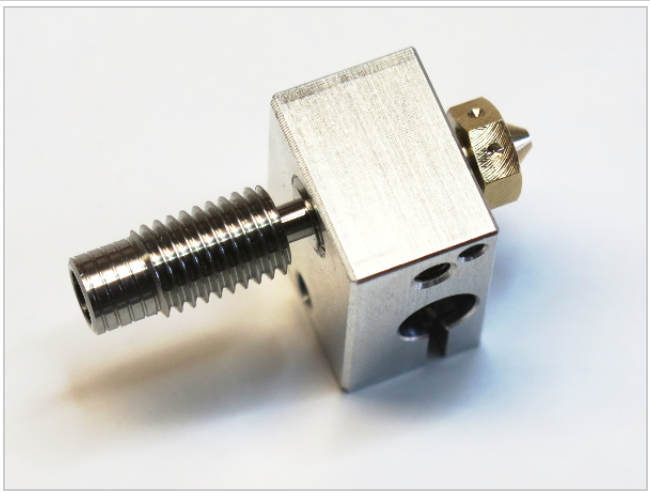
1. The HeatBreak is fragile. If you are using a large spanner, hitting it with a hammer, etc. It will break.
2. If you are not using a thermistor cartridge, be careful with the thermistor, it is small and fragile. Be gentle with the legs. The bead is made of glass - don't crush! It is also very small, so don't breathe.
3. Cable-tie all cables together as additional strain relief. It is important to ensure the wires of the fan and the red/black section of the thermistor cable are cable-tied and strain relieved in such a way that they cannot come into contact with the heater block at any time.
4. You are dealing with high temperatures - the HotEnd gets hot, and may be off your printer when you do the initial tightening. If you touch it, you will get burned!
5. You are dealing with high currents, make sure you double check all your wiring and your power supply rating. It is not recommended to work on anything whilst it is plugged in. Bad wiring with improper current ratings can cause fire.
6. Be sure you have ordered (and received!) the correct voltage heater and fan to match your 3D printer. If the heater cartridge specification is not lasered onto the cartridge, you can easily check with a multimeter, this is described in the #Heater_Cartridge section. Connecting 12v parts to 24v power can result in overheating, component damage or fire.
7. The E3D-v6 is a high performance HotEnd, capable of reaching a wide range of temperatures. The temperatures that ignite some plastics are within the normal printing temperatures of other plastics. If you only plan on printing ABS, PLA, and/or Nylon, it is recommended that you set your heater cartridge “MAX_PWM” to 150 in your firmware, in order to limit the E3D’s heater to a range suitable for these plastics. If you are not printing materials requiring ~300C, there is no need for “MAX_PWM" to be set over 150. This variable can usually be found in the configuration.h file of your printers firmware. You can always change it to a higher value when you want to experiment with higher temperatures, it is much more difficult to extinguish a housefire.
8. Like all 3D printers, printers fitted with a high temperature all metal hotend can be a fire hazard. You are using experimental technology to heat and melt plastic, in a machine that you may have built or modified yourself, that likely does not have safety certification or significant failsafes. Fire/Smoke alarms, supervision of your printer while printing, and expertise should not be considered optional.
9. Your HotEnd and your printer is your responsibility. We cannot be held responsible for damages caused by the use, misuse or abuse of our products.

Assembly Steps

HotSide

Screw Nozzle into the Heater Block into the end closest to the thermistor holes. Unscrew the Nozzle a 1/4 to a 1/2 turn.

Nozzle screwed into block, and unscrewed a 1/2 turn.



Break screwed into block level with top of block.

Screw the Heat Break into the other side of the Heater Block so it is butts up against the nozzle.

Gripping the Heater Block with a spanner, tighten the Nozzle with a second spanner. **Do not over-tighten, we are going to tighten it up later when the heater block is hot.**

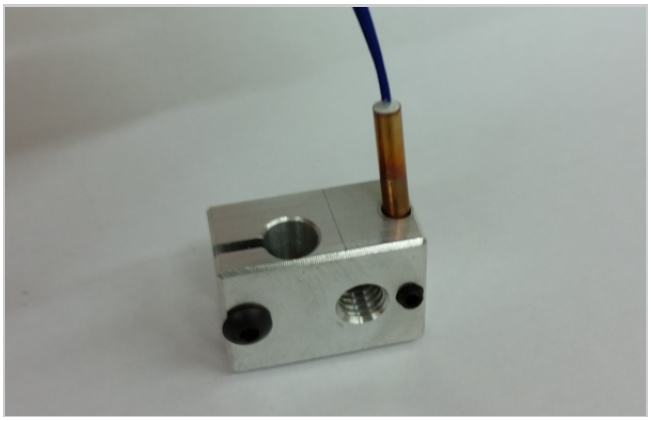
A first, slight tightening of the nozzle against the break.

Thermistor

We have moved away from the tedious sleeving, washer & screw arrangement for mounting our thermistors to our high-performance cartridge style sensors.

- If you have a new-style block and cartridge sensor keep reading.
- If you need the old-style instructions, they can be found on the E3D-v6 Assembly (Old Wiring) page.
- If you want to understand more about the various sensor options for E3D-v6 read the Temperature Sensor Documentation.
- Cable-tie all cables together as additional strain relief. It is important to ensure the wires of the fan and the red/black section of the thermistor cable are cable-tied and strain relieved in such a way that they cannot come into contact with the heater block at any time.

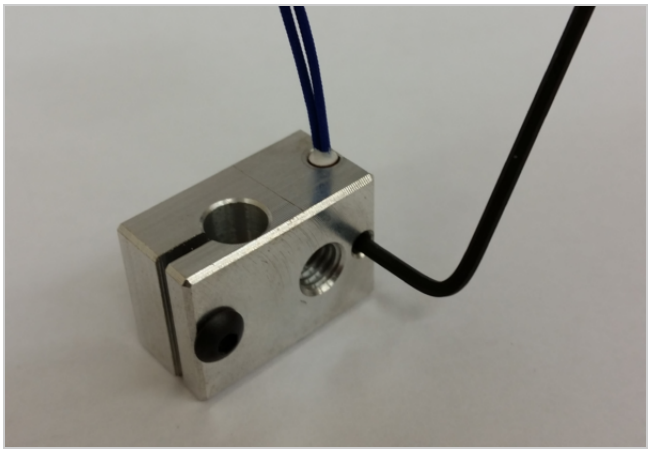
Simply slide the sensor cartridge into the heater block and use the supplied M3 grub screw to fix the cartridge into place. Tighten the grub screw until it just touches up against the cartridge, then do one more half turn.



new easy insertion of thermistor cartridge

It is important not to over-tighten the screw against the relatively soft copper cartridge, doing so can cause a range of annoying problems:

1. Deformation of the cartridge making it hard to remove at a later date
2. Cracking of the potting ceramic resulting in poorer thermal response or in extreme circumstances, short circuit.



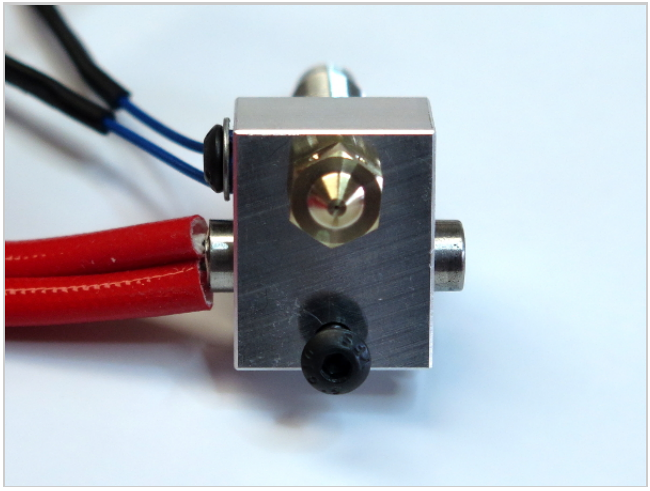
Sensor inserted

Heater Cartridge

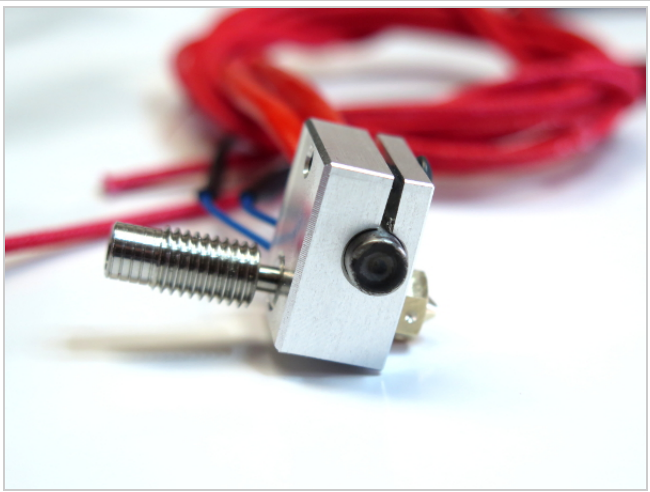
If you have one, grab a multimeter and check the resistance of your heater cartridge against the table below. Expect your value to deviate a little from these, a difference of around plus or minus 5W is fine, however if yours is significantly off or you are concerned you have the wrong cartridge please get in touch.

P\V	12v	24v
40w (Red Leads)	3.6Ω	14.4Ω
25w (Blue Leads)	5.76Ω	23.04Ω
30w (Blue Leads)	4.8Ω	19.2Ω

Insert the Heater Cartridge with the leads exiting the block the same side as the thermistor. Centre the cartridge in it's hole in the block.



Heater inserted into block.

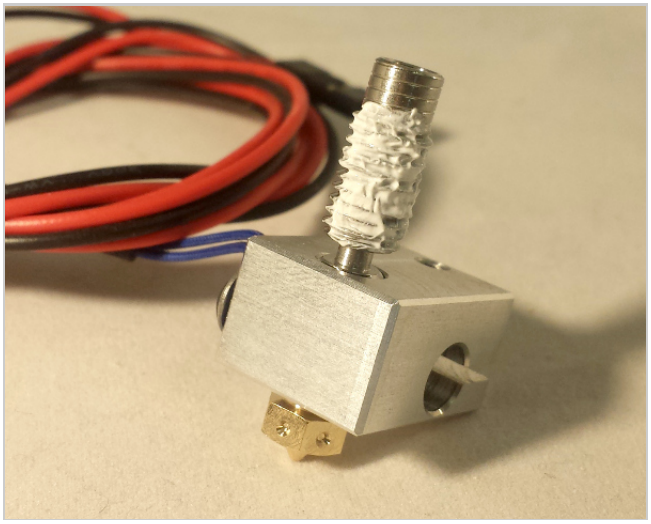


HeaterBlock tightened around cartridge.

Tighten the clamping portion of the heater block around the heater cartridge with the longer M3x10 screw. As in the photo below you should be able to see very slight deformation of the heater block clamp as it wraps around the cartridge for maximum thermal contact.

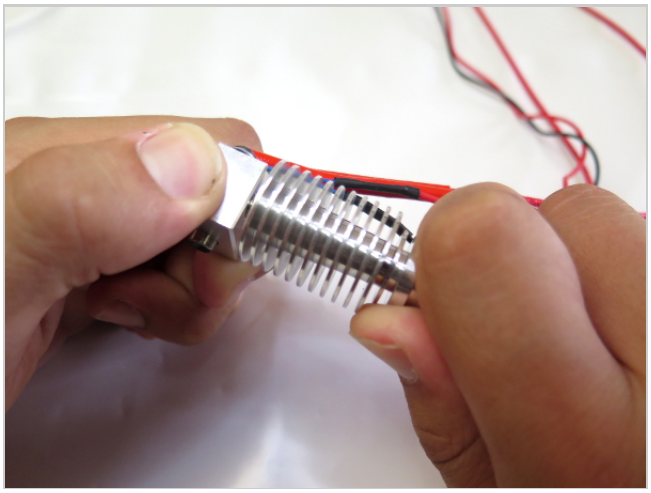
Note: The manufacturing process for heater cartridges often results in a degree of irregularity in both diameter and roundness. This is why we use a clamp, to accomodate this and ensure that in spite of the variation we get maximum thermal contact. If you do struggle to get a firm clamp on the cartridge try rotating it. A washer under the head of the M3 screw will enable you to get a much higher clampling load.

Thermal Compound



Thermal compound spread over the threads of the heat-break.

From mid-September 2015 all E3D-v6 HotEnds will be supplied with a small sachet of thermal compound. This improves heat-transfer from the heat-break threads to the heat-sink for slightly better thermal performance in marginal cases. The thermal compound should be spread evenly across the threads of the heat-break, only on the cold-side of the heat-break that screws into the heat-sink. The compound should not be used on any of the threads on the hot-side of the heat-break. The small sachet of compound contains more than is needed for one HotEnd, so don't feel like you need to use all of it.



Heatsink is screwed down onto top of heatbreak.

Screw the HeatSink onto the HeatBreak by gripping the heatsink in one hand and the heater block in the other. It only needs to be tightened up hand-tight. Do not overtighten.

PTFE Tubing (Where Applicable)

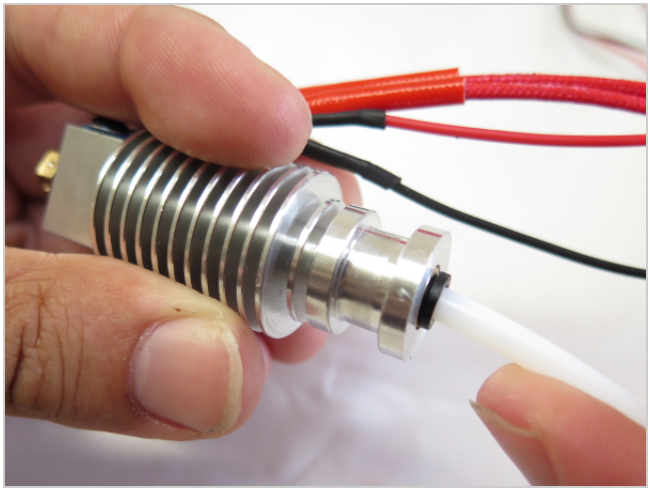
1.75mm Universal (with Bowden)

Insert PTFE Tubing

- These steps apply only to 1.75mm Direct, 1.75mm Bowden, and 3mm Bowden users. 3mm Direct

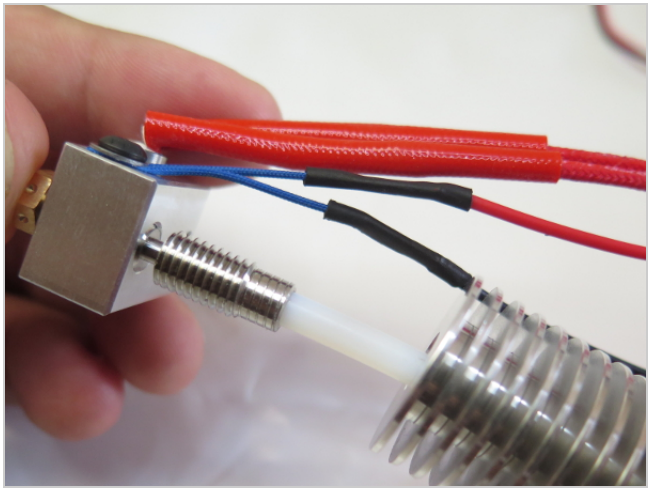
does not use any PTFE tubing.

- The PTFE tubing in the 1.75mm Direct configuration is not optional, you must use the tubing or the HotEnd will not function properly.
- The tubing should be inserted from the top of the now assembled hotend and pushed as far down into the hotend as possible.
- In the 1.75mm versions the PTFE tube actually runs through the Heat Sink and into the Heat Break, please ensure the tubing as seated as deep into the hotend as possible.



PTFE Tubing being pushed down into HotEnd.

In 1.75mm HotEnds the tubing passes right through the heatsink and into the heatbreak. Below is an illustration of how far down the PTFE tubing must extend. The photo below is not an assembly step, just an illustration of what should be happening inside your hotend.



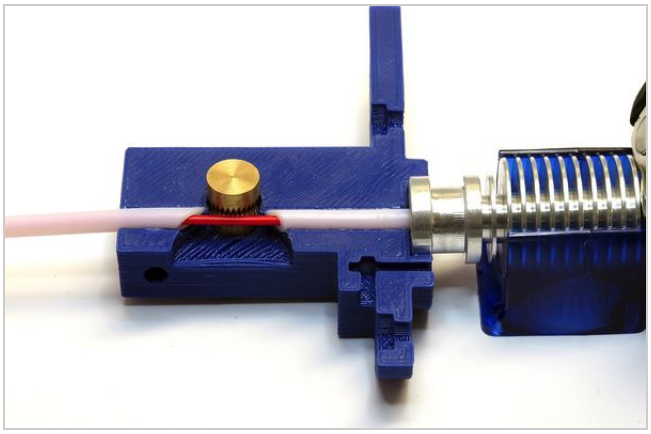
PTFE going down into Heat Break.

3mm Bowden

In the 3mm Bowden version the PTFE tubing pushes into the top of the heatsink and stops inside the heatsink.

3mm PTFE Tubing Inserted.

PTFE Recommendations

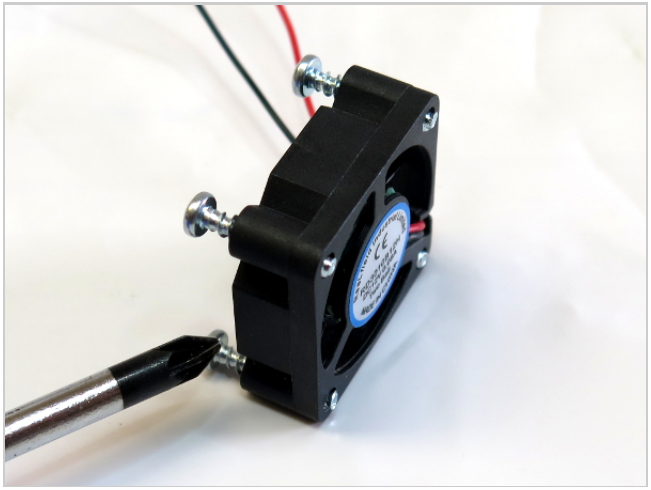


An optimal tubing configuration in a wades extruder.

- On bowden systems it is especially helpful to 'lock in' the PTFE tubing so that it cannot move around during retraction, this increases reliability, and gives much better retraction performance in general. To do this, push the PTFE firmly into the hotend, while pulling upwards on the black collet that retains the tubing. This locks the tubing into place so that it cannot move during retraction. It is important to do this at both ends of the tube.
- To release the tubing from the heatsink simply press down on the black or grey collet in the top of heatsink while pulling on the tubing.
- In 1.75mm Direct configurations thought should be given to running the PTFE right up as close to the hobbed bolt/drive gear as possible as this provides the easiest loading and the best performance with all filament types. However if you do not wish to run PTFE up to the hobbed bolt or drive gear you can simply cut the tubing off flush with the top of the hotend.

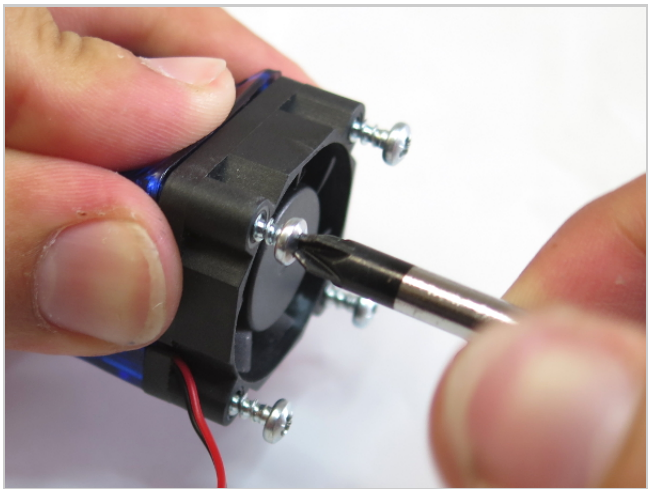
- Shown below is a cutaway illustration of how an optimal PTFE configuration might look in a wades type extruder. The PTFE tubing extends right up to the hobbed bolt.

Fan & Duct



Fan with screws inserted.

- Figure out which way up you want the fan-duct to sit on the HotEnd given your particular mounting arrangements. We recommend mounting it with the over-hang at the top. If you have it hanging down however, please keep it clear of the heater block.
- Remove the fan duct from the HeatSink.
- Screw the screws into the fan such that the ends are just protruding from the other side of the fan. The sticker of the fan must face the heatsink to blow air over the heatsink.

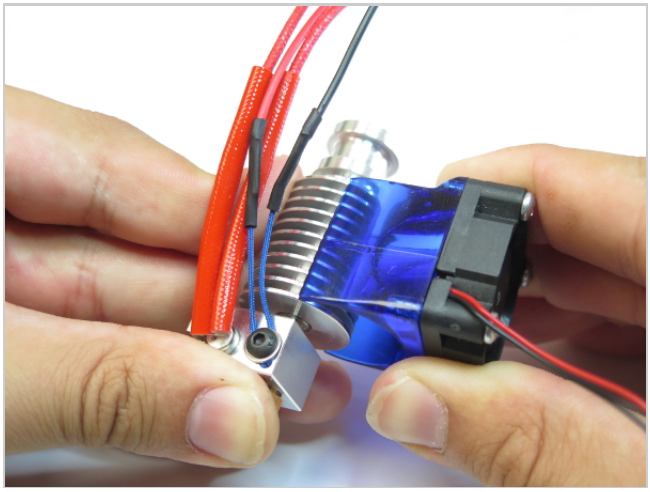


Screwing fan to duct.

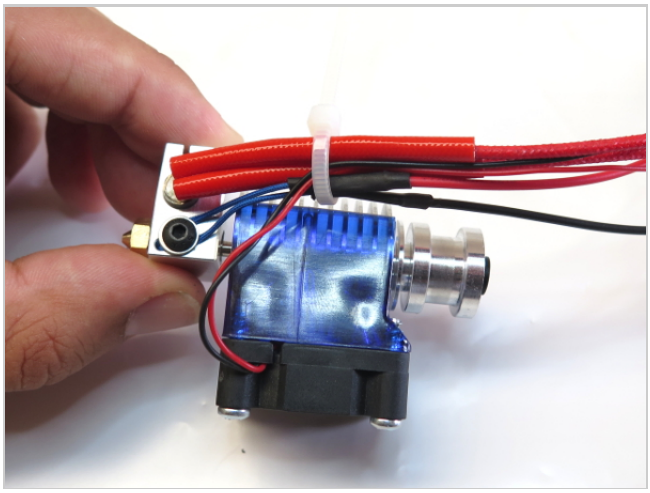
Using the 4 Plastfast screws, attach the fan to the fan-duct such that the wires exit the fan in a convenient location - preferably such that it can be bundled in with the thermistor and heater cartridge cables.

It can sometimes take quite a lot of torque to get the screws all the way in. Be sure to select a screwdriver that is a good fit or you risk striping the heads of the screws.

Clip the fan duct to the HeatSink.



Fan duct clipping to heatsink.



Cable tie all wires together.

- Cable-tie all cables together as additional strain relief.
- It is important to ensure the wires of the fan and the red/black section of the thermistor cable are cable-tied and strain relieved in such a way that they cannot come into contact with the heater block at any time.
- Fan should be wired directly to a 12v power supply and be constantly running. Do not connect to a "Fan" output of a controller board or similar, these are for fans that cool the printed object, not a hotend fan which needs to always be running.

Configure Firmware (Easy!)

In the following stages we are going to configure the HotEnd in firmware then go on to do the final hot-tighten of the HotEnd. This can be done either on or off your printer, however where practical we recommend doing it off your printer, then mounting.

Connect the heater-cartridge and thermistor to your electronics board. Please refer to the documentation specific to your electronics for Pin-Outs and other technical information which may be relevant to the HotEnd installation.

Marlin

Reconfigure your firmware for the Semitec 104GT2 thermistor: In configuration.h:

- #define TEMP_SENSOR_0 5

For safety it is strongly recommended to do the following:

- Set the minimum temperature to detect bad wiring (*HEATER_0_MINTEMP 5* in configuration.h)

In newer versions of Marlin there are extra features for Thermal Runaway Protection (https://github.com/MarlinFirmware/Marlin/blob/RC/Marlin/Configuration.h#L389) should your thermistor come loose.

Upload the new firmware to your electronics.

Repetier

Use thermistor definition number 8:

- #define EXT0_TEMPSENSOR_TYPE 8

Or select "ATC Semitec 104-GT2" if using the Online Configuration Tool (v091) (http://www.repetier.com/firmware/v091/)

For safety it is strongly recommended to do the following:

- Set the *Minimum defect temperature* to ensure that the thermistor shorting out is caught by the firmware.

New in Online Configuration Tool (v092) (http://www.repetier.com/firmware/v091/) are the two options to also improve safety:

- *Decouple hold variance* and *Decouple min temp. rise* to detect the thermistor coming loose. These must be set appropriately for your system to ensure that they work properly.

Upload the new firmware to your electronics.

Smoothieware

Use thermistor definition “Semitec”:

- temperature_control.hotend.thermistor Semitec

Upload the new firmware to your electronics.

RepRapFirmware

Edit the M305 P1 command in file sys/config.g on the SD card (you can do this in the web interface).

- For firmware versions 1.16 and earlier, set the B parameter (beta value) to 4388. This value gives better accuracy at typical printing temperatures in the range 190 to 250C than the B value of 4267 quoted in the datasheet.

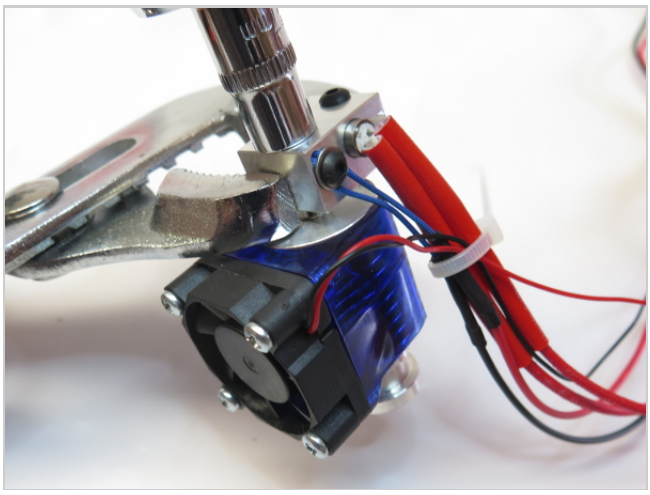
- For firmware versions 1.17 and later, set the B parameter to 4725 and the C parameter to 7.06e-8.

Restart the electronics to process the new config.g file.

PID Tuning

- Connect to the printer
- Run M303 to autotune your PID - check out Thomas Sanladerer's video guide for more information. Please note that not all firmwares support autotune, and you may need to tune manually.
- Set the HotEnd temperature to 285ºC. If you did not do a PID tune, then approach this temperature slowly, exceeding 295ºC will permanently damage the thermistor.

Final Tightening



Doing the final tightening of the nozzle.

- When the HotEnd is at tempereature, tighten the nozzle whilst holding the heater block with a spanner. This will tighten the nozzle against the HeatBreak and ensure that your HotEnd does not leak. You want to aim for 3Nm of torque on the hot nozzle - this is about as much pressure as you can apply with one finger on a small spanner. The nozzle does not need to be torqued down incredibly tightly to form a good seal, when at lower tempreatures the aluminium will contract and hold the Nozzle and HeatBreak together.

You are now ready to mount the HotEnd to your printer. Happy Printing!

Usage Guidance

In general the E3D-v6 hotend is highly tolerant of most printing conditions and is designed to accept the vast majority of filaments on the market. There are however some things to be aware of:

- Filament must be within acceptable diameter tolerance. For 1.75mm this means 1.70mm - 1.80mm and for 3.00mm/2.85mm the filament must be between 2.80mm and 3.05mm
- Excessively long retractions will cause issues by dragging soft filament into cold areas. E3D-v6 hotends need less retraction than most hotends. For direct extrusion systems you should use anywhere from 0.5mm-1.0mm, for bowden systems you might want to go up to 2mm. Retraction beyond 2mm is likely to cause issues.
- The heatsink must be cooled! Heated chambers, fan ducts that restrict flow, and not having the fan running at 100% at all times are common causes of issues. The heatsink should be cool to the touch at all times. If your heatsink is warm to the touch then you have a cooling issue that must be addressed.