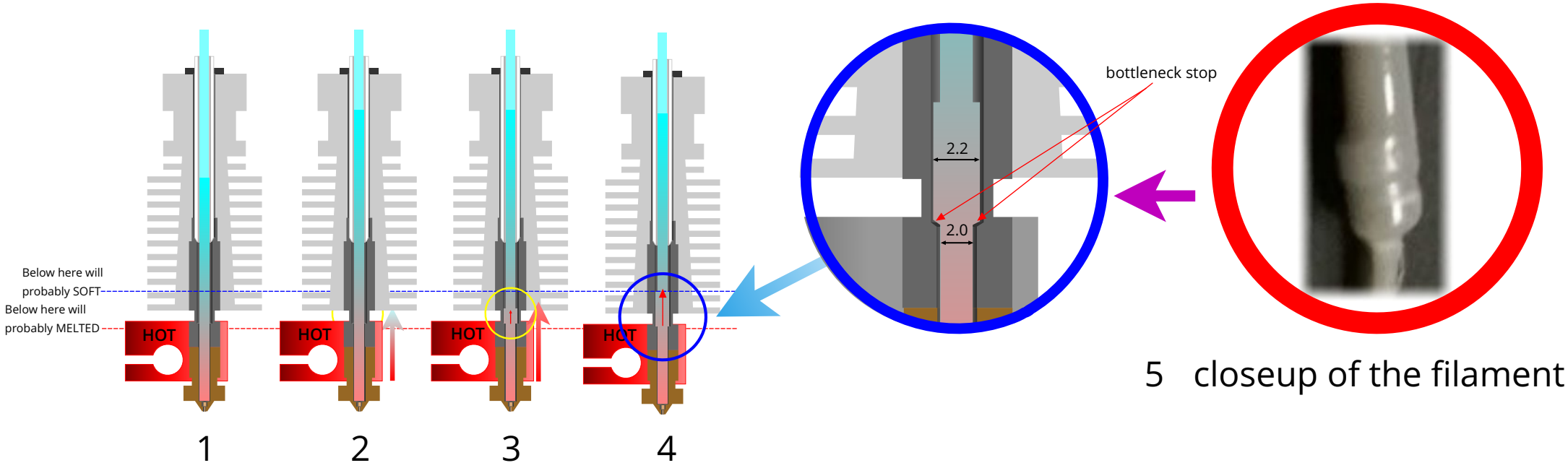
PRUSA edition heat break clogging analysis



1. Here is a schematic of the PRUSA E3DV6. The filament colour is the filament temperature. Part of the heat from the HOT block is transmitted to the heat break that is in contact with it. Even if it is fitted into the circular cooler with fan for ¾ of its size, the small diameter mid part is not completely cold, and raise its temperature warming the filament.
2. As the time elapse, more and more heat is transmitted from the metal heat break to the filament, even if the cooler keeps the temperature under reasonable values. At this point, based on several variables (GCODE, nozzle temperature, filament material, printing speed.. etc.) often happens that the heat break temperature raise enough that **several types of PLA filament may become partially soft (I am unsure if it could happen also with PET-G or ABS).**
3. As the filament is pressed by the extruder, in that section, the soft part of the 1.75 mm filament flexes; it is like “extruded”, expanding itself laterally, over the whole aluminium 2.2 mm diameter of the heat break instead of going down. This is due to the fact that the empty space offers less resistance that the lower melted viscous filament area, so this is why it expands laterally. This creates much more resistance against going down.
4. Once started, this event triggers a chain process where the more filament resistance is encountered the more it expands laterally and up (it is more and more difficult for the extruder fit the soft part into the bottleneck lower 2.0 mm hole bottleneck channel) . This status is visible during the print, since on the bed you can see that your print is starting to under extrude.
5. This filament extrusion grows in up direction, until the temperature is too low to flex the more filament. As soon as the the filament become solid enough in the bottleneck point, the new formed 2.2 mm diameter section could not pass through the remaining 2.0 mm channel, so it stay blocked to the bottleneck. You can see that **no filament exit from the nozzle and the extrude motor gear starts to click.**

END OF GAMES

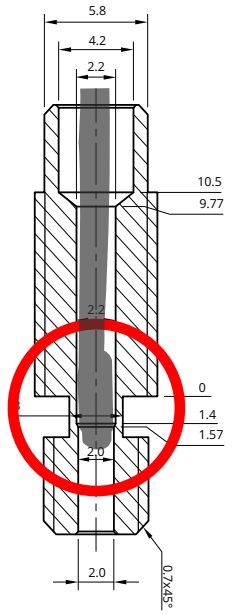
THE NOZZLE IS NOT CLOGGED

At this point, you need to stop the print (the i3MK3 retracts the filament) and just cut 1cm of filament from the beginning (the head blob). The you can start a new print. It will work until all the above condition will be met and the blob will be formed again.

- Same gcode with different materials produces different results: one filament could blob, another could complete the print successfully.
- Same material with different gcode produces different results: Just after a blob, I reprinted using the same material another small complex object with supports, and the printed ended successfully with no issues with very good quality.
- I saw the possibility to clog to increase exponentially with long linear infill (top/bottom surface) that have long lines (e.g. a 18cm x 18cm square)

On Picture 6 you can see the heat break with a piece of filament with a clog fitted inside. It stops exactly at the bottleneck where it pass from 2.2mm to 2.0mm

6



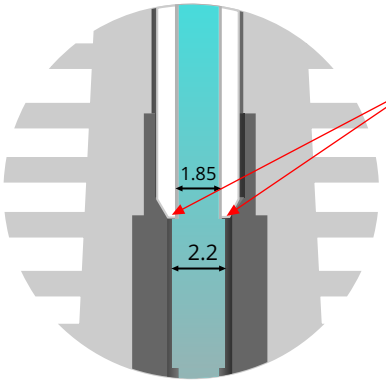
The **E3D-V6** heat break
PRUSA edition drawings

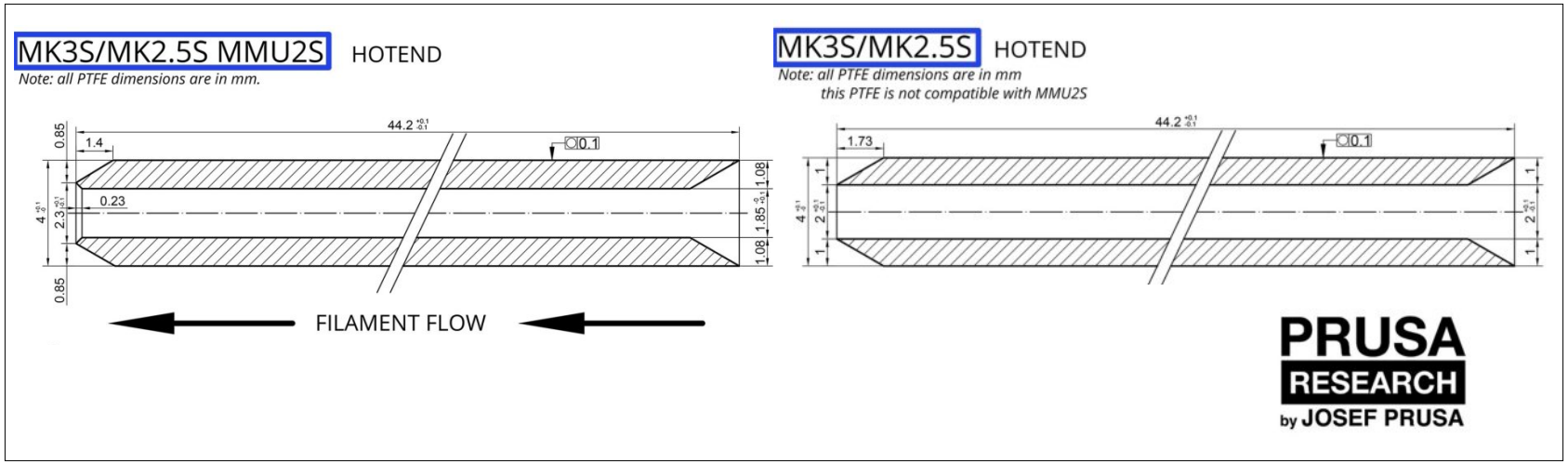
Another side effect that lets force you to dismount completely the extruder:

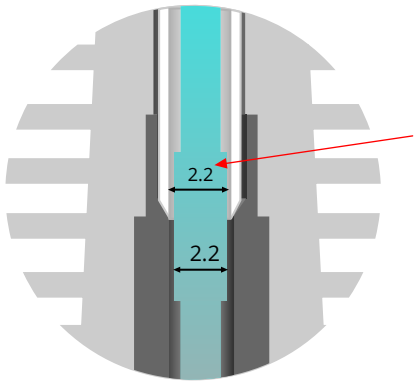
When the i3MK3S will unload the filament, it cannot be taken for granted at all that the filament blob will pass through the PTFE tube inside the cooler!

This because the **PRUSA cooler PTFE tube has an inside diameter of 1.85mm** (*MK3S with MMU*) **or 2.0 mm** (*MK3S plain*) as you see in the PRUSA documents. The filament clog diameter is about 2.1 mm, and it it will not pass through the channel inside the PTFE, or will just fit few mm into it, and then it will jam..

Then the only way to remove the filament it **is completely dismount the MK3 extruder ! Sorry guys.**

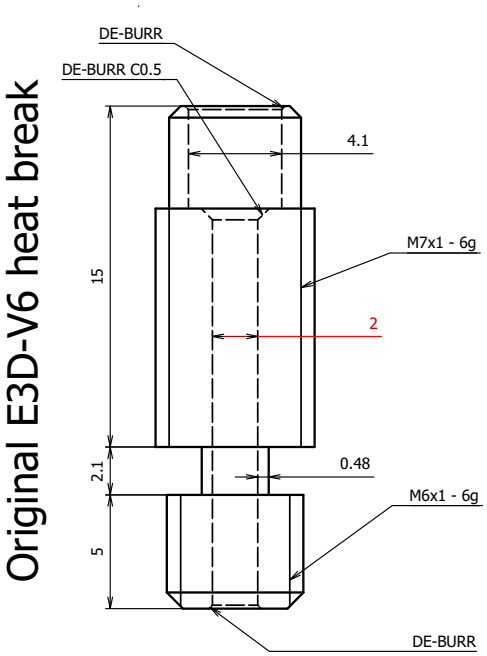


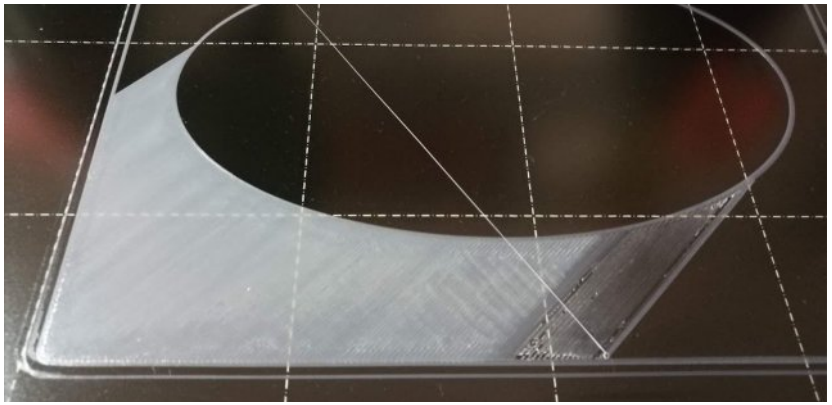




During the tests, after 6 consecutive jams in which I had to dismounts the extruder , **I decided to replace the internal PTFE tube with a new one of 2.2mm diameter (that is the same diameter of the aluminium heat break)**, so that at least the filament clog is able to pass through the PTFE tube and can be automatically unloaded and cut without the need to dismount the extruder.

The bottleneck heat break is a feature of the E3DV6 PRUSA Edition only





How you see that the filament blob has been created (under extrusion)

Several samples of filament blobs

The **original E3D V6 heat break** is different! It has no bottleneck, as you can see from the official schematic.
I ordered one of this, to do more tests.

Filament clog diameter is almost the same of the internal 2.2 mm heat break