Tourniquet 3D Printed Backplates – Breakage Report

Filament

The Canada lab is printing these backplates in Petg, which is not as robust and flexible as ABS, which is what our Gaza lab prints with. This has been the issue with the tourniquet backplates breaking because Petg can become brittle.

Filament quality is also an issue based on colour, quality and moisture, although difficult to gauge and quantify before printing.

Nozzle Temperature

Nozzle temperature was tested from 215 degrees to 235 degrees, with the same black filament (Duramic). Three backplates were printed with varying nozzle temperatures, and were taken off of the print bed immediately after printing.

Results:

Backplates	1st Layer Temp	Printing Temp	Outcome	Photos
#1	215	225	Backplate broke at weak points where the thick and thin areas of the part join.	
#2	220	230	Backplate did not break at all.	
#3	225	235	Backplate slightly cracked at the weak points.	

Bed Temperature

Bed temperature is a major factor in backplate breakage. The default bed temp for Petg is 85 degrees, and this is the appropriate temperature for less breakage. If the ambient temperature is low, 90 degrees is ok. A lower bed temperature than 85 may result in less bed adhesion, and a higher temperature than 85 may result in more breakage due to the temperature difference when the bed cools after printing.

When the backplates are taken off of the hot bed immediately after printing, before the bed cools, there is usually a breakage rate of 0% - 4%.

The cooling bed causes the printed parts to contract, and the thinness of the backplates means that there is more bed adhesion. So, instead of being able to contract, the backplates develop micro-fractures at the weakest points of the part (where the thick and thin areas join), and are more apt to break there. When the backplates are taken off of a cooled bed, the breakage rate is usually 25% - 100%. Although, this can fluctuate based on filament and ambient temperature as well.

Breakage Pattern Photo:

Ambient Temperature

The difference between the hotbed and the ambient temperature of the space is the biggest factor in the backplate breakage. When there is a bigger difference between the two, and a faster speed from hot to cool, the more breakage occurs.

The difference in temperature from the top shelf of the printer cube in the Glia Canada lab is about 2-4 degrees hotter than the lower shelf. The breakage rate of backplates printed on the top shelf printers is approximately 75-85%, whereas when printed on the lower shelf, the breakage rate is approximately 4-12%. This may also be due to the top shelf having a fan which speeds up the cooling of the hotbed after printing.

The code for the hotbed to cool, M140 S0, was taken out of the gcode files for the backplate, although the hotbed will still cool down automatically 30 minutes after printing, due to safety. However, the prolonged heat on the bed creates a slower cooling rate after 30 minutes and lowers the breakage rate as well.

An ambient temperature of 70-75 F (21-24), and slower cooling of the hotbed, both contribute to lower breakage rates for the backplates.

Conclusion

Use the best filament you can. Black is preferable, as any white pigment added can make it more brittle.

Nozzle temp is best at 230 degrees.

Bed temp is best at 85 degrees.

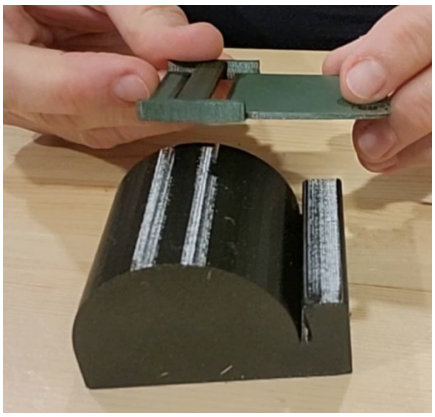
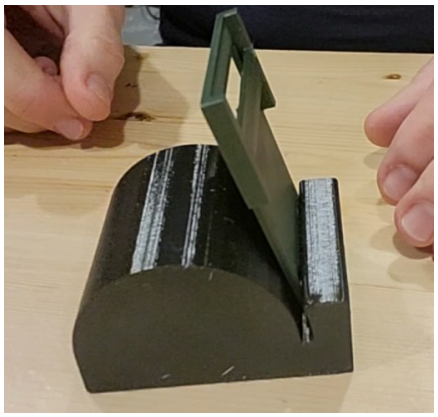
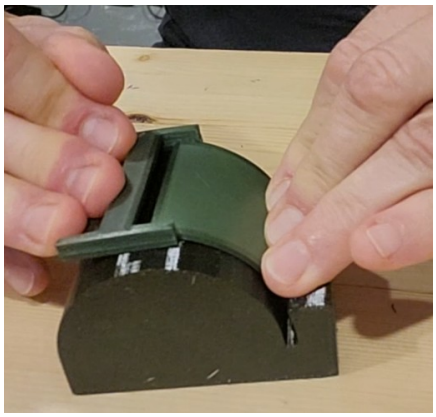
Ambient temp is best at 75 degrees.

Backplate Tester

The backplate tester on the GliaX tourniquet repo, is a great way to test the backplates when they come off of the printer bed.

https://github.com/GliaX/tourniquet/blob/master/assembly_instructions/quality_control/TQ%20backplate%20tester.STL

In order to do a proper test, hold the backplate facing up, and place the thin end into the crevice of the tester. Holding the thin end in the crevice, bend the backplate around the circumference of the tester with even pressure until the free end of the backplate touches the tester. Do not bounce the backplate back and forth. One solid bend is enough to determine the effectiveness of the backplate.

The tester has a circumference of 5.5 cm, which is the smallest limb it will be able to fit on. If the backplate doesn’t break during the test, it will not break on the tourniquet when used properly.