Palette 2 & Palette 2 Pro: Filament Production Speeds, and Maximum Recommended Print Speeds

Palette 2 and Palette 2 Pro create filament in real time during a print. This filament is consumed by 3D printers.

It is important that Palette 2 can produce filament quick enough for a printer so that the printer does not run out of filament during a print. (i.e. Palette 2's filament production speed must be able to exceed the filament consumption speed of the printer.)

For the large majority of printers (except those with particularly high filament consumption speeds), Palette 2 is able to produce filament quickly enough to keep up with the printer's filament consumption in most practical cases. There are some print modes and printing conditions where Palette's speed is a limiting factor and will require you to slow down your print speeds. This article provides practical guidelines to help you have success with your Palette.

There are a variety of factors that affect (1) Palette 2's filament production speed, and (2) the printer's rate of filament consumption. Let's dig into those a bit further.

(1) Factors that affect Palette 2's filament production speed

Palette 2 can *drive* filament very quickly—far faster than any desktop 3D printer can consume it. However, *splicing* filament (joining two filaments together) is what adds additional time. When splicing two filaments together, Palette 2 must cut the filaments, heat them, compress them together, and cool them. Of these actions, the one that takes the longest is cooling. After being heated, the filament must cool enough to retain its shape while moving. When Palette is printing with PLA, its splices require more cooling time compared to splices made using other higher-temperature materials like ABS and PETG. In the chart below, you'll notice that filaments that have *higher* print temperatures like ABS and Nylon can actually be printed at faster speeds because their glass transition temperatures are higher (and therefore require less cooling after splicing).

(2) Factors that affect the printer's rate of filament consumption

On the printer side of things, there are many things that affect how quickly a printer consumes filament (volumetrically). The factors that most contribute to filament consumption include:

- slicer "printing speed"
- extrusion width
- layer height
- extrusion multiplier
- printer acceleration settings
- transition lengths (the longer the transition length, the less frequent the splices)

Based on practical multi-color printing scenarios, we have compiled a list of recommended speeds:

Example Material Combinations	Print speed in [mm/s] with Palette 2	Print speed in [mm/s] with Palette 2 Pro
PLA-PLA	63 - 103	80 - 135
ABS-ABS	83 - 140	122 - 221
PETG-PETG	72 - 121	101 - 176

TPU-TPU	51 - 83	66 - 109
PLA-PVA or PVOH	54 - 87	65 - 108
PLA-TPU	39 - 62	47 - 75
Nylon-Nylon	129 - 236	179 - 280

To determine the recommendations above, we used the following settings:

- 0.2mm layer height, 0.4mm extrusion width, 1.0 extrusion multiplier
- 4 color multi-color print in Palette 2's standard print mode with a transition tower
- recommended splice settings for each material

As mentioned above, despite there being a variety of factors that can affect the optimal print speed, our goal is to provide a practical range that will work for you in most scenarios. If you would like more information about a specific scenario or printer set-up, please contact us at support@mosaicmfg.com and we will do our best to answer your questions. When in doubt, we would recommend using a print speed (the number you enter into your slicer) at the low end of the range. Below we will explain a few ways to increase your average print speed to move towards the upper end of the provided range.

Increasing Average Print Speed

One of the most effective ways to increase your print speed is to use the "Speed Control" functionality built into the connected Canvas Hub experience. When printing in connected mode with this feature turned on, this will slow down your print only when Palette is splicing. This means that your printer can print at a higher speed for most of the print and will only be slowed down during the rate limiting process of splicing. This strategy can be very effective in standard 4 color prints with a transition tower but is also very effective in special print modes like gradient mode and multi-spool mode.

Another strategy to increase your print speed is to select a material that has faster splicing performance. You can see in the chart above that Nylon can print at roughly twice the speed of PLA based on the cooling of Nylon requiring a lot less time.

Generally, increasing the length of the segments being spliced together will increase Palette's effective production rate as it allows the buffer to be used more effectively. This means that printing larger models (which have larger segments of each filament in them) will actually allow you to print the model at a faster average speed. This can also be effective when printing in random mode for example where a 4 color x 15cm segment print will be able to print faster than a 4 color x 8cm segment print. Please note that the chart above does not refer to special print modes and is meant for reference to standard multi-color printing with a transition tower.

We hope that this article is able to shed some light on the factors that affect print speed and can help you select a speed for your prints that is optimal.