



## Technical guide

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### A Technical Guide – Part Five

#### Print Speed, Acceleration, and Motion Control in 3D Printing

When people talk about print speed, they often think in simple terms: faster means lower quality, slower means higher quality. While there is some truth to this, it hides a much more important reality. Speed in 3D printing is not a single setting — it is a complex interaction between motion, temperature, material behaviour, and time.

To understand why speed matters, we need to think about what the printer is actually doing. At every moment, molten plastic is being pushed through a nozzle and placed precisely onto a previous layer. That plastic must still be hot enough to bond properly, but cool enough to hold its shape. Speed directly affects this balance.

When printing too fast, plastic is stretched as it leaves the nozzle. This stretching reduces the contact area between layers, weakening the bond. The part may look acceptable on the outside but fail internally when stressed. This is why some fast prints snap along layer lines even though they appear solid.

Slower printing gives plastic more time to fuse with the layer beneath it. This often improves strength, especially for functional parts. However, printing too slowly can also cause problems. Excessive heat buildup can soften details, cause sagging, or lead to inconsistent extrusion.

Acceleration adds another layer of complexity. Acceleration controls how quickly the printer changes speed and direction. High acceleration allows rapid movements, but it also introduces vibration. This vibration shows up as ringing or ghosting on surfaces and can subtly distort dimensions.

Every time the printer accelerates or decelerates, pressure inside the nozzle changes. If this pressure is not managed correctly, it leads to over-extrusion at corners or under-extrusion during rapid moves. These effects are small but cumulative, especially in precision parts.

Modern printers use features such as pressure or linear advance to compensate for these pressure changes. These systems predict how filament behaves under motion and adjust extrusion accordingly. When tuned correctly, they dramatically improve consistency.

Speed should never be applied uniformly. Different features of a print have different requirements. Outer walls benefit from slower speeds to preserve accuracy and surface quality. Infill can be printed faster because minor inaccuracies are less visible and less critical.

Bridges and overhangs require careful speed control. Printing too fast causes sagging, while printing too slowly allows plastic to droop. Matching speed with cooling is essential here.

Cooling itself must be considered alongside speed. Faster printing generally requires more cooling to prevent deformation. Slower printing often benefits from reduced cooling to improve layer bonding. Using the same fan settings for all speeds is a common mistake.

Material choice also affects optimal speed. PLA tolerates faster printing than PETG or ABS. PETG prefers slower, steadier motion to avoid stringing and weak bonding. ABS and ASA often require controlled, moderate speeds to maintain dimensional stability.

Speed settings influence print reliability as much as quality. Aggressive speeds increase mechanical stress on belts, bearings, and motors. Over time, this reduces consistency and increases maintenance requirements.

Professional printing does not chase the fastest possible result. Instead, it aims for controlled motion that produces predictable outcomes. A print that finishes an hour later but works correctly is far more valuable than one that finishes quickly and fails.

At BritForge3D, speed and acceleration are tuned per material and per application. Functional parts are prioritised for strength and accuracy, while visual parts are tuned for surface finish.

Understanding speed as a tool rather than a shortcut changes how you approach printing. It allows you to make deliberate decisions instead of relying on guesswork or presets.

Once speed and motion are under control, the printer becomes more than a machine — it becomes a predictable manufacturing system.

## Guide 5 Summary – Print Speed, Acceleration, and Motion Control

This guide revealed why print speed is not just about saving time. You learned how speed, acceleration, cooling, and material flow interact to influence layer bonding, surface finish, and dimensional accuracy.

By treating speed as a controlled tool rather than a shortcut, you can produce prints that are both reliable and efficient. Understanding motion control helps reduce failures and improves consistency across prints.

The next guide shifts focus to appearance, exploring how surface finish and post-processing techniques turn printed parts into professional-looking components.

