

Manafish Ultimate Filament Guide

In this guide we will be going through all the most common types of filaments, with the goal of giving you an overview of the different filaments available and what they should be used for.

There are a lot of guides explaining filaments online, but most of them seem to explain all the filament types separately. After reading them, you end up with the feeling that all filaments are good, and it is hard to distinguish between them. Therefore, this guide will focus heavily on *comparing* the filament types and really squeeze out what actually makes each type of filament different from the others.

To make it even easier to compare and find out what filament is best for you, this guide will include "best in category" awards, represented by little gold badges. There is also a price estimate for each filament type, which is based on the prices for Bambu Lab filaments of the given type.

There are a lot of different filaments out there and new types are released all the time, so needless to say we were not able to go through all possible filament types. But we tried our best to include the most common and useful ones!

PLA – The "Default" Filament

Price: \$10-20/kg

Hardened Nozzle Needed: No

Enclosure Needed: No

PLA is the most available, most used and cheapest filament type. It does not shrink much when cooling, which means it produces detailed and dimensionally accurate parts that closely match the 3D model. It also comes in a huge range of colors and decorative variants, making it ideal for aesthetic prints.

However, PLA is relatively brittle and can break easily upon impact. It also has low temperature tolerance, around 60°C, meaning parts made from PLA are unsuitable for high-temperature environments and may start to deform if left in the sun on a hot day.



PETG – Stronger than PLA?

Price: \$11-22/ kg

Hardened Nozzle Needed: No

Enclosure Needed: No

PETG has a lot of PLA's good properties - easy to print (little warping, not that sensitive to moisture), almost as cheap as PLA and can print on almost any printer.

You will commonly hear online that "PETG is stronger than PLA". However, that is only partially true. It is not stronger in tensile strength, but it does have almost double as high impact resistance. This means that if a load is applied slowly, like if you are testing how much weight a beam can take before it breaks, PLA will be slightly stronger. However, if you drop two identical parts made of PLA and PETG to the ground, the part in PLA is by far more likely to break. PETG also has higher temperature resistance than PLA.

The main benefits of PLA are that the parts printed with it will be slightly more dimensionally accurate. Also, PLA filament can tolerate more moisture before it loses quality – PETG filament should ideally be dried before use.

As a conclusion we can say that if your part needs toughness, PETG is the best "default" filament. If you care more about looks, details, and don't want to stress with keeping your filament dry, PLA is better.



PETG-CF – Stronger than PETG?

Price: \$33/ kg

Hardened Nozzle Needed: Yes

Enclosure Needed: No

PETG-CF is a composite where chopped pieces of carbon fiber are added to the filament. According to numbers from Bambu Lab this increases the stiffness by about 60% and the impact strength by about 20%. However, many other sources like YouTubers testing different filaments say that normal PETG is stronger. Either way, all sources agree that the carbon fiber gives it a much more premium look, and it will warp less and is more dimensionally accurate.

There are however two downsides compared to normal PETG. The first is that it is more expensive. The second is that you will need a hardened steel nozzle to print it, as the carbon fibers would easily wear down a normal stainless steel or brass nozzle. If your printer does not have this, you can most likely replace your nozzle quite easily to get one.



PLA-CF – King of Stiffness

Price: \$27/ kg

Hardened Nozzle Needed: Yes

Enclosure Needed: No

PLA-CF consists of PLA infused with chopped carbon fiber. It is similar to PETG-CF in looks and in that it needs a hardened nozzle to print.

The main benefit of this filament is that it is super stiff, meaning it keeps to its shape and requires a lot of force to bend. It is almost twice as stiff as PETG-CF, but it is less tough.

This makes it ideal for parts that will experience a static load and that you do not want to bend, for example shelf holding a heavy object. PETG-CF is however much better for parts that need impact resistance. If you for example were to make a drone frame, PETG-CF would be a better choice, because even though PLA-CF is harder it would break a lot more easily if you crashed the drone.



ASA – Best for outdoor durability and post processing.

Price: \$25/ kg

Hardened Nozzle Needed: No

Enclosure Needed: Yes

ASA is a bit worse than PETG in strength. It also requires a printer with an enclosed chamber to print, and warps more when printing, and gives off toxic fumes so the printer must have some sort of ventilation. It does, however, have three big advantages:

1. Excellent UV Resistance. Other filaments like PETG will lose strength when exposed to UV light, which is emitted by the sun. ASA will not. ASA is also very resistant to moisture. Therefore, ASA is the best filament to use for parts that will permanently be outside, like a mailbox or windmill.
2. ASA can tackle temperatures up to 100°C without warping or losing all its strength. Therefore, it is a good cheap alternative for parts that need to be heat resistant (but it is not the most heat-resistant filament).
3. ASA can be post processed with acetone to make it completely smooth, as shown in the image below.



ABS – Worse than PETG and ASA

Price: \$23/ kg

Hardened Nozzle Needed: No

Enclosure Needed: Yes

We felt we almost had to include ABS because it is such a common filament type, but I'm just going to say it – it is like PETG but worse in almost every aspect! It is weaker, has weaker layer adhesion (layers break apart more easily), requires an enclosed printer, smells bad and emits toxic gases when printing and warps a lot.

The only area where it beats PETG is temperature resistance and its ability to be smoothed with acetone. But ASA has both these properties and is basically the same price. It actually has noticeably better temperature resistance than ABS. Therefore, if you need temperature resistance or smoothing, ASA is probably a better choice.

Polycarbonate (PC) – Strongest Reasonably Priced Filament

Price: \$43/ kg

Hardened Nozzle Needed: No

Enclosure Needed: Yes

Polycarbonate is the same type of filament that is used for Plexi Glass. It has about 40% more bending strength than normal PLA, meaning that you need 40% more force to break it.

The main downside is that it is quite hard to print – it can warp a lot and a printer with an enclosure is required.

It is a very strong and durable filament, while at the same time being reasonably cheap at under \$50 per kg. Any filament that is stronger than this will cost you almost double as much.



PPA-CF – The STRONGEST Filament!

Price: \$208/ kg

Hardened Nozzle Needed: Yes

Enclosure Needed: Yes

PPA-CF is a type of modified nylon filament mixed with chopped carbon fiber. If you do not care about the price and just want the strongest filament possible, this is probably your best choice.

This filament has exceptional strength, stiffness, moisture resistance and temperature resistance. It has about 2x the strength of polycarbonate, 2.5x the stiffness of PLA-CF and can handle temperatures up to 227 °C, which is roughly twice as much as polycarbonate and four times as much as PLA.



Other Nylon Composites

Price: around \$100/ kg Hardened Nozzle Needed: Yes Enclosure Needed: Yes

There are a wide variety of other filaments consisting of some type of nylon infused with carbon fibers. These go under names like "PA-CF", "PA6-CF" and "PAHT-CF".

Generally, these fall somewhere between polycarbonate and PPA-CF in terms of price and strength. They can be good options if you need something stronger than PC but are not willing to go all in and buy the expensive PPA-CF.

TPU – Flexible Filament

Price: \$35-44/kg Hardened Nozzle Needed: No Enclosure Needed: No

The most common type of flexible filament is TPU. This is awesome for a wide variety of applications, like flexible shoe soles, rubber like tires or belts.

When buying TPU, it is important to be aware that it comes in different hardness grades. The hardness is typically measured on the Shore scale. The most common grades to find for TPU are:

- 85 A – Hardness of a leather belt or soft shoe-sole
- 95 A – Hardness of a car tire.
- 98 A – Almost like a golf-ball.

There also exists even softer grades. Generally, the softer the TPU is the bigger pain it is to print, as the filament can bend and get stuck inside the extruder.

It is important to know that in addition to choosing the hardness of the material itself, we can greatly affect the hardness and flexibility of the part we make by changing the infill. A part printed with 98A TPU will not be as hard as a golf-ball unless you have 100% infill, with less infill it will be a lot softer.

The harder grades of TPU work *exceptionally* well for protective parts that need to absorb impacts, such as a bike helmet or shielding on a robot-wars robot.



PVA – Dissolvable Support Filament

Price: \$84/kg

Hardened Nozzle Needed: No

Enclosure Needed: No

PVA is a special type of filament that dissolves in water. If you have a printer capable of printing multiple filaments in one print, this filament can be used to print the supports while another filament is used for the part itself. This makes it super easy to remove the supports – you just submerge the part in water and after some time all the supports will magically disappear.



This is a necessity for models where supports otherwise would be nearly impossible to remove, like the one shown in the illustration. It is also just very convenient.

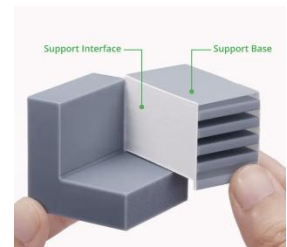
Special Support Filaments

Price: \$52-74/kg

Hardened Nozzle Needed: No

Enclosure Needed: No

There exists a bunch of filaments called things like “Support for PLA”, “Support for PETG”. They work by printing one layer of the filament between the supports and the actual part, as shown in the illustration. They do not adhere to the part, so the supports will be really easy to break off.



Even though the price is pretty high, keep in mind that they will only be used for a thin interface layer. One 0.5kg roll can be enough for a lot of prints.

Historically, these have received mixed reviews. Many people report that a better option is to use PLA as the support interface for PETG prints and PETG as the support interface for PLA prints.

Wood Filled PLA – Wood looking prints!

Price: \$15-30/kg

Hardened Nozzle Needed: No

Enclosure Needed: No

Wood filled PLA is a filament that consists of normal PLA mixed with sawdust from different types of wood. These are mostly used for decorative purposes - the resulting prints look and even smell like wood! In addition to this, the slightly grainy texture makes layer lines almost invisible, and parts printed with this filament can look really premium.

Conductive Filaments

Price: ca. \$100/kg

Hardened Nozzle Needed: Yes

Enclosure Needed: No

Conductive filament makes it possible to 3D-print functional electronics! It typically consists of PLA or ABS infused with conductive carbon or graphene, allowing it to carry small electrical currents. While far less conductive than metals (around 15 Ω -cm for common conductive PLA), it's sufficient for low-voltage circuits, capacitive touch sensors, LEDs, or anti-static enclosures.

Metal-filled Filaments

Price: ca. \$100/kg

Hardened Nozzle Needed: Yes

Enclosure Needed: No

Metal-filled filaments consist of a base filament, typically PLA, that is mixed with Bronze, Copper, Brass, Steel, or Iron powder. These filaments are used mostly for cool looks, as the parts you get will have the look and feel of metal parts, especially if they are polished.

Imagine printing a trophy and it is heavier than normal PLA and looks almost like metal. Really cool stuff!

Glow in the dark PLA

Price: ca. \$25/kg

Hardened Nozzle Needed: No

Enclosure Needed: No

Glow in the dark PLA consists of PLA that is infused with a glow-in-the-dark substance. It has basically identical strength and properties of normal PLA, but after being charged up by sunlight, it glows in the dark!