



## The Ultimate Guide To The 3D Printer Filament

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### What is 3D Printing?

Technology has developed to such an extent that we can now manufacture products, previously only possible with expensive machinery, practically right in our living rooms. One such approach is the ability to use a special machine called the 3D printer or the 3D printing machine to create three dimensional objects, by means of an additive process.

Whereas traditional machining techniques such as cutting, drilling and milling uses a method whereby material is subtracted or cut from the main object, with 3D printing, material is added, hence the term the “additive process”.

How is this accomplished?

The 3D printer uses molten plastic or other material to build layers upon layers, and ultimately create a finished physical object. To be able to print a particular 3D (three dimensional) pattern, the printer is connected to a computer which feeds the design through via a digital file.

What can be produced?

There is a large variety of objects that can be created with this process. The trend is, if you can think it, you can 3D print it. Just to give an example of the possibilities, think of children’s toys, items needed in the medical profession, like prosthetics, jewellery, shoes, gears, and drones. The possibilities are endless.

### The different types of 3D Printers

Your layering process will differ depending on the material you use, and on whether you’re using an industrial or commercial 3D printer. 3D printers have been around for over 20 years. They’ve been used in the creation of rapid prototypes. Rapid prototyping is, at best, the process whereby various techniques are used to quickly create a scale model utilizing a 3D printer.

The problem though, is that industrial 3D printers are very expensive and quite bulky. They are also not very user friendly. On the other hand, industrial 3D printers are very fast, can easily print multiple copies of the same product, all in the same run. They are also able to print in various colors, utilizing an array of materials.

Commercial 3D printers or desktop 3D printers as they are more commonly known, have only been around for a few years. Though they are less precise and much slower than their more expensive cousin, they allow the world of 3D printing and prototyping to be open to hobbyists, DIYers and small scale businesses.

Most of the desktop 3D printers only use thermoplastics as feeding material. A thermoplastic is a type of plastic material that becomes supple and bendable when heated above a particular temperature. It becomes solid again when cooled.

When creating an object, the most common technique used is called fused deposition modeling or FDM. In this process the thermoplastic filament or 3D printer filament (basically the raw material, needed to create the object) is emitted or extruded from a heated print head, a process known as thermoplastic extrusion.

The hot print head would trickle small drops of molten material, in layer upon layer, on the printing bed of the 3D printer, which eventually culminates into your finished product.

## What Materials To Use For 3D Printing

Just as a traditional inkjet printer uses ink cartridges in order to print, so a 3D printer uses filaments. These 3D printer filaments are available online in a variety of materials, lengths, sizes and colors.

We'll take a quick look at a few of the different 3D printer filaments in use today, their print temperature, as well as their bed temperature. We'll also look at what they are mostly used, and will explain the terminology of each afterwards.

Filament	Print Temp. (°C)	Bed Temp. (°C)	Mostly Used For
ABS - Acrylonitrile Butadiene Styrene	210 - 250	50 - 100	Automotive parts, toys
ASA - Acrylonitrile Styrene Acrylate	240 - 260	100 - 120	Outdoor parts - severe conditions
Carbon Fiber Filament	195 - 220	-	Mechanical parts & protective casings
Cleaning Filament	150 - 260	-	Unclogging of nozzles & cleaning
Color Changing Filament	215	-	Used in fun projects
Conductive Filament	215 - 230	-	Circuits & Arduino projects
Flexible TPC-TPE-TPU	225 - 235	-	Toys, wearables and phone casings
Glow-in-the-dark Filament	215	-	Fun projects, Halloween themes
HIPS - High Impact Polysterene	210 - 250	50 - 100	ABS extrusion & support structures
Lignin Filament - Biofila	190 - 225	55	Noble looking & shiny objects
Magnetic Filament	195 - 220	-	Fridge magnets, fun projects
Nylon (Polyamide)	220 - 260	50 - 100	Mechanical parts, gears and bearings
PETG - PET & Glycerol	220 - 235	-	Mechanical parts
Wood PLA Blends	195 - 220	-	Home decor

### 3D Printer Filament #1: ABS - Acrylonitrile Butadiene Styrene

Acrylonitrile Butadiene Styrene or ABS for short, used to be the number one 3D printer filament, but has now been superseded by PLA. However, this does not mean that ABS is not perfect for printing anymore. ABS has excellent properties. It can be extracted easily, is slightly flexible, and is durable. It is mostly used to create things like knife handles, toys, phone cases and car phone mounts. One big disadvantage to using ABS, is the amount of fumes it emits during printing. This can be very dangerous, especially for people with breathing difficulties. When printing with ABS make sure you position your printer in a well-ventilated room.

### 3D Printer Filament #2: ASA - Acrylonitrile Styrene Acrylate

Acrylonitrile Styrene Acrylate or ASA is well known for its strength and its ability to withstand harsh outdoor weather and chemical conditions. ASA is able to preserve its shape and color over long periods of time, a quality that makes it ideal for use in the manufacture of parts for severe conditions and outdoor use. Though ASA possesses these great qualities, it has very low flexibility, and thus can snap easily if you slightly bend it. It is also not considered food safe.

### **3D Printer Filament #3: Carbon Fiber Filament**

Carbon Fiber is an extremely rigid filament which offers great structure. You will find it used mostly in the production of mechanical parts or in industries where high durability is of the utmost importance. It is made from a mixture of PLA with carbon fiber strands, and although it might have high durability, because of its composition, it has the disadvantage of damaging the nozzles of 3D printers. This is especially so, if your nozzle is made of brass like soft metal. You'll notice an increase in the width of the diameter of the nozzle after a couple of uses.

### **3D Printer Filament #4: Cleaning Filament**

Cleaning Filament's only purpose is to clean and unplug the extruder of your 3D printing machine. Why is this necessary? Well, if you switch between two different filament types when extruding, especially if they have different extrusion temperatures, it is wise to use Cleaning Filament as it will prevent the nozzle from clogging up. Cleaning Filament becomes extrudable at 150°C and can retain stability up to 280°C. As different filaments have different colors, it is logical that color from a previous use might still be attached to the nozzle. Feeding about 15cm of Cleaning Filament through the nozzle will clear it of left-over material.

### **3D Printer Filament #5: Color Changing Filament**

This is one fun filament to have, as it allows colors on whatever material it is placed on to change depending on the temperatures they're at. There are various color combinations, each having completely different properties, that will change depending on changes in heat. Some of them are able to respond to light. This filament is ideal for toys, wearables, phone cases as well as visual products. It is quite easy to use, almost like using PLA.

### **3D Printer Filament #6: Conductive Filament**

Conductive Filament brings a whole new world of engineering possibilities into everyone's reach. This filament is a mixture of PLA with a conductive carbon particulate. It allows you to print low-voltage electronic circuits which are ideal for LED's, Arduino projects, sensors and such. It has low durability but is easy to use and print. Although it has medium flexibility it could break with repeated bending.

### **3D Printer Filament #7: Flexible TPE-TPC**

TPE also known as thermoplastic elastomers, is used mainly in commercial applications for the making of automotive parts, shoe soles, electrical insulation, wristbands, smartphone covers and such. TPE is extremely flexible and tough. It is also able to go through rigorous punishment, something PLA and ABS cannot tolerate. It has a negative tendency though of squeezing material out of the extruder in directions other than the nozzle. TPC is another flexible 3D printer filament suitable for outdoor use.

### **3D Printer Filament #8: Glow-in-the-dark Filament**

I'm sure you've seen those glow-in-the-dark stars. Well, they were made with this type of filament. Depending on what color material is used, one can have many glowing colors across the spectrum, from green all the way

to orange. This filament, when based on PLA material is considered non-toxic, but is not food safe. It is used in Halloween themes, as well as in enhancing low light conditions. It is ideal for toys, phone cases, novelty items and wearables.

### **3D Printer Filament #9: HIPS - High Impact Polystyrene**

High Impact Polystyrene or HIPS, is used as packaging material in the food industry. HIPS has a bright white color and is biodegradable. A positive for HIPS is that it has no unpleasant effects on humans and pets. HIPS is a bit different from all other 3D printing filaments, in that it is not used to fabricate or create an object. Instead it is used to provide structure and support.

### **3D Printer Filament #10: Lignin Filament – Biofila**

The Lignin Filament is made from renewable sources by a German company called twoBEars. It uses no animal products, but instead uses lignin which is a component of wood. This is a strong filament with a silky appearance and a great feel. It is used for parts that need to look shiny. It is as easy to print with as with PLA.

### **3D Printer Filament #11: Magnetic Filament**

Magnetic Filament is PLA mixed with powdered iron. This combination creates a grainy metallic finish. It has the added advantage of sticking to magnets. This filament is ideal for fridge ornaments. It is highly durable and depending on the design can be more rigid than flexible.

### **3D Printer Filament #12: Nylon (Polyamide)**

Nylon is a very popular 3D filament. It is affordable, strong and light. It is also less brittle than PLA or ABS, yet more stronger and tougher than both of them. It is used in a wide variety of applications including machine parts, tools, toys, consumer products and such. Using fabric dye you can create various, strong multi-colored products. It has the tendency though to absorb humidity, which could spell trouble for your printing performance. The manufacturing company Taulman has manufactured different types of nylon, used especially in prototyping.

### **3D Printer Filament #13: PETG - PET & Glycerol**

PETG which stands for PET (PolyEthylene Terephthalate) and Glycerol is a newcomer to the market, and is made from PET and glycerol, as the name implies. It is also famously marketed as Amphora AM1800 by Eastman Chemical. A plus point for PETG is that it was specially manufactured for 3D printing. Other thermoplastic 3D printer filaments are re-purposed to fit 3D printing. It portrays good strength, durability and high flexibility. It is good for the environment as it produces little to no odors during the printing process. PETG was also approved by the US FDA (Food and Drug Administration). It is used to produce mechanical parts due to its high impact resistance and its toughness.

### **3D Printer Filament #14: PLA**

Polylactic acid or PLA has now become the favorite 3D printer filament, overtaking ABS. The enthusiasm amongst hobbyists is largely due to the fact that it is a biodegradable thermoplastic made from renewable resources such as corn starch or sugar cane. It is environmentally friendly and thus is even referred to as “the green plastic”. Another great plus point for PLA is that it does not give off the same pungent smell like the sort given off by ABS, and is thus safer for your health and for the environment. The material also doesn’t contract so much when cooling down, and thus a heating bed is not so much of a necessity.