11 Materials

Temperatures and the heatbed treatment before a print according to a specific material.

11.1 ABS

ABS is a very strong and versatile material with **great thermal resistance**. It's suitable for both indoor and outdoor use

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ABS is a thermoplastic polymer; that means that just like PLA, it can be melted and crystallized multiple times without degrading too much. ABS, however, melts at a higher temperature than PLA. Higher melting temperature gives ABS great thermal resistance; your prints won't show signs of deformation **up to 98 °C**.

ABS includes high wear-resistance synthetic rubber, which makes it **very strong and impact resistant**. And last but not least, it's **soluble in acetone**! This makes it really easy to not only connect multiple parts together but also allows you to **smooth prints** with acetone vapors. You still have to be careful when handling acetone, but it's not anywhere near as dangerous as for example PLA solvents.

The best use of ABS is for architectural models, concept models, spare parts (car interior, gears, phone cases), etc.

On the other hand, thermal contraction is where ABS makes it really hard to successfully print something. And that's especially true when printing anything big. Even with the heatbed at 100 °C, your part may start lifting from the build plate and warp. This, and the **unpleasant smell** of ABS, is why you should consider getting an enclosure for your printer when printing with ABS. Or at least place the printer in a warm room.

If you need to use your print outside, or just need your print stronger, give ABS a shot. After all, it's what **LEGO** is made of.

ADVANTAGES	DISADVANTAGES
High impact and heat resistance	Bad smell
Strong and versatile	Worse resolution
Soluble in acetone (easy post-processing)	Needs warm room or enclosure
Can be vapor smoothed	

- **Nozzle temperature:** 255 °C
- **Bed temperature:** 100 °C. You can set the bed temperature between 80 to 110 °C depending the size of an object (larger object means higher temperature)

- **Heatbed:** Make sure the surface is clean as described in 6.3.2 PEI print surface preparation chapter

11.2 PLA

PLA is the most commonly used filament. It's **biodegradable**, **easy to print**, and a very **strong** material. The perfect choice for printing **large** objects thanks to its low thermal expansion (little to no warping) and for printing **tiny** parts because of its low melting temperature. **Only this material is proven for 50 microns layer height.**

PLA has a relatively low melting temperature of about 175 degrees Celsius. Unlike so-called thermoset materials, PLA can be heated past its melting point multiple times with very little degradation. It's also very hard material, but that also means it's somewhat brittle, and once it breaks, it likes to shatter.

The best use of PLA is for printing concept models, prototypes, low-wear toys, etc.

However, PLA is not a perfect material and, just like every other plastic, has some disadvantages. The low melting temperature also means **low-temperature resistance**. Parts start to lose mechanical strength at temperatures over **60 °C**.

The combination of being both biodegradable and having low-temperature resistance means that it's **not ideal for outdoor use**, not to mention low UV-resistance. Also, PLA is only soluble in chemicals like chloroform or hot benzene. So when connecting multiple pieces, you're better off just using glue.

Even though PLA is biodegradable, and the material on its own is food safe, we do not suggest to repeatedly **drink or eat from your 3D prints**. Because of the small fractures on the print surface, bacteria can build up in there over time. You can prevent this by applying a food-safe coating. When **post-processing PLA**, it's better to use wet sanding. Without water you'll quickly start heating the plastic by friction, it will melt locally and make it hard to keep sanding.

ADVANTAGES	DISADVANTAGES
Easy to print	Brittle
Can print tiny parts	Low temperature resistance
Can print huge objects	Difficult post-processing
Hard and stiff	
Low warping	
Environmentally friendly	

- **Nozzle temperature:** 215 °C
- **Bed temperature:** 50 - 60 °C
- **Heatbed:** Make sure the surface is clean, as described in 6.3.2 PEI print surface preparation chapter

11.3 PET/PETG

PETG is a very tough material with good thermal resistance. It's universal but suitable especially for mechanical parts and both indoor and outdoor use. PETG has almost **no warping**, so printing large objects isn't a problem. We use PETG to print parts for our printers!

PETG is one of our favorite materials for 3D printing. It's almost as easy to print as PLA, but it can offer many mechanical properties that PLA prints just cannot achieve.
The G in the acronym PETG stands for Glycol which is added during the manufacturing process. Glycol modifies the properties of PET, so that it's **easier to print, less brittle and clearer** when printing with semi-transparent variants. PETG has low thermal expansion, so even when printing big objects, and without an enclosure, it rarely lifts from the bed and warps. In addition to that, PETG is **ductile**. It has a healthy amount of flex which can prevent parts from breaking under stress.

Unlike PLA or ABS, PETG tends to ooze a bit and may leave **strings of plastic** on your print. You can fight this with increasing retraction and playing with hotend temperature, but if you use our filament presets in **Slic3r or Prusa Control**, we already did that for you and the amount of stringing is minimal. If you witness a tiny bit of stringing anyway, you can get rid of it by quickly blasting your finished prints with a heat gun.

PETG sticks very well to PEI, which is generally a good thing. But sometimes it could stick a little bit too well and you could rip a piece of PEI from the bed, so you should use a **separating agent** (e.g. gluestick).

If you can handle the oozing and strong adhesion, you'll be left with a very durable print, that is considerably temperature resistant and usable for both indoor and outdoor use.

ADVANTAGES	DISADVANTAGES
Easy to print	Possibility of stringing
Good layer adhesion	Not soluble in acetone
Very tough, low warping	Prone to scratches
Temperature resistance	
Little shrinking	
Durable	

- **Nozzle temperature:** 240 °C
- **Bed temperature:** 80 - 100 °C
- **Heatbed:** Make sure the surface is clean, as described in 6.3.2 PEI print surface preparation chapter. Do not use isopropyl alcohol to clean the bed, or the adhesion may be too strong, if you do not have anything else on hand use the bundled glue as a separator after cleaning it. Windex or similar windows cleaner is a great option for PET and you don't need to use the glue after the cleaning. Pour a little amount on an unscented paper towel and wipe the print surface.

11.4 HIPS

HIPS is high impact polystyrene, and as for behavior, it's similar to ABS, so it's easy to print. It's a universal and stable material with excellent heat resistance, and it produces very smooth layers. HIPS is also very malleable, and it can be dissolved using limonene. HIPS is mostly suited for printable mechanical components.

ADVANTAGES	DISADVANTAGES
Smooth	High level of warping
Durable	Bad smell
Soluble	

- **Nozzle temperature:** 220 °C
- **Bed temperature:** 100 °C. You can set the bed temperature between 80 to 110 °C depending the size of an object (larger object means higher temperature)
- **Heatbed:** Make sure the surface is clean, as described in 6.3.2 PEI print surface preparation chapter

11.5 PP

Polypropylene is a flexible and resistant material suitable for printing of precise objects requiring the flexibility, firmness and persistence.

ADVANTAGES	DISADVANTAGES
Tough	High level of warping
Semi-flexible	
Temperature resistance	

- **Nozzle temperature:** 254 °C

- **Bed temperature:** 95 - 100 °C.
- **Heatbed:** The best results are obtained with common scotch tape - just attach the tape directly to the print surface and clean it after the print is finished.

11.6 Nylon (Taulman Bridge)

Nylon is a very tough material suitable for mechanical parts.

ADVANTAGES	DISADVANTAGES
Durable	Demanding storage (it's hygroscopic)
Chemically resistant	
Flexible, but strong	
Chemical resistance	

- **Nozzle temperature:** 240 °C
- **Bed temperature:** 80 - 90 °C.
- **Heatbed:** Use one coat of glue stick. Clean as described after the print.

11.7 Flex

Flex is a very strong and flexible material. There are many use cases where hard plastic is not the ideal or even unusable at all. But whether you need a phone cover, an action camera case or wheels for your RC car, flexible is the way to go.

Before you start printing from Flex, clean the nozzle from the previous material - preheat the nozzle and load PLA to remove any other previous material. When loading Flex, loosen the extruder (idler) screws. Keep in mind that when printing from Flex, the automatic filament change function may not work properly.

Flex has very good abrasion resistance, remains flexible in cold environments, and is resistant to many solvents. It doesn't shrink much when cooling down, so you can be fairly accurate with your measurements and perfect fit models.

ADVANTAGES	DISADVANTAGES
Flexible and elastic	Needs extra steps when loading filament
Little shrinking	Can be tricky to print
Good layer adhesion	Needs to be printed slowly

- **Nozzle temperature:** 230 °C

- **Bed temperature:** 50 °C. You can set the bed temperature up to 65 °C depending on the size of an object. (larger object means higher temperature)
- **Heatbed:** Make sure the surface is clean as described in 6.3.2 PEI print surface preparation chapter. Some very soft flex materials can bond to the bed too much and require use of glue on the bed as a separator to prevent PEI damage.

11.8 Composite materials

Composite materials (woodfill, copperfill, bronzefill, glow-in-the-dark, carbon or aramid composites and many others) consist of a main plastic base and a second material in the form of dust. These materials tend (except for wood composites) to be very abrasive, therefore a hardened nozzle is strongly suggested for long-term printing. A larger nozzle is recommended while printing with wood composites (0.5 mm and up). Please use corresponding print settings in Slic3r or PrusaControl as print parameters can be very different depending on the plastic base.

The first step in polishing is sanding. It's a good idea to start with a coarse grit size (80) and slowly move up the grit table. After sanding, a big improvement in polish can be achieved with steel wool or a brass brush. If you're still not happy with the finish, you can try wet sanding with a very fine grit (1500).

ADVANTAGES	DISADVANTAGES
Easy to print	Needs hardened nozzle
No warping	
Great look after post-processing	

- **Nozzle temperature:** 190 - 210 °C
- **Bed temperature:** 50 - 70 °C (bigger object -> higher temp.)
- **Heatbed:** Make sure the surface is clean as described in 6.3.2 PEI print surface preparation chapter.

11.9 ASA

Acrylonitrile-styrene-acryl (ASA) is a material with properties similar to ABS, its main benefit is increased weather and UV resistance. Another advantage is overall dimensional stability. To achieve a cast-like surface, acetone smoothing can be used…

ADVANTAGES	DISADVANTAGES
Heat and UV resistant	Bad smell
Soluble in acetone (easy post-processing)	High level of warping
Can be vapor smoothed	

- **Nozzle temperature:** 270 - 280 °C
- **Bed temperature:** 100 - 110 °C (bigger object -> higher temp.)
- **Heatbed:** Make sure the surface of the heatbed is clean. Usage of brim is suggested (see Prusa Knowledgebase).

11.10 nGen

Developed by Eastman Chemical Company and colorFabb, nGen offers increased resistance to heat as well as dimensional stability. The material is low-odor and styrene-free.

ADVANTAGES	DISADVANTAGES
High gloss	Brittle
Good surface finish	A bit of warping
Good layer adhesion	

- **Nozzle temperature:** 240 °C
- **Bed temperature:** 80 - 100 °C (bigger object -> higher temp.)
- **Heatbed:** Make sure the surface is clean. Do not use isopropyl alcohol to clean the bed, or the adhesion may be too strong, use window cleaner instead. If you do not have anything else on hand use the bundled glue as a separator after cleaning it. Windex or similar window cleaner is a great option for nGen and you don't need to use the glue after the cleaning. Spray a small amount on an unscented paper towel, and wipe the print surface.