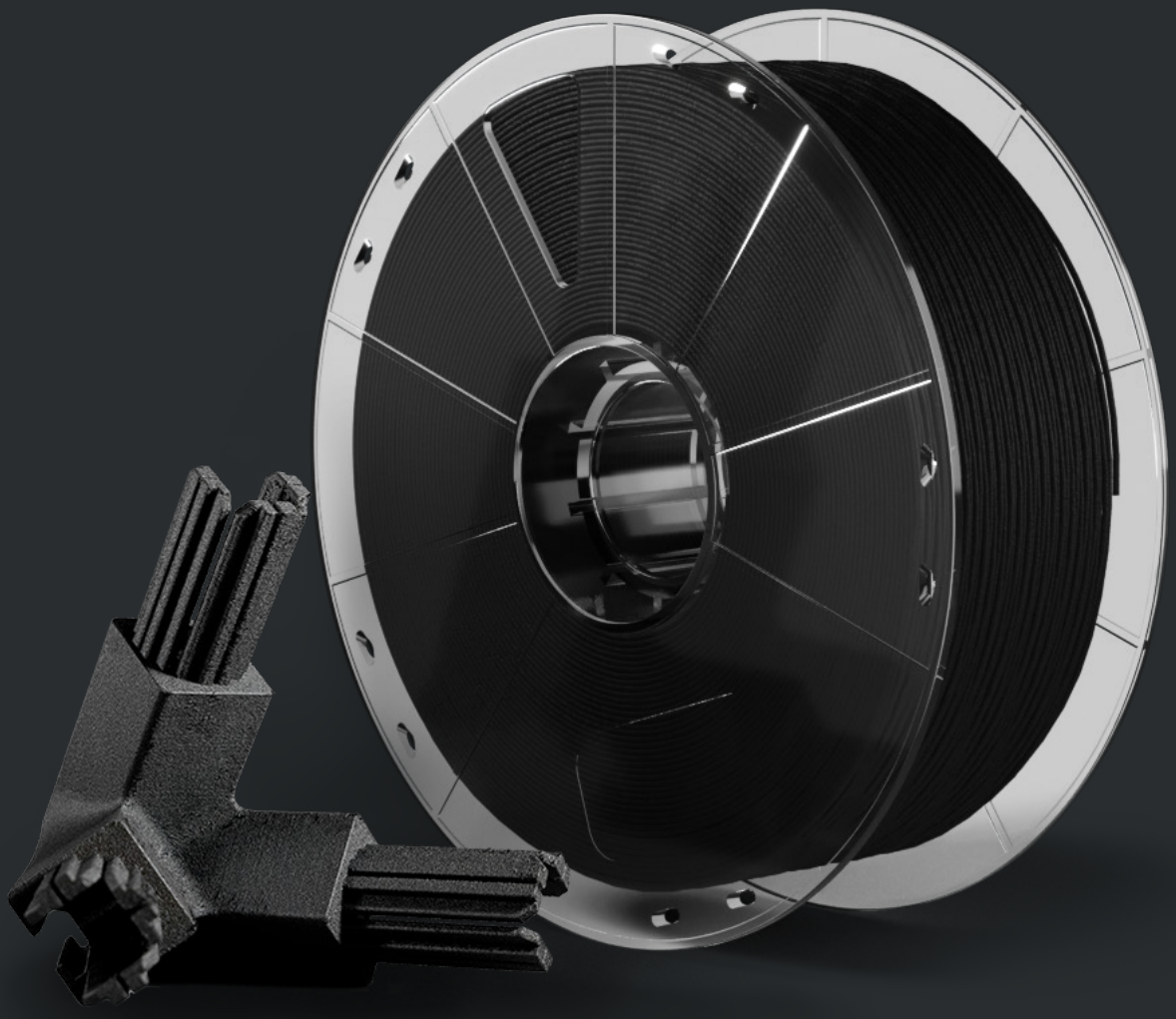
Mosaic

3D Printed Materials Guide

A complete guide on using Mosaic materials for FFF printing



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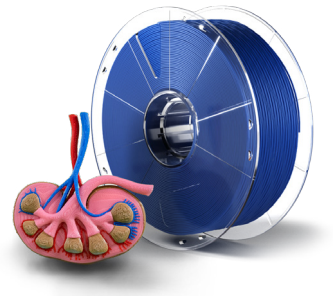
An Introduction

The manufacturing of parts using FFF 3D printing has become more and more prevalent with the increased affordability and availability of 3D printing technology.

Gone are the days of exclusively using 3D printing as a method of rapid prototyping - print farms are a means of full scale production using affordable and cost effective additive manufacturing. The idea of a print farm is to be able to produce a large quantity of printed parts in the most efficient way possible. This requirement of efficiency means that aspects like throughput, cost per part, labour requirements and physical footprint are all key indicators of how well a print farm will perform. Each individual printer in the farm is designed to operate independently from the others, but runs in parallel, in order to capitalize on the maximum possible uptime and high part throughput that FFF technology offers. Coupling this parallel production approach with environmentally friendly and cost effective materials, 3D printing with FFF technology has cemented itself as a viable alternative to large scale production.

Mosaic Pro PLA

Stiff, Vibrant, Biodegradable



Printability:	★ ★ ★ ★ ★
Strength:	★ ★ ★
Rigidity:	★ ★ ★
Durability:	★ ★
Colors:	★ ★ ★ ★ ★
Price:	★ ★ ★ ★ ★

Brief Description

Mosaic PLA is an environmentally friendly biopolymer-based material. It is stiff, easy to print and available in a wide variety of vibrant colors.

Strength	**Tensile Strength** 41 MPa	✓
Regidity	**Tensile Modulus** 3200 MPa	✓
Heat Deflection	**Heat Deflection Temperature** 50°C	✓
Elongation	**Elongation at Break** 2%	✓

Key Features

- ✓ Easy to print
- ✓ Stiff
- ✓ Colour variety
- ✓ Low thermal resistance
- ✓ Economical

Sample Applications

- ✓ Rapid Prototyping
- ✓ Architectural models
- ✓ Figurenes
- ✓ Toys
- ✓ Cosmetic parts

Detailed Description

PLA is the most widely used polymer in the 3D printing world, and for good reason. It is economical, easy to print, and available in almost every colour. PLA is derived from renewable sources, such as corn starch and sugar cane, which makes it more environmentally friendly than the alternatives. This also makes it biodegradable under the right conditions.

PLA is characterized as being stiff but brittle. This means that it doesn't easily bend but is prone to fracture under impact. It also has a relatively low thermal resistance, causing it to deform at temperatures exceeding ~50°C. The combination of these factors makes PLA unsuitable for engineering applications. However, owing to its aesthetics and ease of printing, PLA is uniquely well suited for the production of prototypes, architectural models, figurines, toys, and the like. Given its ease of use, it is also well suited for printing in Element and Array, but will also play nice with virtually any FFF machine it runs through. Mosaic's own PLA comes in a wide array of colours in nice matte finishes giving users superior aesthetic options.

Technical Printing Guidelines

- Hot End temperatures of 190-210°C are recommended. No specialized nozzle required
- Print speed of 40 - 100mm/s are recommended for most applications
- Part Cooling Fan Speed: 100%
- Recommended Build platform materials: PEI, glass, glue stick or blue painters tape
- Although a heated build plate is not required, setting it to 45°C will help with bed adhesion

Tips/Facts

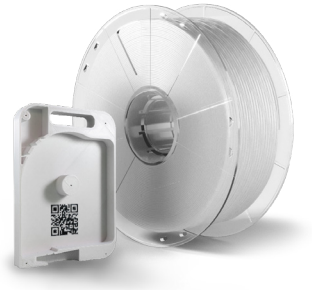
- PLA often has a slightly sweet (non-toxic) aroma when printing, making for a pleasant printing experience
- PLA filament can become brittle over time if exposed to moisture. To restore your filament, dry it at 45C for 4 hours / 500g

Recommended Printing Applications

- Pro PLA is the recommended material for applications with minimal wear and tear
- Low cost and ease of printing make PLA well suited for learning applications in camps, libraries, highschools or postsecondary institutions
- Owing to its aesthetic properties, PLA is also well suited for costume making, toy making and the production of miniatures/figurines

Mosaic ABS

Strong, Stiff, Durable



Printability:	★ ★ ★ ★
Strength:	★ ★
Rigidity:	★ ★ ★
Durability:	★ ★ ★ ★
Colors:	★ ★ ★
Price:	★ ★ ★ ★

Brief Description

Mosaic ABS is a lightweight material with high impact resistance. These characteristics, combined with a high heat deflection temperature, make Mosaic ABS suitable for use in a variety of applications and environments.

Strength	**Tensile Strength** 40 MPa	✓
Regidity	**Tensile Modulus** 2068 MPa	✓
Heat Deflection	**Heat Deflection Temperature** 103°C	✓
Elongation	**Elongation at Break** 8%	✓

Key Features

- ✓ Lightweight
- ✓ Durable
- ✓ Tough
- ✓ Heat Resistant
- ✓ Excellent Surface Quality

Sample Applications

- ✓ Tools
- ✓ Figurenes
- ✓ Toys
- ✓ Car Parts (interior)

Detailed Description

In today's market, there is an ever increasing selection of materials that are available for 3D printing. In the early days, however, ABS was one of the only options available. Despite its long tenure and the interim advances in material science, ABS is still widely used. This is owing to its high performance relative to its cost.

ABS is characterized by high impact strength and thermal resistance, making it suitable for functional end-use parts. Where ABS lacks is in its tensile strength and ease of processing. ABS is notorious for warping as a result of thermal stresses introduced during the printing process. Additionally, molten ABS gives off styrene fumes which are both unpleasant and unsafe for long-term exposure.

Despite its shortcomings, ABS is often a good option for applications which require better mechanical or thermal performance than PLA, but don't necessitate the use of the higher cost engineering-grade polymers. The pitfalls of ABS can be overcome through the use of build plate adhesives, regulation of the temperature in the ambient environment and proper ventilation to eliminate fumes. Fortunately, Mosaic's Element 3D printer is fully enclosed, which helps to mitigate drafts that can exacerbate warping. Mosaic's Element HT and Array platforms benefit from the addition of an actively heated chamber which serves to further reduce the thermal gradients and thus the warp-inducing thermal stresses. Both Mosaic's Element line and Array line have integrated air filtration which reduces the prevalence of ABS fumes.

Technical Printing Guidelines

- Hot End temperatures of 210-230°C are recommended. No specialized nozzle required
- Print speeds close to 60mm/s are recommended for most applications.
- Part Cooling Fan Speed: Not Required, ABS should be left warm while printing in order to promote interlayer adhesion and prevent warping.
- Recommended Build platform materials: PEI or a tacked surface.
- Heated bed Required and Temps of 90-120°C are recommended.
- Enclosure: Recommended but not required.

Tips/Facts

- ABS prints can be sanded to decrease the prevalence of layer lines.
- ABS filament has lower moisture uptake than other thermoplastics, which increases its shelf life.

Recommended Printing Applications

- ABS is the recommended material for or high temperature applications, thanks to it's high thermal resistanceABS' lower price point and relative ease of printing make it well suited for making cost-effective casings and housings.

Mosaic ASA

Durable, Waterproof, Resistant

Printability: ★ ★ ★ ★
Strength: ★ ★ ★
Rigidity: ★ ★ ★
Durability: ★ ★ ★ ★ ★
Colors: ★ ★ ★
Price: ★ ★ ★ ★

Brief Description

Mosaic ASA has excellent mechanical properties, similar to those of ABS. This material has the added benefit of being UV stable, making it suitable for outdoor use.

Strength	**Tensile Strength** 47.5 MPa	✓
Regidity	**Tensile Modulus** 2020 MPa	✓
Heat Deflection	**Heat Deflection Temperature** 96°C	✓
Elongation	**Elongation at Break** 15%	✓

Key Features

- ✓ UV Resistant
- ✓ High Thermal Resistance
- ✓ Durable
- ✓ Tough
- ✓ Hydrolytic Stability

Sample Applications

- ✓ Tools
- ✓ Garden Equipment
- ✓ Planters
- ✓ Signage
- ✓ Automotive
- ✓ Marine

Detailed Description

ASA can be thought of as the new and improved version of ABS. It inherits all of the great strength properties of ABS, while offering the same level of heat resistance and the added benefit of UV light resistance. Its stronger impact strength and heat resistance make it a better choice than ABS for the manufacture of end use parts and similar applications. Its UV resistance also means it can be used for outdoor fixtures, or even vanity applications in textile/sunglasses production.

Unfortunately, ASA has inherited some of the prevalent issues from its older sibling, ABS. Namely the tendency to warp in unregulated print chambers and potentially dangerous fumes emitted by the heated thermoplastic from the ever present styrene component. All Mosaic print chambers are built with fumigation in mind, and extraction hookups can be found on both machines. Minimising exposure is still recommended. Additionally, considering it's relative newness and refinement over ABS, it comes in at a slightly more expensive price point.

Technical Printing Guidelines

- Hot End temperatures of 225-250°C are recommended. No specialized nozzle required.
- Print speeds close to 60mm/s are recommended for most applications.
- Part Cooling Fan Speed: Not Required, as with ABS, ASA should be left warm while printing in order to promote interlayer adhesion and prevent warping.
- Recommended Build platform materials: PEI, Tape or a tacked surface.
- Heated Build Plate Required and temps of 90-120°C are recommended.
- Enclosure: Recommended but not required.
- For the best repeatable result, clean your nozzle after every use.

Tips/Facts

- It's high chemical solubility means that ASA will also take well to vapour smoothing, allowing users to potentially increase the final aesthetic finish of the printed part.
- UV resistance is unique to ASA and makes it better than ABS for most outdoor applications.

Recommended Printing Applications

- ASA is the recommended material for outdoor applications in regions with a lot of sunlight, thanks to it's UV resistance. This could be anything from exterior signage to car parts.
- ASA is also a newer relative of ABS, making it a suitable alternative to ABS and any of its applications.

Mosaic PETG

Glossy, Flexible, Odorless

Printability:	★ ★ ★ ★ ★
Strength:	★ ★ ★
Rigidity:	★ ★
Durability:	★ ★ ★ ★
Colors:	★ ★ ★ ★
Price:	★ ★ ★ ★ ★

Brief Description

PETG is a commonly used alternative to PLA, ABS, and ASA, offering higher strength and environmental durability. It is also odor neutral, has high relative flexibility, is BPA friendly and food safe, making it well suited for a great deal of applications.

Strength	**Tensile Strength** 50 MPa	✓
Regidity	**Tensile Modulus** 2020 MPa	✓
Heat Deflection	**Heat Deflection Temperature** 70°C	✓
Elongation	**Elongation at Break** 23%	✓

Key Features

- ✓ Strong
- ✓ Flexibility
- ✓ BPA Free, FDA Compliant
- ✓ Low Shrinkage

Sample Applications

- ✓ Mechanical Parts
- ✓ Food Storage Containers
- ✓ Snap-fit enclosures
- ✓ Compliant Mechanisms

Detailed Description

Representative of the “perfect” balance of technical quality, ease of use and price, PETG has become an increasingly popular print material due its versatility. Derived from PET, a commonly used plastic for the manufacture of bottled water and other liquid containers, PETG has inherited its FDA compliance and BPA-friendly food safe characteristics. PETG is also resistant to both impact and warpage when printing.

Although it provides a comparable technical showing, it doesn’t truly excel at overall strength and rigidity, where higher grade materials like PEEK and CF Nylon still reign supreme. PETG is effectively a jack of all trades but a master of none. Difficult bridging and stringing are commonplace when working with PETG, easily removed in post-processing but still worth noting as an additional drawback. It’s also important to note that PETG exhibits a unique glossy finish with semi-translucence, which has high aesthetic appeal but makes it more prone to surface wear and scratching.

Despite all of the above, PETG still provides the ultimate flexibility for entry level to mid grade options. It’s incredibly easy to print with and has a higher melting point than PLA or other cost friendly materials. Mosaic PETG provides a wide range of colours to best suit a number of applications or aesthetic needs. Mosaic PETG will print near-flawlessly in Element, Element HT, Array, Array XT or with any Palette equipped 3D printing system, so long as the hot end can reach ~240°C. It is also optimized to produce the best final print quality while reducing any potential wear on print heads or internal components.

Technical Printing Guidelines

- Hot End temperatures of ~245°C are recommended. No specialized nozzle required.
- A maximum print speed around 90mm/s is recommended for most applications
- Part Cooling Fan Speed: Not Required
- Recommended Build platform materials: Glue Stick or Painters tape for optimal adhesion.
- Heated bed Not required but Temps of 75-90°C are recommended to further promote adhesion/
- Enclosure: Not required
- For the best repeatable result, clean your nozzle after every use.

Tips/Facts

- A carefully calibrated print head will reduce spider webs or stringing common with PETG. Mosaic printers will optimize this automatically, but parameter adjustment is also recommended on 3rd Party printers for best final print quality.

Recommended Printing Applications

- BPA free and FDA approved as Food Safe means you can store food in PETG printed containers, as long as the nozzles are cleaned after using Non-BPA/Food Safe Materials
- PETG is a good all rounder and its lower cost also means it can be used in the place of materials like ABS and ASA in printing environments like schools and libraries.

Mosaic Flex (TPU)

Flexible, Durable

Printability: ★ ★
Strength: ★ ★
Rigidity: ★
Durability: ★ ★ ★ ★ ★
Colors: ★
Price: ★ ★ ★

Brief Description

Mosaic TPU is a flexible material with incredibly high elasticity, almost like rubber.

Strength	**Tensile Strength** 50 MPa	✔
Regidity	**Tensile Modulus** 150 MPa	✔
Heat Deflection	**Heat Deflection Temperature** 138°C	✔
Hardness	**Shore Hardness** 98A	✔

Key Features

- ✓ Strong
- ✓ Flexibility
- ✓ BPA Free, FDA Compliant
- ✓ Low Shrinkage

Sample Applications

- ✓ Mechanical Parts
- ✓ Food Storage Containers
- ✓ Snap-fit enclosures
- ✓ Compliant Mechanisms

Detailed Description

The family of Thermoplastic Elastomers (TPE, or TPU in our case) represent a unique corner of the additive manufacturing and 3D printing space. Unlike most of the other materials, where characteristics like rigidity, stiffness and form retention are of paramount importance, TPU is the polar opposite. It is designed to be springy, pliable and flexible, while still incorporating some degree of hard plastic in order to be printed into a retainable shape. As the example print suggests, Mosaic TPU is designed to be more like a rubber tire and less like a rubber band - a fair degree of “hardness” but still retaining some degree of elasticity. This makes it somewhat easier to work with while still offering the opportunity to capitalize on the classic TPU elasticity.

While its elasticity is perhaps its greatest benefit, it’s not without some sacrifices, specifically in the material’s ease of use. The mixed formula of hard and soft plastics in TPU have made it notoriously hard to print with in the past, and is prone to clogging extruders if print parameters aren’t perfect. Element and Array are both optimized/designed to work well with Mosaic TPU and users of those machines are far less likely to experience any of the typical TPU challenges when working with either system. The level of variations in TPU formuli also mean that your printer effectively needs to be calibrated exactly to that specific material, otherwise filament pulling, kinking, coiling, and under extrusion are commonplace. Mosaic’s Element and Array systems are calibrated automatically and will mitigate a lot of these issues, but it’s important to test and try a number of parameters before printing TPU in a 3rd Party system. Mosaic’s Element and Array systems also use a direct drive extrusion system, that generally plays nice with TPU, as compared to Bowden drive systems.

TPU is the perfect fit for unique applications like textile manufacturing, or creating wheels, belts, bands or gaskets with specific tolerances. Its rubber-like nature also makes it the ideal choice for producing protective casings for true shock absorption.

Technical Printing Guidelines

- Hot End temperatures of 220°C-240°C are recommended. Direct Drive extruders recommended for optimal printing.
- Print speeds less than 70mm/s are recommended for most applications.
- Part Cooling Fan Speed: Lower speeds around 10-50% are recommended.
- Recommended Build platform materials: PEI or Painters tape for optimal adhesion.
- Heated bed Not required, but temps of 50-65C are recommended to further support adhesion/ removal.
- Enclosure: Not required.
- Lower layer heights in the 0.1mm range can help prevent typical TPU binding issues.

Tips/Facts

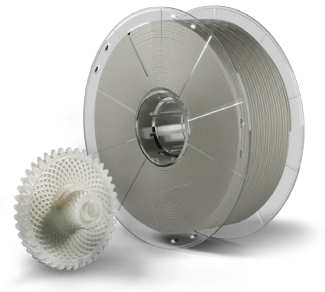
- Feed rates, retraction settings and travel movement parameters are all vitally important to ensuring the success of your print. Consult your printer’s manual or our support centre before use with Mosaic TPU. Element and Array printers will automatically calibrate for ideal printing with our TPU formula.

Recommended Printing Applications

- TPU is the go-to material for recreating flexibility in 3D printed objects.
- For industrial printing, TPU is great for making orthopedics, prosthetics or common engineering components like belts, tires or gaskets.

Mosaic Nylon 6

Strong, Lightweight, Durable



Printability: ★ ★ ★ ★
Strength: ★ ★ ★ ★
Rigidity: ★ ★ ★
Durability: ★ ★ ★ ★ ★
Colors: ★
Price: ★ ★ ★

Brief Description

Mosaic Nylon is a versatile material with good flexibility, wear resistance and high strength-to-weight ratio. Nylon typically needs a heated chamber that is locked behind expensive professional/industrial machines, Element and Element HT makes it more accessible than ever!

Strength	**Tensile Strength** 50 MPa	✓
Regidity	**Tensile Modulus** 2120 MPa	✓
Heat Deflection	**Heat Deflection Temperature** 104°C	✓
Hardness	**Elongation at Break** 15%	✓

Key Features

- ✓ Durable
- ✓ Self-lubricating
- ✓ Flexibility
- ✓ High Strength-to-weight ratio
- ✓ Hygroscopic

Sample Applications

- ✓ Prosthetics
- ✓ Gears
- ✓ Jigs and Fixtures
- ✓ Mechanical Components
- ✓ Structural Parts

Detailed Description

Nylon materials, also referred to as Polyamide, are a very popular class of 3D printing materials in the light industrial and professional spaces. Once again being a paragon of versatility, Nylon brings with it enhanced durability, flexibility and a high strength-to-weight ratio when compared to materials like PETG and ASA. As a result, it is a more expensive material to work with; however, it carries with it the additional benefits of being self-lubricating and safe for medical use. This makes it uniquely suited for internal applications in medicine, dental or prosthetic manufacturing. In terms of other "Light Industrial Materials" it also still offers a very attractive feature-to-price ratio for general part manufacturing as well as being strong enough for most mechanical jigs and fixtures.

Although an incredibly robust material in terms of beneficial characteristics, its greatest recognizable shortcoming is in its relatively high hygroscopicity when compared to other print materials. While all thermoplastics are prone to some degree of moisture absorption over time, Nylon is generally on the higher end of that scale, and requires careful storage prior to printing. The benefit of using Mosaic Nylon with Mosaic's Element and Array systems is that our Material Pods are designed with this principle in mind, and will prevent moisture from entering any and all contained filaments. For 3D printer setups in which the filament spool is normally exposed and not kept in a dry box he ambient environment should have low humidity and moisture, or else layer adhesion and surface quality issues are likely to occur in the final print. A heated build plate and enclosure around the build platform, like those on Array and Element, are required when working with Nylon, in order to promote first layer adhesion and prevent warping

Technical Printing Guidelines

- Hot End temperatures of 220°C-240°C are recommended. SS Nozzles are recommended to maximize nozzle longevity/printer uptime.
- Print ~60mm/s are recommended for most applications. Avoid speeds higher than 100mm/s to prevent under extrusion.
- Part Cooling Fan Speed: Cooling fan not required.
- Recommended Build platform materials: PEI or Glue Stick for optimal adhesion.
- Heated bed Not required, but temps of 70°C-90°C are recommended to further support adhesion/removal and prevent warping.
- Enclosure: Highly recommended.

Tips/Facts

- Nylon can be used for "cold-pulls," allowing nylon to pull out any excess material debris in your nozzle by bonding with it when it cools. The self-lubrication means that the cooled nylon can then be manually pulled through a metal nozzle with relative ease.
- Nylon should never be exposed to the air for long periods of time and is one of the materials we recommend you always store in a dry box or Mosaic Material Pod, if you're using Element or Array.

Recommended Printing Applications

- Nylon is the go-to material for most industrial, engineering or automotive applications and can be used to create many common engineering parts.
- Nylon is also Food Contact approved, making it suitable for food-centric applications as well.

Mosaic PC (Polycarbonate)

Tough, Durable, Stable

Printability: ★ ★ ★
Strength: ★ ★ ★ ★
Rigidity: ★ ★ ★
Durability: ★ ★ ★ ★ ★
Colors: ★
Price: ★ ★ ★

Brief Description

Mosaic PC is an extremely tough material boasting high heat resistance, durability and impact resistance, while specializing in having high optical clarity.

Strength	**Tensile Strength** 63 MPa	✓
Regidity	**Tensile Modulus** 2320 MPa	✓
Heat Deflection	**Heat Deflection Temperature** 128°C	✓
Hardness	**Elongation at Break** 120%	✓

Key Features

- ✓ Tough
- ✓ Strong
- ✓ High Thermal Resistance
- ✓ Optical Clarity (clear)

Sample Applications

- ✓ Car Parts
- ✓ High Temp. Environments
- ✓ Light housings
- ✓ Optical Components

Detailed Description

Polycarbonate represents the highest strength material in the sea of light industrial or intermediate 3D printing filaments for Fused Filament Fabrication. Its ultimate strength is higher than that of Nylon-6 and Carbon filled counterparts while offering a moderately higher stiffness level when compared to the former. Polycarbonate's incredibly high toughness and heat tolerance also make it suitable for stringent environmental conditions found in engineering applications. Mosaic PC is also optimized to make the most of PC's typically high optical transmission and clarity, making it the perfect fit for manufacturing applications focused on optical components or light fixtures.

When working with a PC, it's important to have an incredibly high temperature hot end in order to extrude the material consistently. A heated build platform and fully-enclosed, temperature controlled print chamber will significantly reduce any chance of warping, oozing or other common PC print defects. All of Mosaic's printers are capable of working with PC, although the heated build platform and chamber of Element HT and Array will generally help make printing with PC a smoother experience. Also, much like Nylon, PC is also incredibly Hygroscopic and will need to be handled in a moisture controlled environment to prevent bubbling or print defects.

Technical Printing Guidelines

- Hot End temperatures of 220C-240C are recommended. SS Nozzle is also highly recommended
- Print speeds ~50mm/s are recommended for most applications. Avoid speeds higher than 80mm/s to prevent under extrusion.
- Part Cooling Fan Speed: Not required, although using speeds between 10-40% can help with printing overhangs, but it's advised to keep fan speed lower to avoid warping.
- Recommended Build platform materials: PEI or Glue Stick for optimal adhesion.
- Heated bed required, but temps of 80-120C are recommended to further support adhesion and prevent warping.
- Enclosure: Required.

Tips/Facts

- Slightly lower print temperatures can help when working with a PC spool that has absorbed moisture.
- Mosaic PC comes in black, for applications that make the most of the strength benefits of PC, or transparent for applications specializing in optical transmission.

Recommended Printing Applications

- Given it's unique optical properties, PC is well suited for any industrial application where optical clarity is important. This includes things like flashlights, electronic casings or laser and light casings.
- Being an incredibly durable material at a similar price point also means PC is well suited for many of the manufacturing and engineering applications Nylon is commonly used.

Mosaic ESD

Stiff, Conductive

Printability:	★ ★ ★ ★ ★
Strength:	★ ★ ★
Rigidity:	★ ★ ★
Durability:	★ ★
Colors:	★ ★ ★ ★ ★
Price:	★ ★

Brief Description

Mosaic ESD is a specialty material that is electrically dissipative, making it suitable for contact with electrical devices.

Strength	**Tensile Strength** 55 MPa	✓
Regidity	**Tensile Modulus** 2560 MPa	✓
Heat Deflection	**Heat Deflection Temperature** 55°C	✓
Hardness	**Elongation at Break** 10%	✓

Key Features

- ✓ Electrically Dissapative
- ✓ Easy to Print

Sample Applications

- ✓ Housings
- ✓ Jigs and Fixtures
- ✓ Metering
- ✓ Connectors
- ✓ Sensing Applications

Detailed Description

Mosaic ESD was specifically engineered to be electrically dissipative, with a surface resistance of 10^7 - 10^9 Ohms. Components printed with this material won't accumulate static electricity, which can be harmful to sensitive electronics. This property makes Mosaic ESD the ideal choice for metering and sensing applications, electronics enclosures, housings, jigs, fixtures, and much more.

Much like PLA, ESD retains the ease of use and straightforward printing of it's non-conductive cousin. Low shrinkage, warping and simple print parameters all remain. Although not as diverse in colour as our PLA, Mosaic ESD also retains that wonderful surface finish for clean final prints. Most of the other, non-technical properties are found in ESD as well, including it's very low odor, and environmentally friendly plant based composition.

Technical Printing Guidelines

- Hot End temperatures of 210C-230°C are recommended. No Specialized nozzle needed.
- Print speeds <=~60mm/s are recommended for most applications.
- Part Cooling Fan Speed: Not required, although ranges between 50%-100% speed are advised.
- Recommended Build platform materials: PEI or Glue Stick for optimal adhesion.
- Heated bed is not required, but temps of ~30-60°C are recommended to further support adhesion/ removal and prevent warping.
- Enclosure: Not Required.
- Post Print Drying: Let dry for ~4 hours at room temperature for best structural results.

Tips/Facts

- Testing indicates that using higher or lower extruder temperatures can achieve higher or lower conductivity, respectively. It is advised to test ESD prints to see how they work with your specific setup before using final parts for electronic applications.

Recommended Printing Applications

- ESD is a highly specialized PLA that is best for industrial and electrical engineering applications in conveying, metering and sensing.
- Given that it is also similar to PLA, any light industrial uses like the production of jigs, casings and connectors is also a good technical fit. Note that ESD comes in at a higher price point and wouldn't be the most cost effective in lieu of PLA.

Mosaic Matrix (CF Nylon)

Strong, Stiff, Smooth

Printability: ★ ★ ★ ★
Strength: ★ ★ ★ ★
Rigidity: ★ ★ ★ ★
Durability: ★ ★ ★ ★ ★
Colors: ★
Price: ★ ★ ★

Brief Description

Matrix is a proprietary blend of carbon fiber reinforced nylon that is optimized for printing on Element. This material has a high strength-to-weight ratio and excellent wear resistance. The composition of the material has been optimized to yield parts with high aesthetic quality.

Strength	**Tensile Strength** 63 MPa	✓
Regidity	**Tensile Modulus** 3800 MPa	✓
Heat Deflection	**Heat Deflection Temperature** 145°C	✓
Hardness	**Flexural Strength** 84 MPa	✓

Key Features

- ✓ Stiff
- ✓ Strong
- ✓ High Thermal Resistance
- ✓ Low Shrinkage
- ✓ Excellent Surface Quality

Sample Applications

- ✓ Structural Components
- ✓ Mechanical Parts
- ✓ Automotive Parts
- ✓ Brackets
- ✓ Protective Casings

Detailed Description

Mosaic Matrix was specifically designed to offer similar printing qualities found in Nylon materials, but the introduction of carbon fiber improves upon the strength and wear characteristics, improving tensile strength, tensile modulus and flexural strength. As mentioned above, the composition of the material provides an incredibly clean final print and overcome the layer lines. This produces prints with incredible surface finish and arguably the best aesthetic finish across most of the commercially available print materials.

Matrix also retains a lot of the printing characteristics typically found in Nylon, making for a relatively straightforward printing experience on most available printers and an easy transition for those familiar with working with Nylon. Given that Matrix is one of our flagship materials it is also optimized to work with Element and Array, providing the best printing experience straight from the spool.

Technical Printing Guidelines

- Hot End temperatures of 240°C-270°C are recommended. No Specialized nozzle needed.
- Print speeds <=~60mm/s are recommended for most applications.
- Layer Heights should be no lower than 0.2mm to avoid nozzle clogging
- Part Cooling Fan Speed: Not required, although some fan may improve overhang performance. Recommended Build platform materials: PEI, clean bed with isopropyl alcohol prior to printing.
- Heated bed is not required, but temps of ~30-80C are recommended to further support layer bonding and structural properties.
- Enclosure: Not Required.

Tips/Facts

- Unlike typical nylon, CF-Nylon like Matrix trade improved structural and aesthetic qualities for the removal of their FDA approval for food and surgical safety.
- CF reinforced are typically harder on nozzles than non reinforced counterparts, as such hardened steel nozzles like those on Array and Element are recommended for other printing systems.

Recommended Printing Applications

- Mosaic Matrix is ideal for any applications which require light weight and rigidity.
- Carbon fiber reinforced parts, designed to use less material and save weight, are extremely popular in aerospace, civil engineering, the military, and motorsports.

Mosaic Origin (CF PETG)

Stiff, Smooth, Stable

Printability:	★ ★ ★ ★ ★
Strength:	★ ★ ★ ★
Rigidity:	★ ★ ★
Durability:	★ ★ ★ ★ ★
Colors:	★
Price:	★ ★ ★ ★

Brief Description

Origin is a proprietary blend of carbon fiber PETG that is optimized for printing on Element and Array. This material is strong, durable and easy to print. The addition of carbon fiber makes layer lines almost indistinguishable, yielding parts with high aesthetic quality.

Strength	**Tensile Strength** 56 MPa	✓
Regidity	**Tensile Modulus** 5230 MPa	✓
Heat Deflection	**Heat Deflection Temperature** 78.6°C	✓
Elongation	**Elongation at Break** 3%	✓

Key Features

- ✓ Stiff
- ✓ Low Moisture Absorption
- ✓ Low Shrinkage
- ✓ High Surface Quality

Sample Applications

- ✓ Structural Components
- ✓ Mechanical Parts
- ✓ Functional Parts
- ✓ Brackets
- ✓ Protective Casings

Detailed Description

Like Matrix, Mosaic Origin was specifically designed to offer similar printing qualities found in PETG materials, but the introduction of carbon fiber improves upon the core strength and wear characteristics, improving it's tensile strength, tensile modulus and flexural strength. Mosaic Origin is twice as stiff as regular PETG.

As mentioned above, the primary reason for including carbon fiber is to provide an incredibly clean final print and overcome the layer lines typically found on most FFF prints. This produces prints with incredible surface finish and arguably the best aesthetic finish across most of the commercially available print materials. Origin also retains a lot of the printing characteristics typically found in PETG, making for a relatively straightforward printing experience on most available printers and an easy transition for those familiar with working with PETG already. Origin is one of our flagship materials also optimized to work with Element and Array, providing the best printing experience straight from the spool. When printing with CF Reinforced materials, Origin offers a cheaper and easier to print material on a wider array of machines when compared to Matrix.

Technical Printing Guidelines

- Hot End temperatures of 230-250°C are recommended. No Specialized nozzle needed.
- Print speeds <=~60mm/s are recommended for most applications.
- Layer Heights should be no lower than 0.2mm.
- Part Cooling Fan Speed: Not required/no specific recommendations.
- Recommended Build platform materials: PEI Bed, Hairspray as a release agent.
- Heated bed is not required, but temps of ~80°C are recommended to further support bed and first layer adheasion.
- Enclosure: Not Required.

Tips/Facts

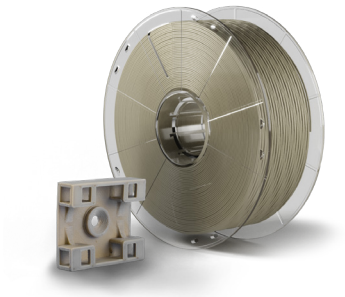
- Unlike typical PETG, CF-PETG like Origin trades improved aesthetic qualities for the removal of their FDA approval for food use. CF reinforced materials are typically harder on nozzles than their non-reinforced counterparts, as such, hardened steel nozzles like those on Array and Element are recommended for other printing systems.

Recommended Printing Applications

- Mosaic Origin is ideal for any applications which require light weight and rigidity.
- Carbon fiber reinforced parts, designed to use less material and save weight, are extremely popular in aerospace, civil engineering, the military, and motorsports.
- One unique use case is for Drone, RC and other high-stress hobbyist environments where light weight and high-strength improve performance.

Mosaic PEEK

Strong, Resilient, Industrial



Printability: ★ ★
Strength: ★ ★ ★ ★ ★
Rigidity: ★ ★ ★ ★ ★
Durability: ★ ★ ★ ★ ★
Colors: ★
Price: ★

Brief Description

Mosaic PEEK is a high performance engineering-grade thermoplastic. Owing to its strength, durability and low flammability, this material has applications in numerous industries, from automotive and aerospace to medicine and dentistry.

Strength	**Tensile Strength** 100 MPa	✓
Regidity	**Tensile Modulus** 3720 MPa	✓
Heat Deflection	**Heat Deflection Temperature** 140°C	✓
Elongation	**Elongation at Break** 28%	✓

Key Features

- ✓ Extremely Strong
- ✓ Extremely Durable
- ✓ Autoclavable

Sample Applications

- ✓ Aerospace
- ✓ Automotive
- ✓ Medical/Dental
- ✓ Gears/Bearings
- ✓ Oil/Gas

Detailed Description

PEEK is an ultra high performance engineering-grade thermoplastic. This material excels at nearly everything, with incredible strength, resistance to a broad range of chemicals, and a high degree of thermal stability. PEEK is also inherently flame resistant, self-extinguishing and boasts long-term hydrolytic stability. The properties of PEEK can be improved even further through post-print annealing in a temperature-controlled oven.

For all of its strengths, PEEK has its share of shortcomings as well, specifically related to its ease of processability. PEEK requires incredibly high nozzle and bed temperatures, as well as an actively heated chamber in order to have success printing this material. For these reasons, PEEK printing is exclusive to Element HT and Array XT. Additionally, PEEK is one of the most costly materials to print with, and for the sake of cost-effectiveness other light industrial materials are recommended in place of PEEK unless a specific high stress use case for the material is recognized prior to printing.

Technical Printing Guidelines

- Hot End temperatures of 375-410°C are recommended.
- Print speeds <=50mm/s are recommended for most applications.
- Layer Heights should be no lower than 0.2mm.
- Part Cooling Fan Speed: Not required.
- Recommended Build platform materials: high temperature adhesive glue advised.
- Heated beds required, set to temperatures of ~140°C are recommended to further support both bed and first layer adhesion .
- Enclosure: Required, heated chambers also required to be set to 70-140°C.
- Post-print Annealing is recommended in order to obtain maximum part strength.

Tips/Facts

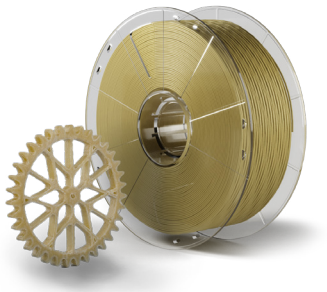
- PEEK is inherently flame resistant and self-extinguishing.
- PEEK also has incredibly low smoke and toxic gas emissions, making it safe to print.
- PEEK parts exhibit high dimensional accuracy making it well suited for mass part production with Array.

Recommended Printing Applications

- PEEK is typically the go-to cost-effective means to print ultimate high stress parts. These parts are also commonly found in Auto, Aerospace and Defense industries, in places like
- engines, helicopter components and jet thrusters.
- PEEK’s excellent thermal properties also make it the go to choice in Oil and Gas industries, where gaskets, primary valves and back up rings need to be incredibly strong.

Mosaic PEKK

Strong, Resilient, Industrial



Printability:	★ ★ ★ ★
Strength:	★ ★ ★ ★ ★
Rigidity:	★ ★ ★ ★ ★
Durability:	★ ★ ★ ★ ★
Colors:	★
Price:	★

Brief Description

Mosaic PEKK is a high performance engineering-grade thermoplastic. Owing to its strength, durability and low flammability, this material has applications in numerous industries, from automotive and aerospace to medicine and dentistry.

Strength	**Tensile Strength** 105 MPa	✓
Regidity	**Tensile Modulus** 3200 MPa	✓
Heat Deflection	**Heat Deflection Temperature** 182°C	✓
Elongation	**Elongation at Break** 10%	✓

Key Features

- ✓ Extremely Strong
- ✓ Extremely Durable
- ✓ Autoclavable

Sample Applications

- ✓ Aerospace
- ✓ Automotive
- ✓ Medical/Dental
- ✓ Gears/Bearings
- ✓ Oil/Gas

Detailed Description

Like PEEK, PEKK belongs to the PAEK family of polymers. PEKK retains the favourable attributes of PEEK, including mechanical, thermal and chemical resistance, while being significantly easier to print. PEKK also has a number of certifications permitting its use in high-stakes industries such as aerospace and defense.

While PEKK has similar attributes to PEEK, the significantly enhanced printability comes with a single sacrifice - price. While it may be the easiest to print of most of the readily available types of industrial grade FFF printing materials, Mosaic PEKK is the most expensive material in our lineup. There is a price to pay for uniformly high printing characteristics.

Technical Printing Guidelines

- Hot End temperatures of 345-375°C are recommended.
- Print speeds 20-50mm/s are recommended for most applications, although higher speeds are possible.
- Part Cooling Fan Speed: Not required.
- Recommended Build platform materials: High Temperature Adhesive glues.
- Heated beds required, set to temperatures of ~120-140°C are recommended to further support layer bonding and structural properties.
- Enclosure: Required, heated chambers also required to be set to 70-140°C.
- As with PEEK, Annealing is recommended in order to obtain maximum part strength.

Tips/Facts

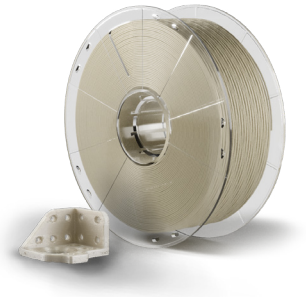
- PEKK is inherently flame resistant and generates little to no smoke.
- Annealing is also recommended to maximize mechanical, thermal and the chemical resistance properties that are a hallmark of this material.

Recommended Printing Applications

- PEKK is the cost-effective means to print ultimate high stress parts. These parts are also commonly found in Auto, Aerospace and Defense industries, in places like engines, helicopter components and jet thrusters.
- PEKK's excellent thermal properties also make it the go to choice in Oil and Gas industries, where gaskets, primary valves and back up rings need to be incredibly strong.

Mosaic PEI 9085 (Ultem 9085)

Strong, Resilient, Industrial



Printability: ★ ★ ★
Strength: ★ ★ ★ ★
Rigidity: ★ ★ ★ ★ ★
Durability: ★ ★ ★ ★ ★
Colors: ★
Price: ★ ★

Brief Description

Mosaic PEI 9085 is a high performance engineering-grade thermoplastic. Owing to its strength, durability and low flammability, this material has applications in numerous industries, from automotive and aerospace to medicine and dentistry.

Strength	**Tensile Strength** 105 MPa	✓
Regidity	**Tensile Modulus** 3200 MPa	✓
Heat Deflection	**Heat Deflection Temperature** 182°C	✓
Elongation	**Elongation at Break** 10%	✓

Key Features

- ✓ Strong and Durable
- ✓ High Chemical Resistance
- ✓ High Thermal Resistance
- ✓ Hydrolytic Stability
- ✓ Dimensional Stability

Sample Applications

- ✓ Jigs and fixtures
- ✓ Aerospace
- ✓ Automotive
- ✓ Electronics
- ✓ Military

Detailed Description

Ultem 9085 falls squarely into the category of high-performance polymers. This material has exceptional dimensional stability, thanks to its low heat creep sensitivity and uniform thermal expansion. Ultem 9085 is flame-retardant, has a high strength-to-weight ratio and is resistant to a wide range of chemicals. These properties make Ultem 9085 suitable for a variety of industrial applications and have earned it numerous certifications from the FAA and other regulatory authorities.

Although Mosaic PEI 9085 has similar technical qualities of PEEK and PEKK, it is less rigid and has lower impact, heat and chemical resistance and its formula sits in a different family of thermoplastics. At a deeper level, PAEK materials like PEEK and PEKK are semi-crystalline and PEI is amorphous in structure. Simply put, that means that PEI is less prone to warping when cooling when compared to PEEK. This plants PEI at a lower price point and yet maintaining a higher level of quality in these key structural fields when compared to Nylon and PC, making it well suited for industrial applications.

Technical Printing Guidelines

- Hot End temperatures of 350-380°C are recommended. Print speeds 20-50mm/s are recommended for most applications, although higher speeds are possible.
- Part Cooling Fan Speed: Not required.
- Recommended Build platform materials: High Temperature Adhesive glues.
- Heated beds required, set to temperatures of ~120-140°C are recommended to further support layer bonding and structural properties.
- Enclosure: Required, heated chambers also required to be set to 70-140°C.

Tips/Facts

- Although not the typical use case for this material, Mosaic PEI 9085 is also FDA approved and food safe (when printed with the proper considerations)
- Stable dielectric constant and dissipation factor over a wide range of temperatures and frequencies, making it perfect for applications in electrical engineering.

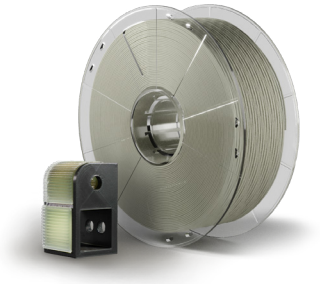
Recommended Printing Applications

- Mosaic PEI may be an excellent material choice for today’s demanding electrical applications, including connectors, MCB components like housings, shafts and levers, hard disk drive internals, FOUPs, BiTS, PCBs, MCCB internals, Plenum devices, LCD projector internals, fuel cell components, and many other applications.
- Excellent thermal properties also make it the go to choice in Aerospace, Automotive and Transportation, leaving PEEK and PEKK for the ultra high demands of Military and Defense manufacturing.

Support Materials

Dissolve LT

Water Soluable



Printability: N/A
Strength: N/A
Rigidity: N/A
Durability: N/A
Colors: ★
Price: ★ ★ ★

Brief Description

Mosaic Dissolve LT is a convenient support material that enables the production of complex geometries and easily washes away in water.

Heat Deflection	**Heat Deflection Temperature** 60.2°C	✔

Key Features

- ✓ Water Soluble
- ✓ Biodegradable

Sample Applications

- ✓ Support Material

Detailed Description

Dissolve LT is a water soluble support filament for use with low temperature materials such as PLA and PETG. Soluble supports enabled the construction of complex geometries while drastically simplifying the post-processing procedure, as compared to same material support. Subsequent to printing, simply place the component in a vat of water and watch as the support structures miraculously dissolve away. Dissolve LT is biodegradable, allowing the aqueous solution of dissolved supports to be safely poured down the drain.

Technical Printing Guidelines

- Hot End temperatures of 180-200°C are recommended. No special nozzle required
- Print speeds ~60mm/s are recommended for most applications, although higher speeds are possible.
- Part Cooling Fan Speed: Not required.
- Recommended Build platform materials: PEI or Painters tape.
- Heated bed not required.
- Enclosure: Not Required

Tips/Facts

- Given the soluble nature of the material, Dissolve LT is an incredibly hygroscopic and should be stored in an airtight and dry environment. For Mosaic Printers like Element and Array, storing the material inside the Material Pod is a viable solution.
- Multi-material printers like Element and Array can combine Dissolve LT with other print materials in a single print job, enabling the production of complex geometries not normally possible in a single print.

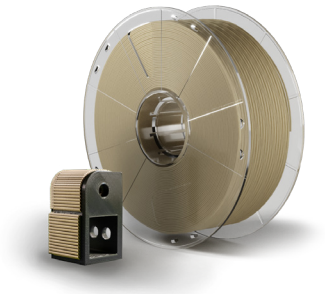
Recommended Printing Applications

- Dissolve LT is best used when printing delicate or intricate structures to avoid breaking segments when performing the structure removal process.
- Given the simple act of submerging a print in liquid, we recommend using Dissolve LT whenever supports are needed to optimize the post-production process.

Support Materials

Breakaway LT

Clean Breakaway



Printability:	N/A
Strength:	N/A
Rigidity:	N/A
Durability:	N/A
Colors:	★
Price:	★ ★ ★ ★ ★

Brief Description

Mosaic Breakaway LT is a convenient support material that enables the production of complex geometries and easily breaks away after printing.

Key Features

- ✓ Biodegradeable
- ✓ Easy to clean up

Sample Applications

- ✓ Support Material

Detailed Description

Breakaway LT is a specialty support material for use with low temperature materials like PLA and PETG. The composition of Breakaway LT is such that it won't fuse with the build material, allowing it to be easily removed after printing. Breakaway LT requires more manual labour to remove than Dissolve LT but doesn't require time for dissolution and can thus be removed much faster. This material is convenient for use in the construction of complex geometries with severe overhangs and other such features.

Technical Printing Guidelines

- Hot End temperatures of 190-220°C are recommended. No special nozzle required
- Print speeds 40-100mmm/s are recommended for most applications.
- Part Cooling Fan Speed: Not required.
- Recommended build platform materials: PEI, Painters tape, Glue Stick.
- Heated bed not required, Room temp (60C) recommended.
- Enclosure: Not Required
- No specific drying requirements

Tips/Facts

- Multi-material printers like Element and Array can combine Dissolve LT with other print materials in a single print job, enabling the production of complex geometries not normally possible in a single print.
- Mosaic Breakaway LT is also much more moisture resistant and has a much greater shelf life then Dissolve LT and other soluble support materials.

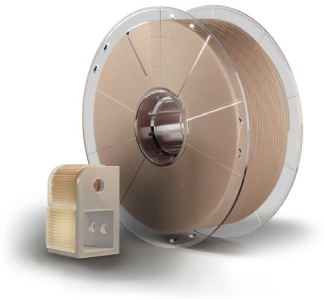
Recommended Printing Applications

- Breakaway LT is best used when printing larger structures that would be difficult to submerge in a liquid solution.
- Breakaway LT is also perfect for printing in less-moisture resistant materials like Nylon and PC, where it's less advisable to put them in any liquid solution.

Support Materials

Breakaway HT

High Heat, Clean Breakaway



Printability: N/A
Strength: N/A
Rigidity: N/A
Durability: N/A
Colors: ★
Price: ★ ★ ★

Brief Description

Mosaic Breakaway HT is a convenient high-temperature support material that enables the production of complex geometries and easily breaks away after printing.

Key Features

- ✓ High Temperature Endurance
- ✓ Easy to clean up

Sample Applications

- ✓ Support Material

Detailed Description

Breakaway HT is a speciality support filament for use with high temperature materials such as PEEK, PEKK and Ultem. Soluble supports enabled the construction of complex geometries while drastically simplifying the post-processing procedure, as compared to same material support. Breakaway HT requires more manual labour to remove than Dissolve LT but doesn't require time for dissolution and can thus be removed much faster. This material is convenient for use in the construction of complex geometries with severe overhangs and other such features. Despite it's higher temperature tolerances, it retains the same ease-of-breaking when compared to the LT variation of HT.

Technical Printing Guidelines

- Hot End temperatures of 350-380°C are recommended. No special nozzle required
- Print speeds ~60mm/s are recommended for most applications, although higher speeds are possible.
- Part Cooling Fan Speed: Do not use a part cooling fan.
- Recommended Build platform materials: Nano Polymer Adhesive is recommended as is the case with most other high temperature materials.
- Heated bed required, temps of 120-160°C recommended.

Tips/Facts

- This support is best removed while the printed part is still warm, and not fully cooled.

Recommended Printing Applications

- Breakaway HT is best used when printing overhangs and intricate structures in high-temperature industrial materials like PEEK, PEKK and PEI 9085.
- Element HT and Array are fully calibrated to use Breakaway HT specifically as a support structure, to optimize the printing experience.