Mech Power

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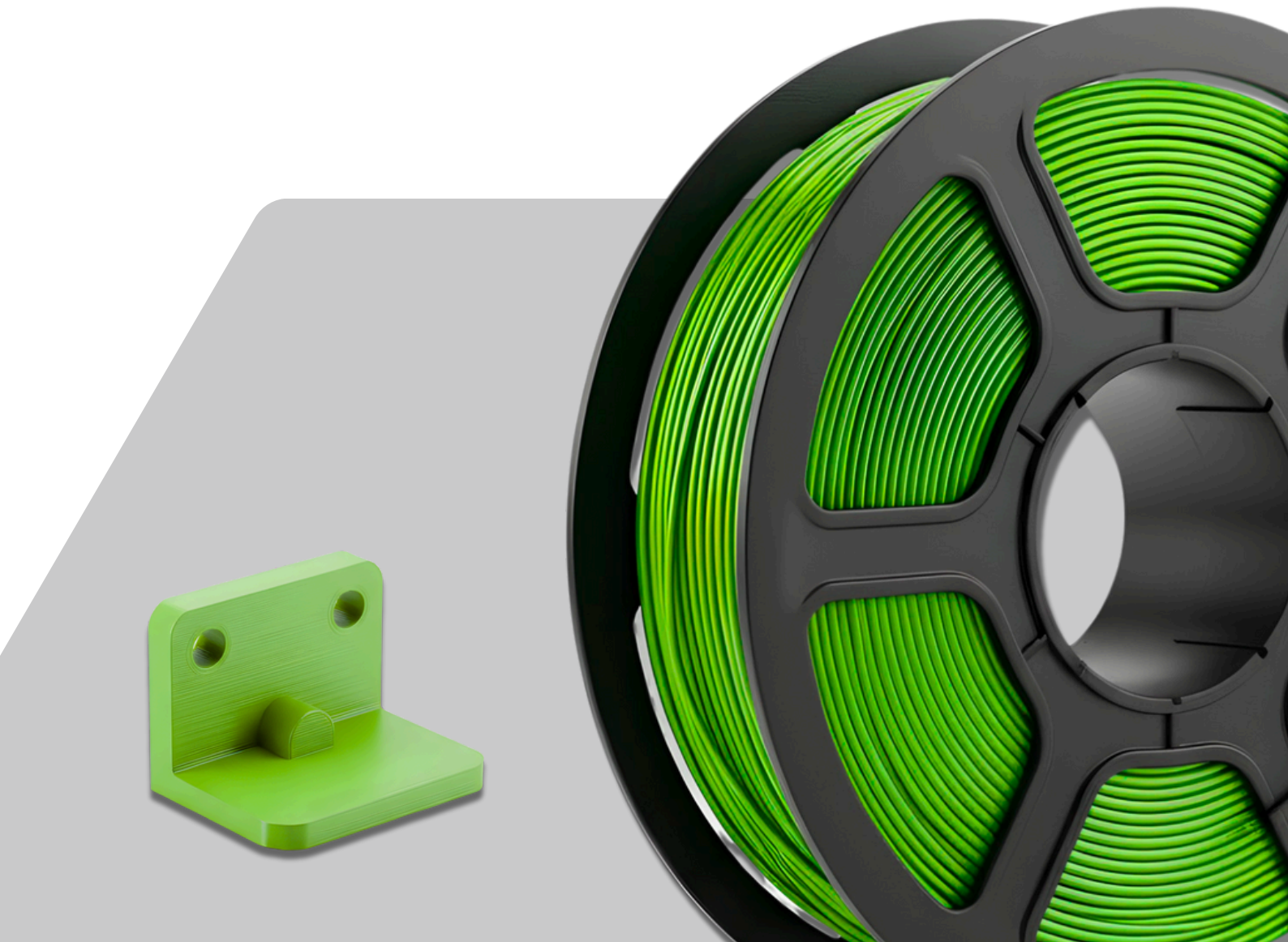
# FDM 3D PRINTING

## DESIGN GUIDELINES



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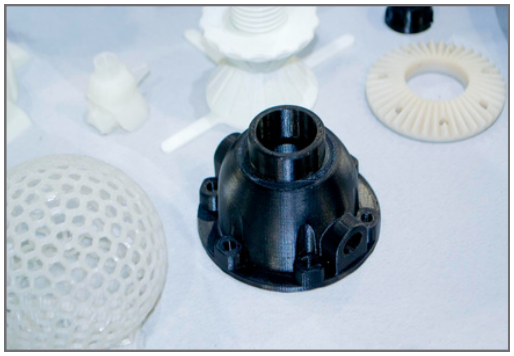
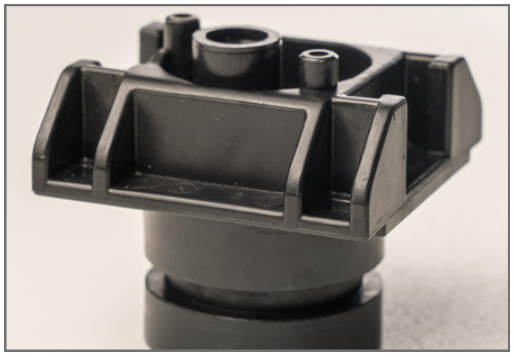
# Overview – FDM

Fused Deposition Modeling (FDM) is one of the most widely used additive manufacturing processes where melted thermoplastic filament is extruded layer by layer to form the final part. At Mech Power, we use FDM to produce strong, functional parts with a maximum build size of 330 × 240 × 240 mm.



To achieve reliable results, set wall thickness between 1.2 and 1.6 mm to maintain structural integrity and printing efficiency. Overhangs beyond 45° will require support structures, which need to be considered during design for easier removal and finishing.

Embossed or engraved features are designed to a minimum width of 0.6 mm and a minimum height of 2 mm to avoid issues with dimensional clarity and enable seamless assembly. The minimum diameter of a hole that can be printed is 2 mm, and pins are kept at a diameter of 3 mm or more. A 0.5 mm clearance is recommended between joining parts to keep tolerances, enabling proper function after printing and assembly.



Dimensional accuracy for FDM parts is typically ±0.3% (minimum ±0.3 mm). This makes it ideal for producing prototypes, jigs, fixtures, and customized parts where both strength and function are key.

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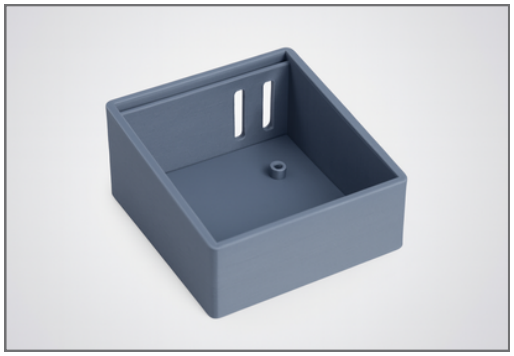
# Printing Process

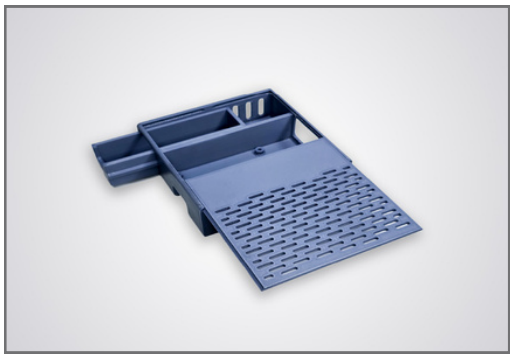
Every FDM part is produced through three main stages: pre-processing, production and post-processing.



## Pre-Processing

Your 3D design is prepared using slicing software, where the model is converted into layers and tool paths for the printer to follow.

## Production



The printer then builds layer by layer, extruding melted filament to actually build from the ground up until the part is built completely.

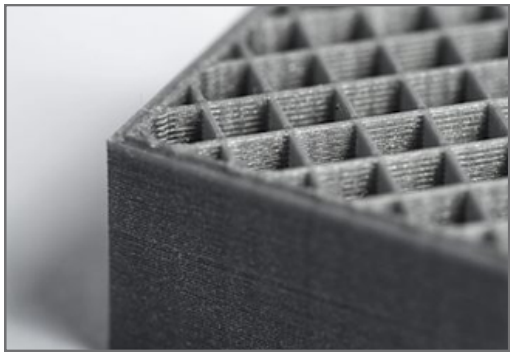
## Post-Processing

After printing is complete, temporary supports are removed and finishing steps such as sanding, painting, or fitting of inserts into the parts to give the parts its final look and functionality.

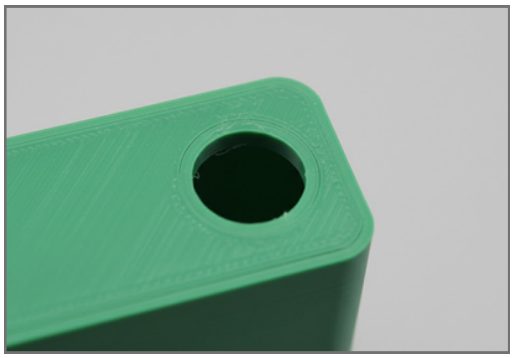
# Tolerances

## 3.1 General Tolerances

To maintain dimensional accuracy and reliable functionality, a tolerance of approximately ±0.5% is recommended for FDM-printed parts, with a minimum deviation of ±0.5 mm.



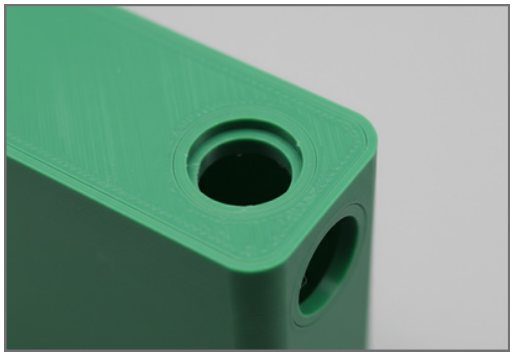
This level of tolerance generally maintains the accuracy of features, cutouts, and details throughout the part. Very thin sections or tightly fitted areas may require slight design allowances for shrinkage and clearance. Considering these factors during design supports smoother assembly and reduces the need for post-print adjustments.



By keeping tolerances realistic at the design stage, your parts can move from concept to functional product with fewer adjustments after printing.

## 3.2 Holes

When designing parts with holes it's important to consider both size and orientation. We recommend a minimum hole diameter of 2 mm to maintain circular accuracy and ensure proper resolution during printing.



Holes printed parallel to the XY plane generally produce smoother and more accurate results than those built vertically, as the layering process naturally favors horizontal paths.

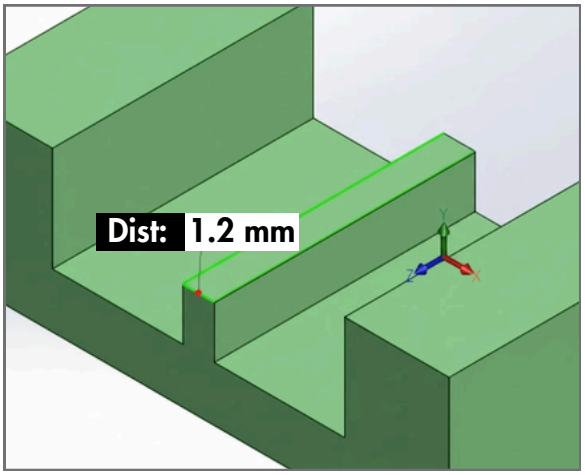
**Design Tip**

For precise fits such as screw or connector holes, keep final sizing slightly oversized or plan for a quick post-processing step like reaming or drilling to achieve exact dimensions.

## 3.3 Wall Thickness

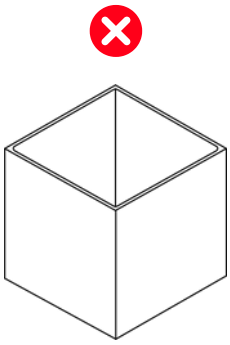
Wall thickness is one of the most important factors in achieving strong and reliable 3D printed parts. We recommend a minimum wall thickness of 1.2 to 1.6 mm for walls to ensure the part maintains both strength and accuracy.

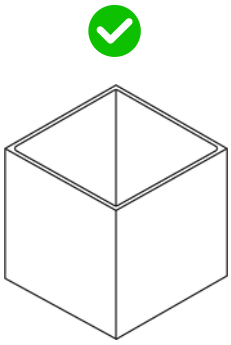
Thinner walls may result in reduced rigidity or deformation, while closed profiles such as circular or continuous walls tend to provide more consistent print quality than single straight lines.

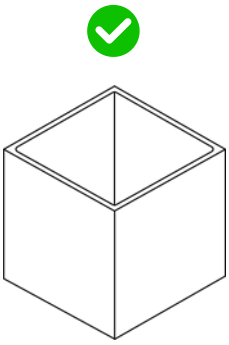


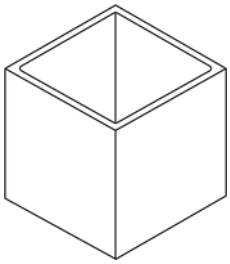

**Design Tip**

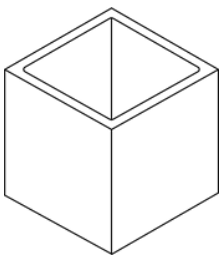
For functional parts, use the higher end of the wall thickness range in load-bearing or stress-prone areas. This small adjustment improves durability and reduces the risk of post-processing errors.

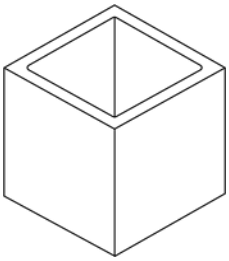

0.8 mm


1.2 mm

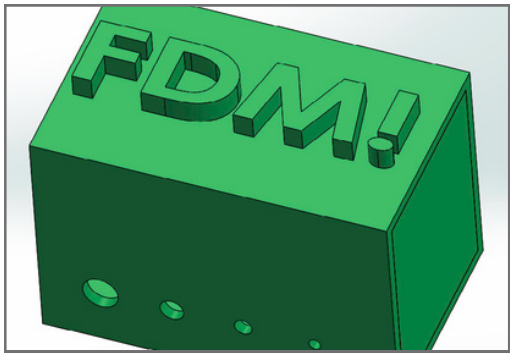

1.3 mm


1.4 mm


1.5 mm


1.6 mm

## 3.4 Text and Small Details



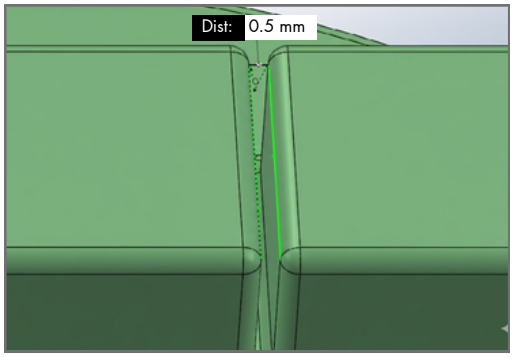

Text and fine details often challenge FDM printing because the filament width limits how precisely these features can form. To ensure clear and readable results, raised or recessed text should maintain a minimum width and height of about 1 mm, with slightly thicker characters preferred for better legibility.

Using clean, regular fonts instead of narrow or condensed ones improves visibility and reduces the chance of incomplete lettering. Whenever possible, keep text oriented parallel to the XY plane, allowing the printer to build each layer cleanly and prevent characters from appearing distorted or flattened.

**Design Tip**

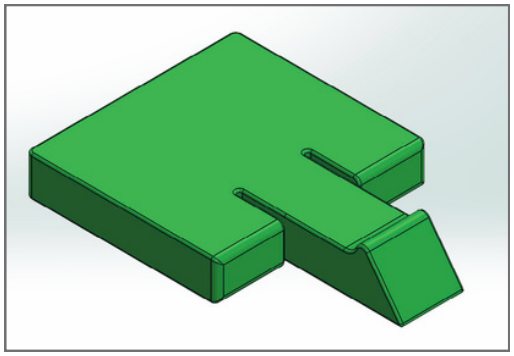
For branding or labeling, opt for bold sans-serif fonts and position text on flat surfaces. This helps your printed logos and markings appear sharper after finishing.

## 3.5 Gaps




For parts with narrow gaps or openings, maintaining adequate clearance helps ensure clean printing and easier support removal. Gaps that are too tight may cause fused layers or trapped support material after printing.

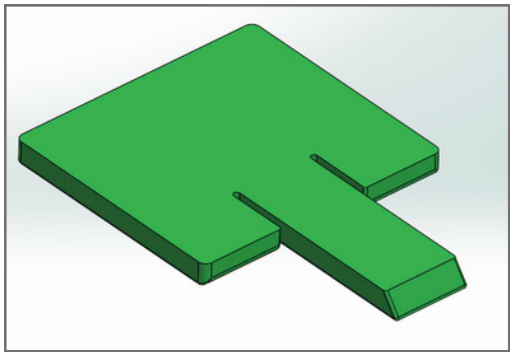
Positioning gaps parallel to the XY plane helps achieve sharper edges and better resolution while minimizing the need for additional support structures. This also ensures that airflow slots, cutouts, or vent patterns remain functional and accurate after printing.



**Design Tip**

Always visualize how support material will be removed from enclosed gaps. A small design adjustment at this stage can save significant time during post-processing.

## 3.6 Tabs



Tabs are often used for alignment, fastening, or panel connections, but they can break if they are not of the right size. To improve strength, keep tab dimensions proportional to the overall size of the part and avoid making them too thin or narrow.

Whenever possible, orient tabs parallel to the XY plane to increase layer bonding and reduce stress along print lines. This orientation helps tabs withstand greater mechanical load during assembly or use.

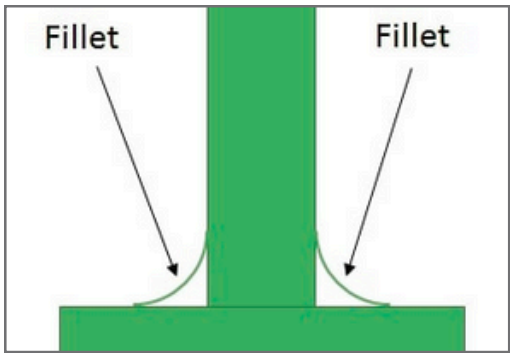
**Design Tip**

For larger or high-stress assemblies, consider designing tabs as replaceable or insertable components that can be printed separately and attached post-processing. This approach enhances durability and simplifies repair if a tab gets damaged.

# Features

## 4.1 Fillets

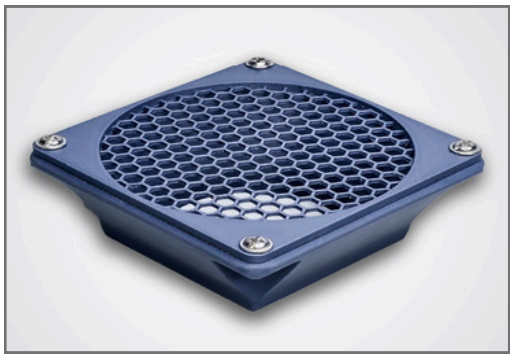
Fillets improve part strength and enhance overall appearance. Rounded corners spread out stress, so your parts are less likely to crack or split while printing or when you're using them.




Fillets also allow surfaces to build more naturally, reducing the need for extra supports on overhangs or curved transitions. This not only improves part strength but also results in cleaner surfaces and faster post-processing.

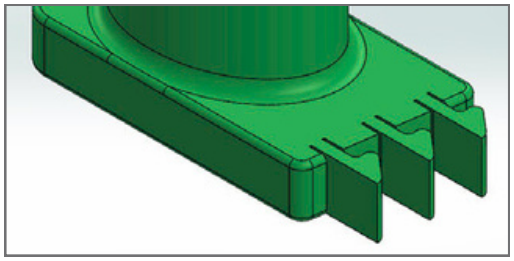
## 4.2 Infills

Infill selection plays a major role in balancing part strength, material use, and cost. We adjust infill density based on how your part will be used. We use a minimum infill density of 40%, making sure every part maintains structural integrity even in lighter configurations.



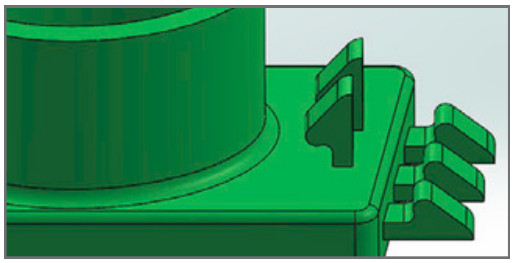
## 4.3 Orientation

Part orientation in FDM printing has a direct impact on both strength and surface finish. The way a part is positioned on the build platform determines how layers bond, how smooth the visible surfaces appear, and how much support material is needed.



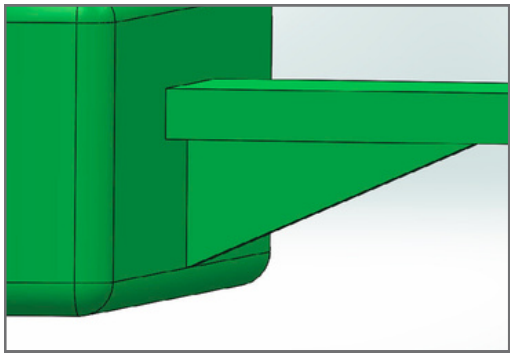
Successful orientation features

Features such as tabs, holes, or text are generally stronger and cleaner when printed parallel to the XY plane, as layers stack evenly and details resolve more accurately. Aligning fragile or curved features in the same growth direction helps improve overall part consistency and reduces weak points caused by layering.



Unsuccessful orientation features

## 4.4 Ribs



Ribs help stiffen large flat enclosure panels without making the part heavy. Use ribs to guide load paths and control flex. Keep rib height and thickness proportional to the parent wall so the surface stays smooth and the part prints clean. Add gentle fillets at rib bases to spread stress and improve print quality.

Place ribs in the XY direction where possible for better layer bonding. Break very long ribs into shorter segments to limit warp. Use cross-ribs or gussets near fasteners and corners for extra stiffness. Leave access so supports can be removed easily.

### Rib Design Standards: Thickness, Height & Support

**Rib thickness:** Maintain the rib thickness at 40%–60% of the nominal wall thickness. This creates a more uniform wall section, which helps the part cool evenly and prevents sink marks (depressions) from appearing on the opposite, visible surface.

**Rib height:** The rib height should be no more than three times the nominal wall thickness. Taller ribs can increase the risk of warping and other cooling-related issues.

**Radii at base:** Add a generous fillet (a rounded corner) where the rib meets the main wall or boss base. A common guideline is a radius of 0.25 to 0.5 times the nominal wall thickness. This prevents stress concentrations and strengthens the joint.

**Support ribs:** For added strength, especially with taller bosses, use gussets or ribs to connect the boss to the nearest wall. Connecting the boss to a wall provides better stability and helps distribute loads more evenly.

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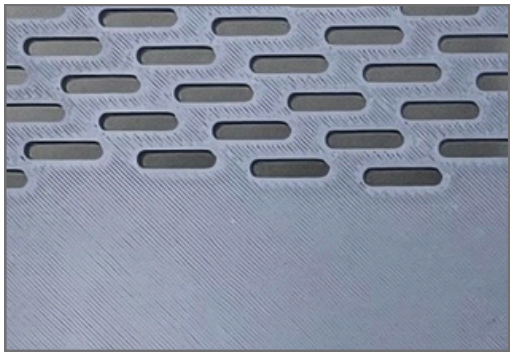
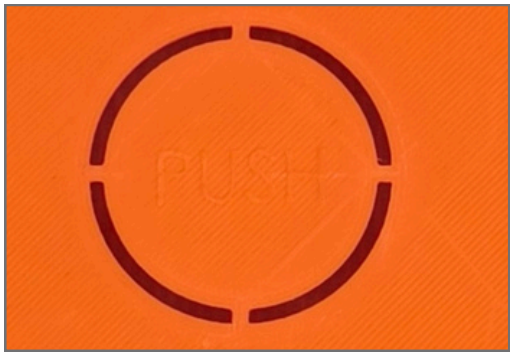
# Surface Finish

FDM printing naturally produces a layered surface texture due to its extrusion-based process. The visible “stepping” effect becomes more noticeable on shallow angles and curved surfaces, which can give parts a slightly rough appearance compared to other manufacturing methods.



To achieve a smoother finish, design curved or angled features so they build parallel to the print bed whenever possible. This orientation helps layers form more evenly and reduces visible banding.

Post-processing is where printed parts transition from raw prints to finished functional products. We offer multiple finishing options to enhance the strength, appearance, and usability of your parts.



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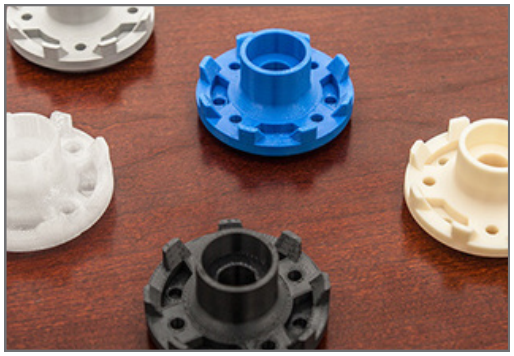
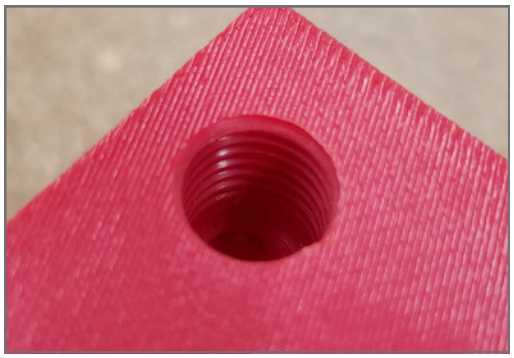
# Finishes and Post-Processing

**Common Finishing Options**

- **Raw:** As printed surface with visible layer lines.
- **Sanding:** Smoothens the layer lines for a refined surface. Available in both dry and wet finishes.
- **Painting:** Matte or glossy finishes to match your product's look and branding.
- **Insert & Hardware Integration:** Threaded heat sink inserts can be added post-print for assembly-ready parts.





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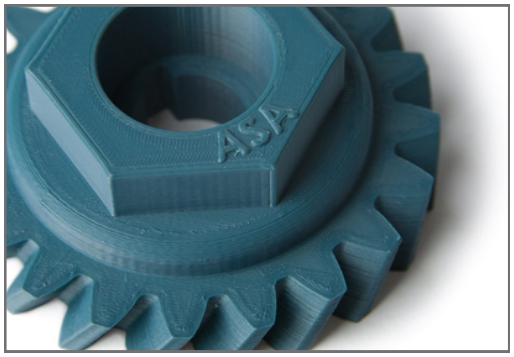
# Supported Materials

We offer a wide range of functional thermoplastics suitable for both prototypes and production-grade parts:

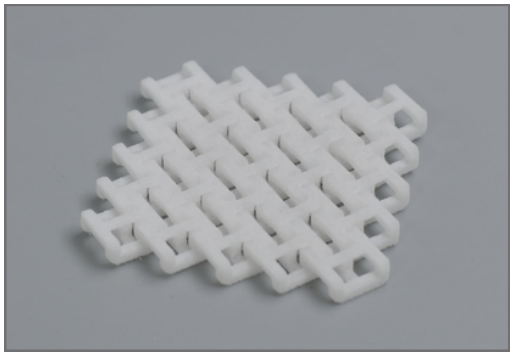
- **ABS:** Strong, affordable, and ideal for functional prototypes or housings.
- **ASA:** UV-resistant and durable, perfect for outdoor or exposed applications.
- **PLA:** Cost-effective and easy to print; suitable for visual models and concept parts.
- **PETG:** Combines good strength with flexibility and chemical resistance; ideal for general-purpose parts.
- **TPU:** Flexible and rubber-like; used for impact-absorbing or vibration-damping components.
- **TPE:** Soft, elastic material suited for grips, seals, and flexible joints.

These materials are available in multiple colors, allowing for design flexibility and brand consistency. Below is a quick reference table outlining the material options we offer for FDM printing along with their available filament colors.

ABS




ASA

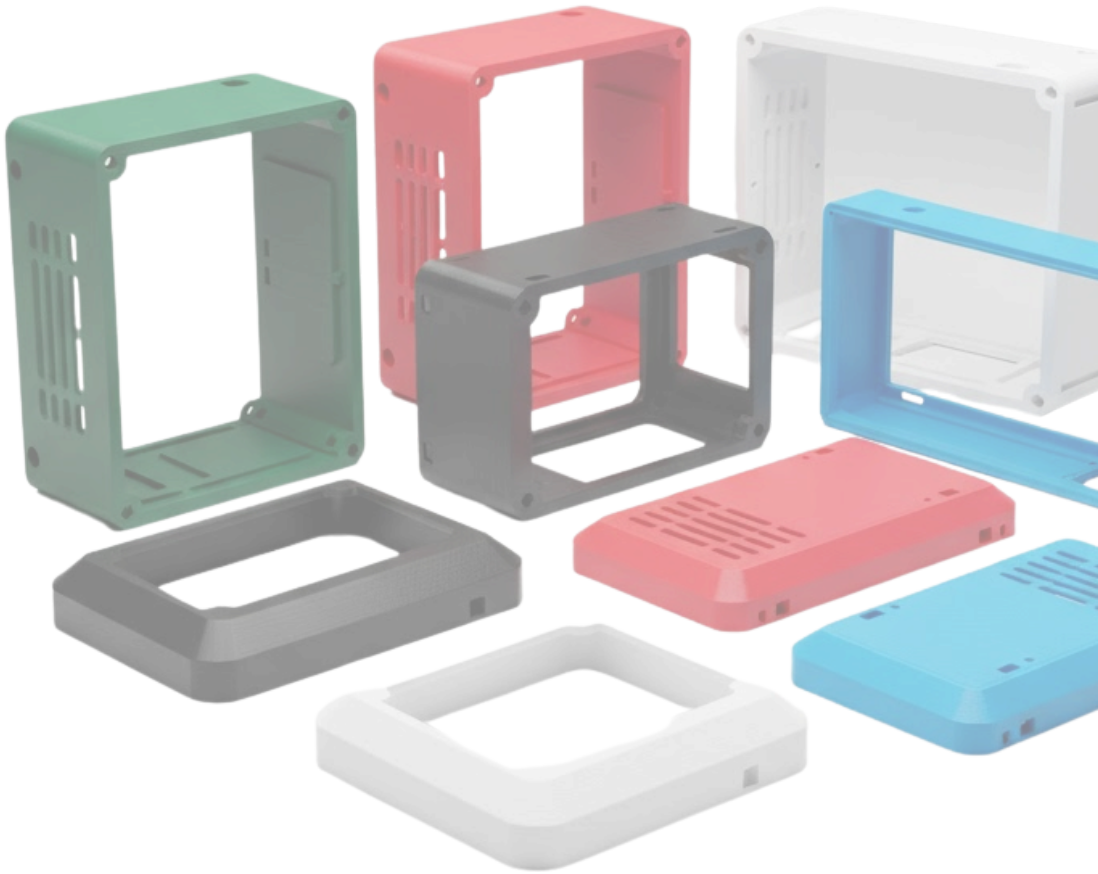


TPU

| Material Options | Filament Colors Available |
|---|---|
| **ABS** | Black, White, Grey, Blue, Green, Orange, Red, Yellow |
| **ASA** | Black |
| **PLA** | Black, White, Grey, Blue, Green, Orange, Red, Natural |
| **PETG** | Black, Blue, White, Yellow, Natural |
| **TPU** | Black, Natural |
| **TPE** | Natural |

**Design Tip**

Always define the required surface finish and mechanical inserts during file submission. This ensures your printed parts receive the exact post-processing steps needed to match performance and aesthetic goals.



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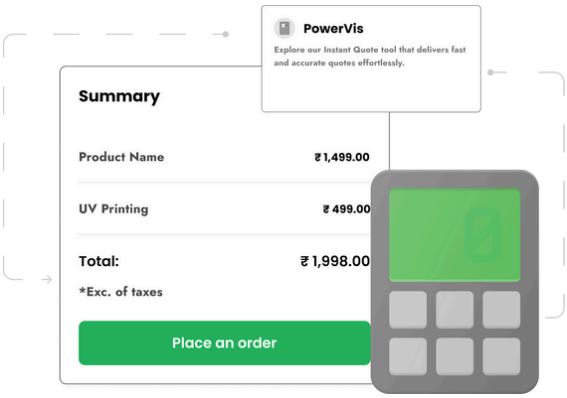
# Resources at Mech Power

Get Instant Quotes for your 3D Printing projects directly from our website.

Simply upload your CAD file and receive pricing and lead time instantly.

**Explore our online FDM 3D Printing Service :**
https://mechpowertech.com/fused-deposition-modeling




## Accepted File Types:

.stl, .obj, .wrl, .step (.stp), .iges (.igs), .3mf, .dxf, .dwg and .zip (with models and textures) files up to 300 Mb.

## Available Services:

Enclosure Design | Sheet Metal Fabrication | CNC Machining

3D Printing
(FDM & 3D Resin Printing)

Injection Molding

## Engineering & Support

Our technical and sales teams are here to help you at every stage of your build from design guidance to final delivery.

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**Email:** sales@mechpowertech.com **Website Support:** https://mechpowertech.com/contact-us

**Hours:** Monday to Sunday, 9:00 AM – 6:00 PM IST (Tuesday Closed)
**Phone:** +91 9898412126

You can also access FAQs, design tips, and technical resources directly from our **Resources Section** on the website including design guidelines, material data, and process insights to help you optimize every part you build.