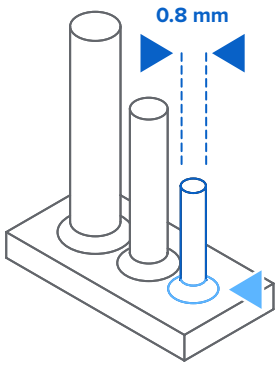
Note: The following guidelines are intended as a general reference for printing with Formlabs materials on Fuse Series printers. While these recommendations apply to most situations, they may not reflect all circumstances and materials. Users should refer to the material-specific guidelines for additional information and considerations.

Reference Dimensions

These reference dimensions were developed for Nylon 12 GF Powder and serve as a baseline set of guidelines for printing with Fuse Series printers. Please see the Material Specific Characteristics section below for material-specific design considerations and how they are expected to deviate from results typically achieved with Nylon 12 GF Powder.

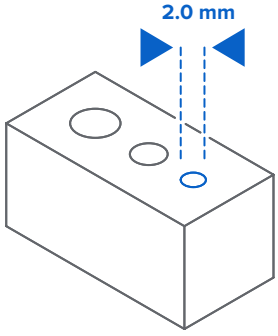


MINIMUM PIN DIAMETER

0.8 mm

The minimum pin diameter is the smallest diameter that can be printed successfully.

Note: Take extra care when cleaning thin pins in the Fuse Sift powder recovery station to prevent them from snapping. Filleting the edges where they meet the bulk of the part will mitigate this risk.

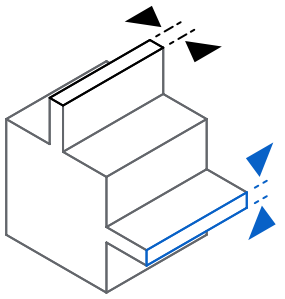


MINIMUM HOLE DIAMETER

2.0 mm

Holes with a diameter less than 2.0 mm may close off during printing.

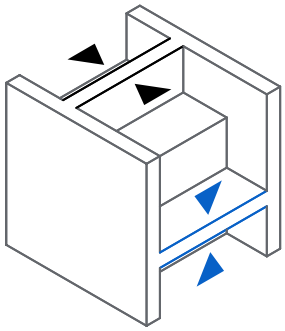
Note: For precisely concentric holes, design an undersized pilot hole and use a reamer to open the hole to its intended diameter.



MINIMUM UNSUPPORTED WALL THICKNESS

- **Vertical Walls: 1.5 mm**
- **Horizontal Walls: 1.5 mm**

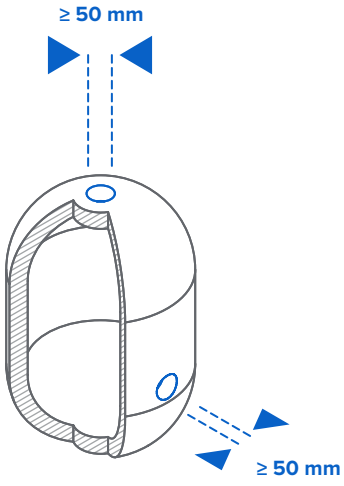
The minimum unsupported wall thickness is the minimum thickness required for a wall supported on fewer than two sides. Walls that are too thin may warp or detach from the model.



MINIMUM SUPPORTED WALL THICKNESS

- **Vertical Walls: 1.5 mm**
- **Horizontal Walls: 1.5 mm**

The minimum supported wall thickness is the minimum thickness required for a wall supported on two or more sides. Walls that are too thin may warp or detach from the model.

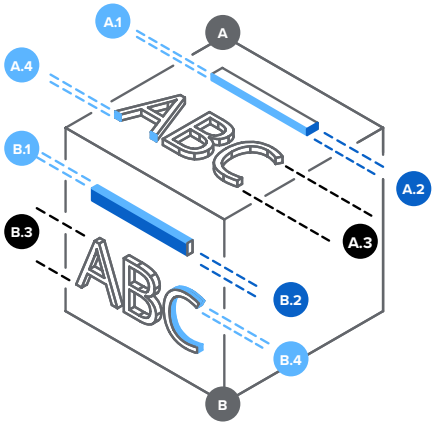


ESCAPE HOLES

Enclosed cavities remain filled with unsintered powder without proper escape holes. For best results, include at least **2 escape holes** from your cavity greater than or equal to **50 mm** in diameter.

Note: More and larger escape holes make it easier to remove unsintered powder from internal cavities. To guarantee a clean internal surface, design the part so that the surface in question is easy to access with cleaning tools.

MINIMUM EMBOSSED FEATURES



A. HORIZONTAL FACES:

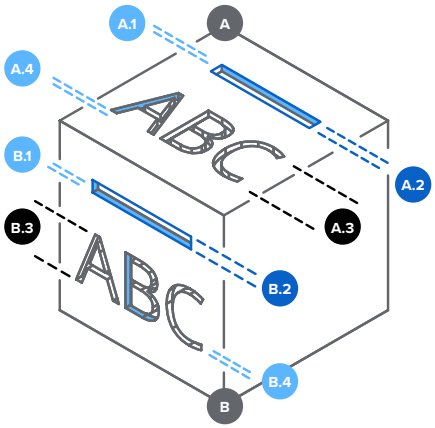
- A.1 **Depth: 0.8 mm**
- A.2 **Width: 0.8 mm**
- A.3 **Text font height: 4.5 mm**
- A.4 **Text font depth: 0.8 mm**

VERTICAL FACES:

- B.1 **Depth: 0.8 mm**
- B.2 **Width: 0.8 mm**
- B.3 **Text font height: 4.5 mm**
- B.4 **Text font depth: 0.8 mm**

Embossed features are extruded from the surface of the model. Small embossed features may not be visible on the finished part. Use a bold font where possible for best results with embossed text.

MINIMUM ENGRAVED FEATURES



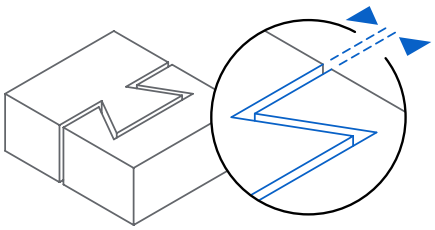
A. HORIZONTAL FACES:

- A.1 **Depth: 0.4 mm**
- A.2 **Width: 0.4 mm**
- A.3 **Text font height: 3 mm**
- A.4 **Text font depth: 0.4 mm**

VERTICAL FACES:

- B.1 **Depth: 0.4 mm**
- B.2 **Width: 0.4 mm**
- B.3 **Text font height: 3 mm**
- B.4 **Text font depth: 0.4 mm**

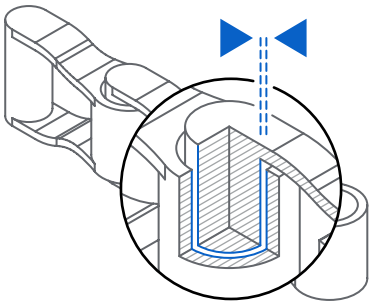
Engraved features are cut from the surface of the model. Small engraved features may not be visible on the finished part. Use a bold font where possible for best results with engraved text.



MINIMUM ASSEMBLY TOLERANCES

Features less than 20 mm²: 0.2 mm
Features greater than 20 mm²: 0.4 mm

Leave a slight clearance between printed parts intended to mesh or interface after printing, like assembly joints or gears.



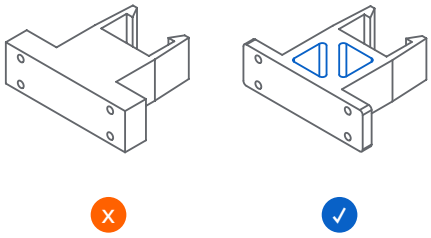
INTEGRATED ASSEMBLY CLEARANCE

Features less than 20 mm²: 0.5 mm
Features greater than 20 mm²: 0.6 mm

For parts that will be printed together in an integrated assembly, leave clearance to prevent the parts from fusing together during the print.

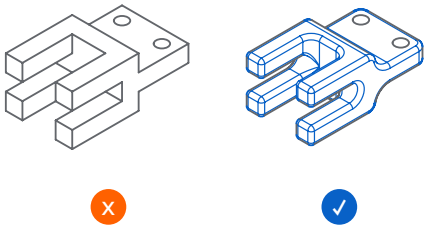
Achieving Design Success

The SLS 3D printing process differentiate itself by using loose powders, fused together to create your part, which enables printing without dedicated support structures. As with any process, there are ways to optimize your design to optimize print success and results. These recommendations can help you conserve material and print time while optimizing your part for successful printing and implementation.



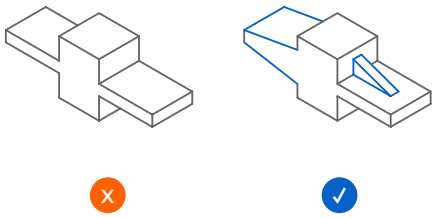
MAINTAINING UNIFORM THICKNESS

Where possible, keep the thickness of your parts relatively consistent. This will alleviate warping issues as parts cool. Consider shelling thicker parts to maintain a uniform thickness and save material.



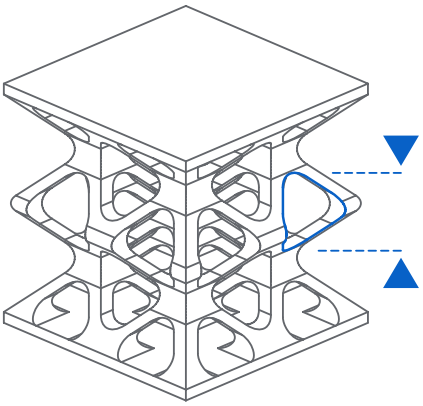
REDUCING STRESS CONCENTRATIONS

Parts can experience stress buildup at sharp changes in cross-section, such as thin extrusions from thick bases. Design gradual edge transitions instead of abrupt ones to reduce concentration of Vapour Smoothing solvents. We recommend a minimum radius of **≥ 1.0mm** to mitigate this.



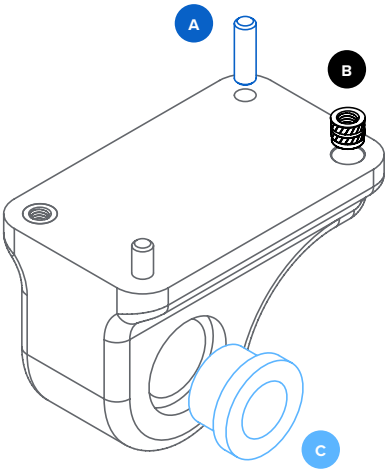
MANAGING ASPECT RATIO

Parts with a high aspect ratio are susceptible to warping. Features such as ribs or drafts can mitigate risk of warping on thin, extruded sections like cantilevers and wires.



DESIGNING LATTICES

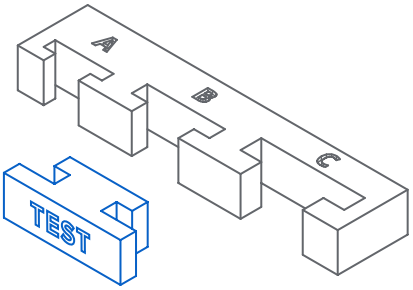
When designing a lattice structure, keep in mind that loose powders will need to be cleared from the lattice. To ensure easy powder removal in the Fuse Sift, design lattices with no smaller than **8 mm** gaps, and leave open faces in your lattice so that you don't trap powder inside.



INTEGRATING HARDWARE IN YOUR DESIGNS

Identify where it makes sense to integrate hardware into your printed designs. Here are some examples:

- **A** Dowel pins as precise locating features
- **B** Heat set inserts for durable threaded connections
- **C** Bushings for concentric interfaces to shafts or rails



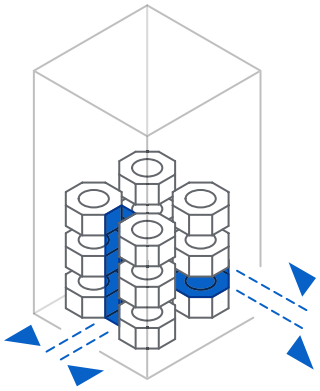
WHEN IN DOUBT, TEST!

If you are concerned about the success of a specific feature, create a small test print of the specific geometry in question. Isolate the feature and print the test part in the same intended orientation as the full part to get the best indication of design success.

Note: You might want to try printing multiple test pieces with different dimensions at once to test various fits before committing to a larger print.

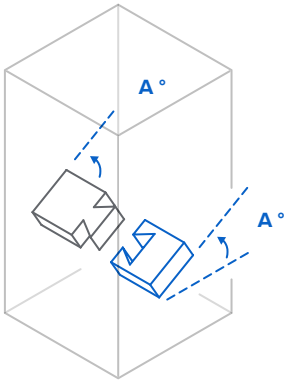
Part Orientation & Chamber Packing

Part layout in the Fuse Series build chamber can also affect print success. Below are a few helpful tips to keep in mind when laying out your parts.



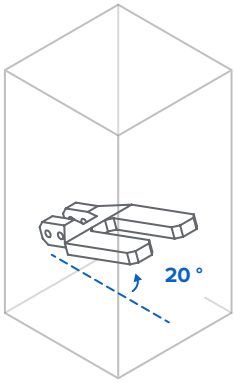
PART SPACING

When packing parts in the build chamber, space parts at least **5 mm** apart for high-quality results. Distribute parts across the chamber to reduce the potential for thermal buildup.



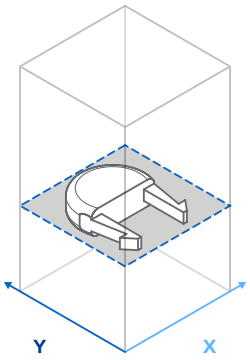
INTERFACING COMPONENTS

Parts that are designed to interface should have their mating features oriented in the same rotation to ensure they fit cleanly together.



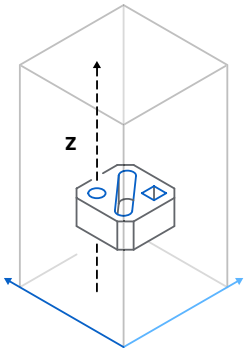
HIGH-ASPECT-RATIO PARTS

High-aspect-ratio parts that are wide and relatively flat should be printed at a slight angle of about **20 °** to minimize warping.



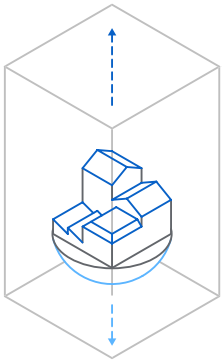
FLEXURAL FEATURES

Printed parts are tougher in the XY plane than in Z. Align features like snap fits and other flexural elements so they bend within the XY plane where possible.



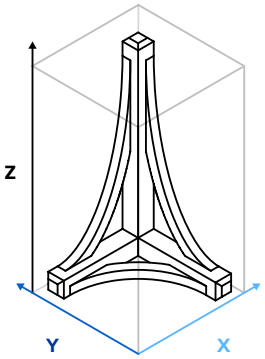
DIMENSIONAL ACCURACY

Features like holes and pins are most accurate with their axes oriented in Z. When possible, align these features vertically in the chamber.



SURFACE FINISH

For features where a smooth surface finish is desired, such as rounded faces or contours, orient the surface facing downward. For features that need a sharp, crisp finish, orient them facing upward.



BUILD VOLUME AND PACKING DENSITY

The build volume refers to the largest possible part that can be printed on the Fuse 1 Series printers. There is no physical limit to the packing density within that build volume, which means that the entire build volume can be filled, to maximize part size, and minimize powder waste. The maximum part size may vary slightly from one material to the other, please refer to the section below for details.