



SL design guide

Stereolithography
design considerations

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DIRECT MANUFACTURING



SL Design guide

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Stereolithography design guide

Stereolithography (SLA[®]/SL) is the original 3D printing process still widely used today for its accuracy and speed. SL is often used for prototypes, large concept models, form and fit prototypes, masters for tools and investment casting patterns.

Stratasys Direct Manufacturing is a leader in additive manufacturing, and we partner with our customers to deliver customized parts. We hold many manufacturing patents and represent one of the most extensive industry knowledge bases in the world, particularly when it comes to Stereolithography.

Stereolithography rapidly builds components using a precise UV laser to cure and solidify thin layers of a photo-reactive resin. One of the most accurate 3D printing technologies, SL is often used for prototypes, master patterns, or large concept models that require coatings or finished surfaces. Stratasys Direct offers a suite of professional finishing options to accurately replicate product design requirements and achieve a high-quality surface finish.

Design Considerations	SD SL	HD SL	SD SL Sparse
Build Volume (unsegmented)	25" x 29" x 21" *	5" x 5" x 9.5"	25" x 29" x 21" *
Resolution Z (Layer Thickness)	0.004"	0.002"	0.007"
Resolution XY	0.010"	0.005"	0.010"
Accuracy	±0.010" or ±0.001"/", whichever is greater	±0.005" or ±0.001"/", whichever is greater	±0.015" or ±0.002"/", whichever is greater
Minimum Wall Thickness	0.060"	0.060"	0.060"

* Parts that are larger than the build volume can be assembled and bonded together with no loss in structural integrity or accuracy. Segments are assembled on fixtures and measured before permanent bonding.

SL design considerations

As with any manufacturing process, various issues can impact the performance of a particular design.

Materials

A range of Stereolithography photopolymers are available, from clear to strong, rigid plastics to special formulas for investment casting patterns. [Material datasheets](#) should be consulted to determine if there are material-specific design considerations that should be incorporated.

Surface finish/texture

Stereolithography produces parts with a generally smooth surface finish. Depending on the layer thickness, slow sloping surfaces may have some small stair-stepping or tree bark appearance. SL part surfaces are easily hand sanded, blasted or tumbled for a smoother finish.

Color

SL materials are available in white or clear, and Stratasys Direct's expert finishing team can apply any color through secondary painting or dyeing.

Cosmetics

Our finishing experts take your 3D printed prototype and transform it into a replica of your finished product. Any surface look is achievable when backed by our expert model makers with years of experience.

Custom finishing, texture, color, artwork, EMI/RFI shielding, plating and other functional coatings can bring additional value to SL prototypes and models.

Part size

The max build envelope for the SL machine is 25" x 29" x 21", however, parts can be built in segments and accurately bonded in post-processing. For HD SL, segmenting and bonding is not recommended due to the small size of part features and the chance of corrupting those features.

At Stratasys Direct, we can build extremely light, large-scale parts in record time with our SD SL Sparse build method. The sparse process is ideal for nonstructural appearance models as these parts build faster, weigh less and cost less than solid SL models. They also have a better as-built surface finish than conventionally-modeled 10-20 pound foam.



Material considerations

Stereolithography currently utilizes UV curable photopolymer materials. Material properties can be found on stratasysdirect.com.

Dimensional accuracy

Typical tolerances for SD SL are $\pm 0.010''$ or $\pm 0.001''/''$, whichever is greater.

Typical tolerances for HD SL are $\pm 0.005''$ or $\pm 0.001''/''$, whichever is greater.

Typical tolerances for SD SL Sparse are $\pm 0.015''$ or $\pm 0.002''/''$, whichever is greater.

Tighter tolerances may be offered on a case-by-case basis.

Minimum feature size

The minimum practical SL feature size is 0.020'' for SD SL and 0.010'' for HD SL. Smaller features may be built, but must be reviewed on a case-by-case basis.

Draft

Draft, or lack thereof, is not an issue for Stereolithography parts.

Wall thickness

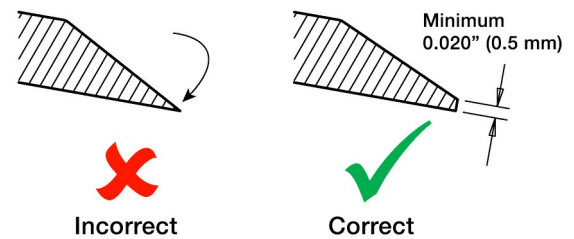
In general, the minimum recommended wall thickness is 0.060'' as smaller walls may not hold up when it comes to support removal or media blasting. Maximum recommended wall thickness is 1.5'' thick, unless the part is built with SD SL Sparse. For parts with a high aspect ratio, it's recommended to increase the wall thickness to increase strength.

Interior corners

One of the most significant benefits of the SL process is that interior features such as stiffeners, baffles, ribs and struts can be designed and constructed as one integral part.

Feathered edges

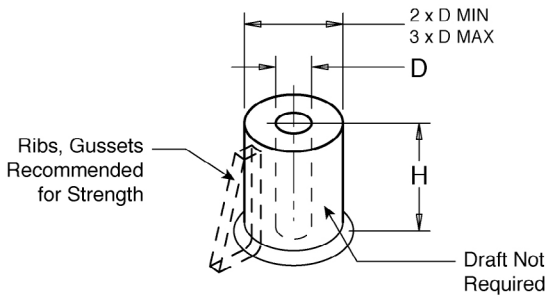
Feathered or knife-edges should taper to no less than 0.020 inches (0.5 mm), see figure below. Edges tapering to less than .020'' cannot be guaranteed to fully resolve.



Design consideration	Specifications
Minimum hold diameter at 1 mm thickness	0.02 in (0.5 mm)
Minimum shaft diameter at 10 mm height	0.02 in (0.5 mm)
Minimum printable font size for embossed or debossed letters or numbers	0.15'' (0.4 mm) wide; 0.15'' (0.4 mm) thick
Minimum clearance at 1 mm thickness	0.02 in (0.5 mm)

Bosses

Bosses are used for attaching fasteners or accepting threaded inserts. The boss diameter should be 2.0 and 3.0 times the diameter of the insert to provide sufficient strength and to minimize hoop shrink, see figure below. The height of the insert should not exceed the height of the boss, as hoop shrinkage may occur below the level of the boss. As with injection-molded parts, ribs and gussets can be added to the boss for increased strength. See Inserts for more information. It is not necessary to add draft to the boss.



Holes

Holes should have a minimum diameter of 0.5 mm. Holes smaller than 0.05 mm may be closed by the printing process.

Inserts

Similar to the SLS process, it is not possible to build parts around metal inserts. The insertion must take place as a secondary operation. Threaded inserts with adhesives are recommended.

Joints

When designing joints in SL be sure to leave a clearance of 0.5mm between moving parts. If the you are looking for a tight fit you may use a minimum clearance of 0.1mm.

SL materials can be bonded with a variety of adhesives. Lap joints, with a 0.1 inch bond line clearance, are the preferred joint method. The recommended joint overlap is 3-5 times the wall thickness.

Joint performance can be adversely affected by temperate and bonding techniques, joint geometry and other factors. Stratasys Direct Manufacturing strongly recommends that a vigorous prototyping program be used to validate any SL production designs that include joints.

Orientation

There are key considerations for designers when building 3D models in a certain orientation, including surfaces that need a higher level of detail, accuracy, part strength and smooth surface finish.

The accuracy of the parts is better in the XY plane than in the Z direction. Features that require the highest resolution should be placed in the XY plane. In order to avoid stair-stepping with curved or sloped surfaces, do not position those surfaces with angles less than certain values with the horizontal (XY plane), depending on the thickness of the layers.



Design Services

Need additional help designing for Stereolithography? Our design services team can optimize CAD models for functionality and value with SL. Companies can collaborate with our experts to enhance designs or quickly implement changes before manufacturing parts.

[Get more information >](#)

stratasysdirect.com



Stratasys Direct Manufacturing Locations

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