DESIGN GUIDE

1. Guidelines.
2. Recommendations.
3. Best practices.

atum3D connects superior Digital Light Processing (DLP) technology to cost-effective, high quality serial manufacturing capabilities. Thanks to our open resin platform, a rapidly growing number of different material properties are available for use. 3D Manufacturing Excellence starts with creating a well-designed model to get the best result out of your DLP Station printers. This Design Guide has been created to make your life easy. We'll guide you through the most important specifications and our recommendations for designing parts for print.

atum 3D

3D Manufacturing Excellence

DESIGN GUIDE

Proprietary algorithms and firmware enable unprecedented accuracy levels for your parts using the combination of atum3D's DLP Station hardware and Operator Station software. This guide includes two sets of design parameters:

1. ***Generic:*** *known to work well with many resins and settings, without crossing any design limits;*
2. ***Benchmark****: validated with a commercially available "tough" resin (100 µm x,y resolution, 100 µm layer heights); can be considered a reference to what can be realized with a specific build material and optimised settings.*

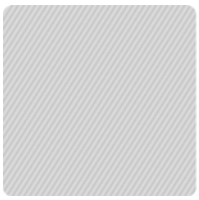
To validate the values of one or more design parameters for your specific resin and settings, consider printing the benchmark model available for download on the atum3D website.

GENERAL TOLERANCES

Final tolerances that can typically be achieved with printed parts.

100 µm x,y	± 0,2 mm
70 µm x,y	± 0,15 mm

MAXIMUM BUILD ENVELOPE



The maximum size for printed parts depends on the different DLP Station model and resolution.

405	192 x 108 x 250 mm
365 EXZ & 405 EXZ	192 x 108 x 450 mm

MINIMUM SUPPORTED WALL THICKNESS

A supported wall is connected to other walls on two or more sides. Limit wall height to 10x wall thickness.

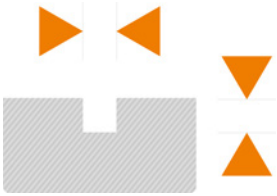
	Generic	Benchmark
100 µm x,y	0,4 mm	0,3 mm
70 µm x,y	0,3 mm	0,2 mm

MINIMUM UNSUPPORTED WALL THICKNESS

An unsupported wall is connected to other walls on less than 2 sides. Thinner walls may deform.

	Generic	Benchmark
100 µm x,y	0,6 mm	0,3 mm
70 µm x,y	0,6 mm	0,3 mm

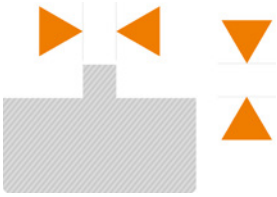
MINIMUM ENGRAVED DETAIL



Engraved details smaller than recommended may not be visible.

	Generic	Benchmark
100 µm x,y	0,4 mm	0,25 mm
70 µm x,y	0,4 mm	0,25 mm

MINIMUM EMBOSSED DETAIL



Embossed details smaller than recommended may not be visible.

	Generic	Benchmark
100 µm x,y	0,1 mm	0,1 mm
70 µm x,y	0,1 mm	0,1 mm

MAXIMUM UNSUPPORTED OVERHANG

Longer unsupported horizontal overhangs may deform. Consider applying temporary supports.

	Generic	Benchmark
100 µm x,y	1 mm	1 mm
70 µm x,y	1 mm	1 mm

MAXIMUM HORIZONTAL SUPPORTED BRIDGE

Longer bridge spans may deform. Try to avoid using (wide) bridges, or adjust the geometry if possible.

	Generic	Benchmark
100 µm x,y	4 mm	10 mm
70 µm x,y	4 mm	10 mm

MINIMUM HOLE DIAMETER

Smaller diameter holes may disappear/fill during print. Highly dependent on resin properties.

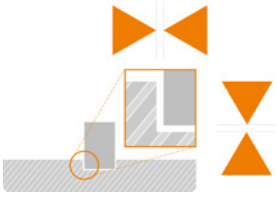
	Generic	Benchmark
100 µm x,y	0,5 mm	0,3 mm
70 µm x,y	0,4 mm	0,3 mm

MINIMUM UNSUPPORTED OVERHANG ANGLE

Larger angles may cause deformation. Consider applying temporary supports to overhangs.

	Generic	Benchmark
100 µm x,y	70°	80°
70 µm x,y	70°	80°

MINIMUM CLEARANCE FOR ASSEMBLED PARTS



Parts for assembly should be designed with at least the recommended tolerance clearance.

	Snug	Regular	Moving
100 µm x,y	0,2 mm	0,3 mm	0,4 mm
70 µm x,y	0,2 mm	0,3 mm	0,4 mm

MINIMUM VERTICAL COLUMN DIAMETER

Limit the diameter:height ratio to1:7.

	Generic	Benchmark
100 µm x,y	d 0,4 mm - hmax 3,5 mm	d 0,3 mm - hmax 3,5 mm
70 µm x,y	d 0,4 mm - hmax 3,5 mm	d 0,3 mm - hmax 3,5 mm

Do you have any questions, would you like more information or can we advise you on additional specifications? Please contact our team.

DESIGN CONSIDERATIONS

The most important thing to keep in mind when designing parts for 3D printing in CAD software is that the digital model will become a physical object. During the design phase, there are no laws of physics to adhere to, such as gravity. Anything can be drawn in 3D - but not everything can be 3D printed. Below are the key considerations to take into account when designing parts for DLP printing.

1. AVOID STEEP OVERHANGS

The DLP process builds the parts layer-by-layer. Material cannot be printed into the air, so every layer must be printed over some underlying material.

Overhangs are areas of the model that are either partially deposited on the layer below or not supported at all. There is limit on the angle DLP Station printers can produce without requiring additional supports.

For most commercially available resins, this angle is approximately 25°. Flexible resin might behave differently.

It is considered good practice to limit the overhangs of a model, as layers printed over supports usually have a rougher surface finish, which could potentially have to be post-processed.

2. USE A FLAT LAYER AS BASE LAYER

It's recommended to start a print with a flat layer. This facilitates post-processing. For example, a flat surface is easier to sand than a curved surface, or one with many holes. Support removal may also be more difficult if the surface contains many openings.

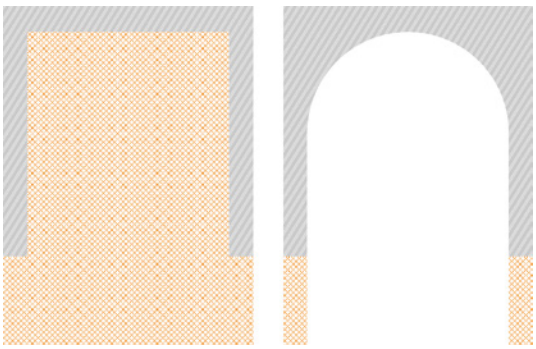
3. SUPPORT BOTH EXTERNALLY AND INTERNALLY

When overhangs can not be avoided and are longer than the recommended values included in this guide, additional supports are required to ensure printability.

Supports can be added locally, or automatically generated using the MAGS AI feature of atum3D's Operator Station software. Models should be supported both internally and externally, depending on the geometry.

When placing supports, also consider easy removal beforehand. Areas where supports are to be removed should be reachable, also for surface finishing. An example are supports the middle of a pipe.

Designing self-supporting structures, like lattice or Voronoi structures, can help reducing resin consumption while minimizing the need for additional supports. Specific design features, such as fillets and chamfers, can also help to avoid additional supports.



Try to avoid supporting the functional areas of the part. If one side of the part is supposed to slide in or fit with another part, it is recommended not to place supports on that side to prevent scarring and additional post-processing. MAGS AI allows marking these key areas, and automatically orientates and supports the part accordingly.

Please note: in DLP printing, the primary function of supports is not to counteract gravity, but rather to withstand the pulling forces required to detach the print from the resin tray surface after every layer.

4. HOLLOW OUT THE MODEL, ADD DRAIN HOLES

If possible, try to hollow out the model to significantly reduce both resin consumption and part cost. This also implies adding drain holes to the design, which levels out the pressure of the liquid resin inside and outside the part, in turn preventing deformation.

Drain holes also facilitate removing excess resin inside the part after the print. Designing at least two drain holes improves the airflow and resin drainage. Without drain holes, resin could be trapped inside the part.

100 µm x,y	3,5 mm
70 µm x,y	3,5 mm

Please note: the above values are highly dependent on the specific resin used. High viscosity resins might require larger drain holes.

5. MINIMIZE THE Z CROSS-SECTIONAL AREA

The key variable to consider when orienting a part for DLP printing is the z-axis cross-sectional area. The pulling forces required to detach the print from the resin tray are directly proportional to the 2D area (slice) of the previous layer.

This leads to the common practice to orientate and print parts at an angle relative to the Build Plate in order to minimize the cross-sectional area, and thereby the applied force on the model in the z-direction.

6. PRINTING LATTICE STRUCTURES

DLP Station printers are very well suited to print lattice structures using flexible resins. To ensure printability, the lattice structure needs to be self-supporting in the print direction.

The links of the lattice structure should be at least 750 µm thick. The model including the lattice structure should preferably be supported on a solid part instead of at the end of a lattice cell.

7. CLEANING THIN WALLS OR COLUMNS

Care should be taken when cleaning thin walls or columns. These types of thin structures may absorb ethanol/ IPA and swell. It is advisable to limit this effect as much as possible by minimizing the part immersion time.
