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ETEC Design Guide

Manufacturer:
EnvisionTEC US LLC
A Desktop Metal Company
15162 S. Commerce Dr. Dearborn,
Michigan 48120
USA

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Overview

About This Guide

This guide provides general design guidelines for part geometries that are well-suited for fabrication with ETEC's DLP and cDLM 3D printers.

A detailed overview of design for additive manufacturing is beyond the scope of these instructions.

Applicable Printers

This guide was developed for the following ETEC printers:

- Envision One cDLM series (including Envision One cDLM XL)
- P4K series (including P4K 90, P4K 75, P4K 62, P4K 35)
- D4K

Note: Testing for this guide was performed with ETEC's **E-RigidForm** material. This guideline is most applicable to rigid materials. Minimum feature size is dependent on material, printer, and geometry. All applications should be validated with the appropriate equipment.

About the Technology

The **Envision One** features patented cDLM (continuous digital light manufacturing) technology, which enables the ability for continuous printing. With little to no delay between layers, the Envision One delivers exceptional speed, print resolution, surface finish, and part properties.

The **P4K** is the opposite of other, one-size-fits-all 3D printing solutions. With a range of models available, users can choose their optical configuration based on part size, feature-size requirements and throughput, and tailor a solution that best suits their needs. With resolutions of between 23µm-90µm on the X and Y axes, the P4K can easily produce detailed parts in a range of sizes.

Introducing the **D4K**, the highest resolution professional-grade desktop 3D printer. In addition to having the fastest speed for a standard DLP printer, the D4K from ETEC delivers extremely accurate parts with the finest detail available. Brought to you by the original inventors of DLP 3D printing technology.

With ETEC's family of **hard plastics**, you get the dimensional accuracy, surface quality and speed of the world's leading DLP printing systems, along with material properties rivaling leading thermoplastic materials (e.g. ABS, PA12, ULTEM, and TPU). So whether you're looking to mass-produce housings or couplings – ETEC has you and your applications covered!

Visit **envisiontec.com** for more information.

Minimum Features

Build Envelope

The build envelope is the maximum available printing space on a 3D printer. It determines how large of an object the printer can build.

The size of the build envelope depends on the size of the projector, the distance between the projector and the material tray, and the maximum height of the build platform in the Z axis.

Build envelope:

Printer:	D4K	P4K 90	P4K 75	P4K 62	P4K 35	Envision One cDLM series
X axis	140 mm	223 mm	192 mm	160 mm	95 mm	180 mm
Y axis	83 mm	141.5 mm	120 mm	100 mm	56 mm	101 mm
Z axis	110 mm	220 mm	220 mm	220 mm	200 mm	175 mm (320 mm XL)
Pixel size	50 µm	90 µm	75 µm	62 µm	35 µm	93 µm

Minimum Part Size

There is no minimum part size for the Envision One cDLM, P4K, or D4K.

Tip: Printed parts under 5.0 x 5.0 x 5.0 mm may be hard to handle during post-processing.

Feature Size

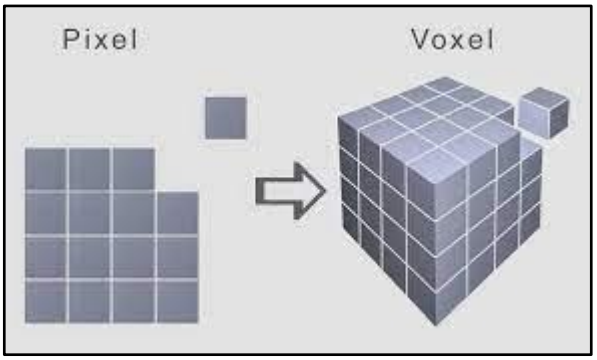
The minimum resolvable feature size is dependent on:

- the specific printer,
- the material,
- and the feature geometry.

To better understand the achievability of small features, it is useful to think in terms of voxels.

Voxels

A voxel is a three-dimensional pixel.



The dimensions of a voxel are based on:

- the native pixel size of the printer in the X and Y coordinates,
- and the layer height in the X and Z or Y and Z coordinates.

Layer Height

Layer height is the thickness of the material cured in each layer during a print job.

Note: Layer height is material dependent.

Pixel Size and Layer Heights:

Printer:	D4K	P4K 90	P4K 75	P4K 62	P4K 35	Envision One cDLM series
Pixel Size:	50 µm	90 µm	75 µm	62 µm	35 µm	93 µm
Layer Height:	25 - 150 µm	25 - 150 µm	25 - 150 µm	25 - 150 µm	25 - 150 µm	50 - 150 µm

Minimum Feature Size
The minimum feature size must be at least three times the voxel size of the printer.

Example: The D4K has a 50 µm voxel size, and a minimum resolvable feature size of 3.0 pixels or 150 µm.

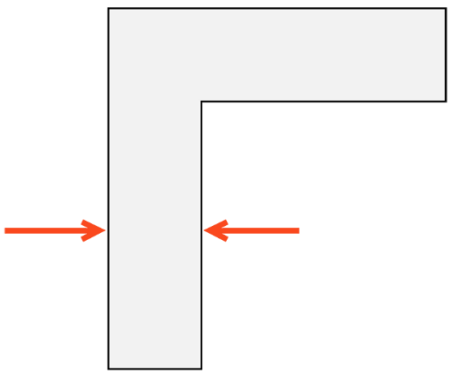
For horizontal features ETEC recommends a minimum resolvable feature size of five times the layer height.

Example: E-RigidForm material has a 100 µm layer height, and a minimum resolvable horizontal feature size of 500 µm.

Wall Thickness

Part wall thicknesses from as thin as 2.0 mm to over 10.0 mm are printable without special considerations. The printability of wall thicknesses under 2.0 mm depends upon:

- geometry,
- orientation,
- and material.



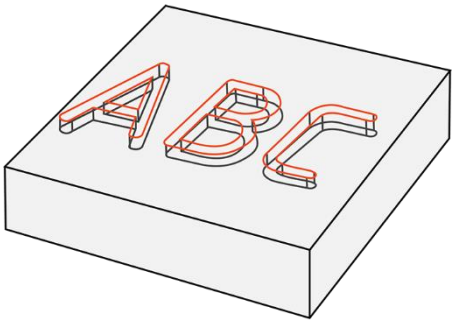
Freestanding walls as thin as 0.20 mm can be printed when correctly oriented and reasonably sized.

Minimum Wall Thickness
The minimum recommended wall thickness is 0.50 – 1.0 mm, depending on the material and geometry.

Character Height

Minimum character height differs if:

- the text is raised or recessed, and
- the text is placed on a surface that is vertical or horizontal to the Z axis.



The recommended feature depth/height for text is 0.50 mm.

Note: Testing was performed with both serif and sans-serif fonts. Sans-serif fonts are slightly more legible at the minimum size.

Minimum Character Height:

	Raised (Positive)	Recessed (Negative)
Parallel	2.0 mm	1.0 mm
Perpendicular	3.0 mm	1.0 mm

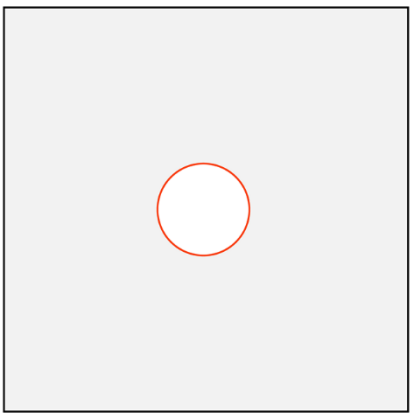
Self-Supporting Features

Self-Supporting Horizontal Hole

Horizontal holes are built during the printing process through a series of overhanging layers. The overhang distance of each layer increases slightly as the hole is built.

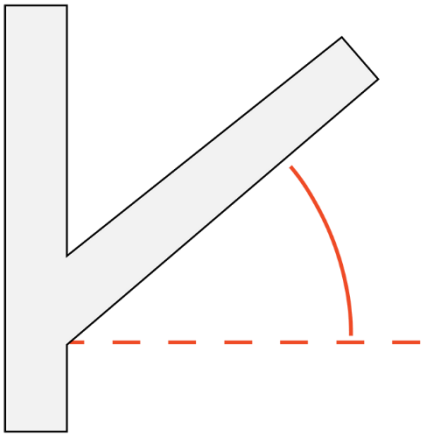
For small to medium holes, the maximum overhang is less than the recommended maximum support-free printing.

Holes as large as 25.0 mm can be printed without supports. Holes up to 75.0 mm are possible to print without supports, however some deformation can occur.



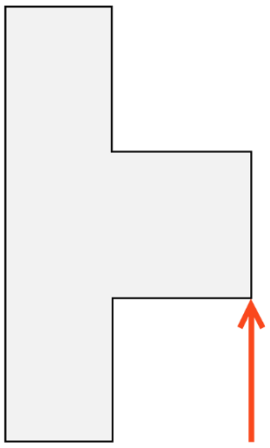
Self-Supporting Angle

The maximum self-supporting angle is 30° from horizontal. Angles as shallow as 15° may be printed without supports, but some deformation can occur.



Self-Supporting Overhang

Overhanging features are printable without supports in some instances. Overhanging features within 1.0 – 2.0 mm are possible to print without supports.



Supports are recommended for overhanging features longer than 2.0 mm.

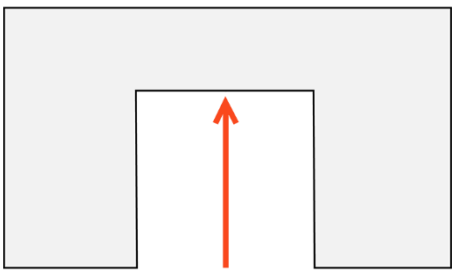
Tip: Fillets or chamfers can be utilized in the design process to help reduce the length of unsupported overhangs.

Self-Supporting Bridge

Bridging features are geometries where a span between two areas is connected by a new layer of material.

Bridges should be kept under a maximum length of 5.0 mm.

Tip: Chamfers and fillets can be utilized in the design process to reduce the effective bridging distance.

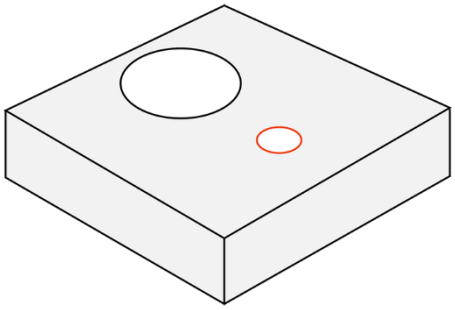


Best Practices

Venting and Draining

Resin flow must not be inhibited during the DLP and cDLM printing processes. Unvented and watertight volumes require special considerations.

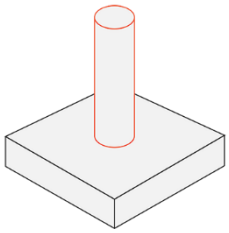
A small drain/vent hole should be used to enable reliable and accurate printing.



Vent holes should be around 1.0 mm in diameter. Slightly smaller holes are possible, depending on the material, printer, and geometry.

Drain/vent holes larger than 1.0 mm may be used and sealed with a printed plug after post-processing.

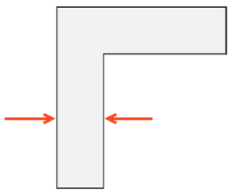
Quick Reference



Minimum Feature Size

Recommended minimum: 0.50 mm

Absolute minimum: 3.0 – 5.0 voxels

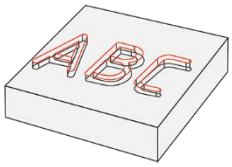


Wall Thickness

Recommended minimum: 1.50 mm

Absolute minimum: 0.20 m

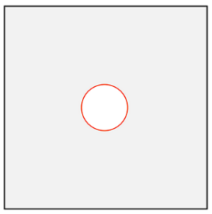
Recommended maximum: 12.0 mm +



Character Height

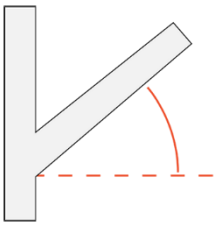
Raised (positive) character height minimum: 2.0 mm horizontal surface, 3.0 mm vertical surface.

Recessed (negative) character heigh minimum: 1.0 mm horizontal surface, 1.0 mm vertical surface.



Self-Supporting Horizontal Hole

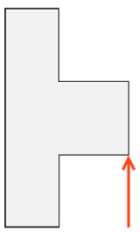
Recommended maximum: 25.0 mm diameter.



Self-Supporting Angle

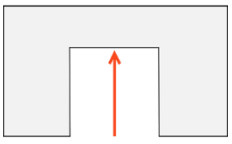
Recommended maximum: 30° from horizontal

Absolute maximum: 15° from horizontal



Self-Supporting Overhang

Recommended maximum: 1.0 - 2.0 mm



Self-Supporting Bridge

Maximum recommended: 5.0 mm