



# Design guide

## *Black Zirconia*

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***zetamix***  
by **NANOE**

# The printing limits of a black zirconia part :

- The values given below are found with the “Black Zirconia Template – 0,6 Diameter” print profile with a 0,6mm nozzle. By changing some parameters, some features can be improved, but at the expense of others.
- Part shrinkage: Due to post-printing treatments, the dimensions of the final piece will be different from the printed one. It is recommended to create the .stl file with the dimensions of the final piece, then change the scale in x,y and z to 125,3%, directly in the slicer.

## MAXIMUM PART SIZE

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The maximum size of a workpiece is determined by the size of the thermal debinding/sintering furnace chamber.

Thus, a part cannot exceed the following dimensions (after printing)=

Y= 200mm      Y=100mm (recommended)

X=70mm

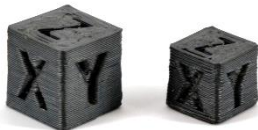
Z1=55mm

Z2=70mm

## MINIMUM PART SIZE

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6mm x 6mm x 6mm



The minimum final dimensions are a cube of 6mm. A smaller piece will have non protruding edges and not good details.

Limiting factors are the width and height of the layer. Decreasing the layer height as well as the printing speed can improve the sharpness of the print.

## MINIMUM WALL THICKNESS

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1mm



The width of the wall must be proportional to the width of a layer, since such a thin wall does not have an infill.

At least more than 1 layer width is required, i.e., about 1mm thick (see figure A). It is possible to print a single layer width but taking into account the fragility of the part this is not recommended (see figure B).

If the Height/Width ratio > 5, there is a risk of the wall collapsing during the postprocess.

## MINIMUM UNSUPPORTED OVERHANG

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$\theta = 40^\circ$



The angle between the floor and the piece must be at least  $40^\circ$ . If it is not the case, supports will be required.

But if the angle is between the roof of the piece and the floor the piece must be at least  $15^\circ$

## MINIMUM PIN DIAMETER

$\varnothing = 2,3mm$



Figure A

The minimum size of the diameter for a pin is 2,3mm.

Be careful, if the height is over 27mm for this diameter, the piece will be very brittle (see figure A). It is therefore recommended to reinforce the base.

## MINIMAL HOLE SIZE

$\varnothing = 0,6mm$



The minimum size of a vertical hole is 0,6mm in diameter. A smaller hole may be closing up.

For a horizontal hole, the minimum size is 1mm in diameter. A smaller hole may be closing up.

## MINIMUM EMBOSSED/ DEBOSSED FEATURE



Width = 0.6mm (1 layer width)  
Height = 0.4mm (2-layer height)

This information is especially useful for writing a text on a surface. Printing too small may cause the material to be indistinguishable from the rest of the surface.

## SOME EXAMPLES

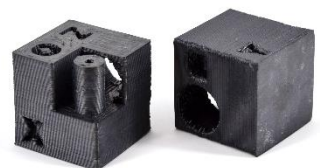
Connecting parts



Holes parts



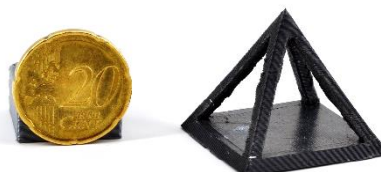
Complex parts



Engraved details



Angles

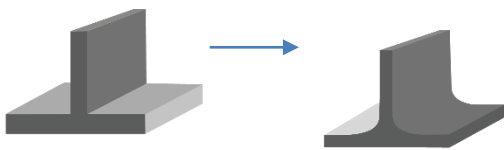


# Different printing constraints related to ceramics

- **Beware of critical angles in the printing part :**

Make sure that the characteristics of the part match the criteria mentioned above. Furthermore, reinforcing the part at critical points will limit the risk of fracture during the various processes:

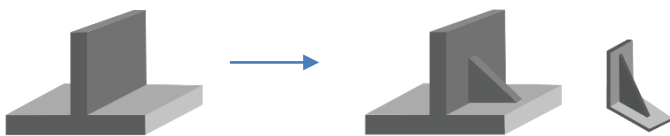
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Avoid abrupt change of size.

Prefer rounded corners to steep angles

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Possibility to reinforce thin walls

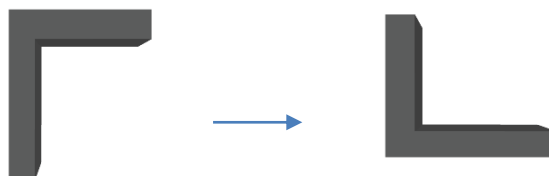
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- **Optimise the contact of the surface with the bed**

The direction in which the piece is printed will have a significant impact. It can:

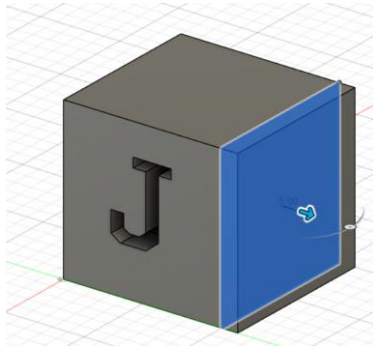
- Reduce printing time
- Increase surface quality
- Increase mechanical properties (FDM printing of Zetamix is anisotropic due to the orientation of the layers)
- Avoid the presence of support

The presence of a large flat surface can help along with the choice of the side to be printed first.



- **Dimensional Precision**

The expected tolerance of our alumina filaments and the technology is **+/- 1%**



- **Twisted parts**

Some parts can twist during the postprocess depending on the geometry and the way you printed them (see figure A et B).

If the Height/Width ratio  $> 2$ , there is a risk of twisting. Thus, it is necessary to print one layer clockwise and the other one counterclockwise

