

## 1- Zetamix General guidelines silicon carbide

Zetamix filaments are on a fine powder ( $< 1.0 \mu\text{m}$ ) and a thermoplastic binder system for the FDM process. Green parts need a binder removal in a two-stage debinding process before being sintered. First debinding step is dissolving the binder in a solvent bath. In the second debinding step the remaining binder is thermally removed. These general guidelines are based on the processing of test parts with a wall thickness of 2 mm.

It is recommended not to exceed a wall thickness of 6mm.

The recommendations are considered to work as a standard guideline and must be adapted to individual wall-thickness and part-design.

### Filament characteristics

<b>Typical material properties</b>	
<i>Product</i>	Filament for FDM process
<i>Binder basis</i>	Polyolefinebased binder system
<i>Appearance</i>	Grey filament

<b>Typical processing properties</b>	
<i>Printing temperature</i>	120-130°C
<i>Plate temperature</i>	40 °C
<i>Nozzle size</i>	From 0.2mm to 1mm 0.6mm recommended
<i>Retraction</i>	Yes (but not necessary)
<i>Printing speed</i>	Up to 200mm/s (very dependent on the printer) 40-60mm/s recommended
<i>Debinding process</i>	Two-stage debinding process
<i>1st step : chemical debinding</i>	24 hours in an acetone bath at 40°C (it depends on the geometry of the part) → Mass loss > 12% 2 hours drying in ambient atmosphere
<i>2nd step : thermal debinding</i>	Thermal debinding up to 700 °C with a 10°C/h ramp, 1 hour holding time, all achieved under primary vacuum
<i>Sintering</i>	Sintering to 2200°C with a up to 300°C/hour ramp, 1 hour holding time, all achieved under argon (90 mb)
<i>Sintering shrinkage rate</i>	x,y = 16.8% $\pm$ 1% z = 22.6% $\pm$ 1%
<i>Oversize factor</i>	In x,y direction = 120.2% In z direction = 129.2%

### Printing instructions:

The filament is softer than plastic filaments. Therefore, it is preferable to use a driving gear which is not too much aggressive and will not crush the filament (ideally a grooved driving gear). The filament can be grinded by the extruder, that's why it should be cleaned regularly.

In order to avoid filament grinding, we recommend to load the filament without any pressure at all and then delicately increase it until the filament just gets pushed through the PTFE tube.

We recommend printing the piece on flexible plate. The part can be detached by bending it.

If the room temperature exceeds 25°C, we recommend using an air conditioner or an external fan.

The filament is advised to be used for one year.

An Ideamaker profile is available on the website for you to use or draw inspiration from.

## 2- Debinding and sintering Recommendations

### First step: solvent debinding (acetone bath)

#### Step 1: Solvent bath

- It is recommended to debind the printed parts in an acetone bath at 40 °C for 24hours.
- The duration is depending on wall thickness and part geometry but takes at least 2 hours.
- At least 12% of the weight of the piece should be removed during the solvent debinding step (after drying).

#### Step 2: Drying

- Let the parts dry in ambient air for about 1 hour.
- The parts shouldn't be placed on an absorbent fabric to dry off.
- This step is essential to measure the mass removed by the solvent debinding step.

### Second step: thermal debinding and sintering

Because of the shrinkage, there is a change of volume.

Please modify the scale in the slicer before printing, as it is mentioned in "Oversize factor".

Place the parts on a crucible inside the furnace for both thermal debinding and sintering.

#### Thermal debinding cycle :

- 10°C/h ramp to 700°C under primary vacuum
- 1 hour holding time

#### Sintering cycle :

- 100°C/h ramp to 150°C under secondary vacuum
- 300°C/h ramp to 2200°C under partial vacuum (90 mb argon)
- 1 hour holding time at 2200°C
- 300°C/h cooling ramp, return to secondary vacuum under 1000°C