

## 1- Zetamix General guidelines White Zirconia

Zetamix filaments are on a fine powder (< 1.0 µm) 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.

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>                  | White filament                 |

| <b>Typical processing properties</b> |  |
|--------------------------------------|--|
| <i>Printing temperature</i>          | 180 °C   |
| <i>Plate temperature</i>             | 40 °C  |
| <i>Nozzle size</i>                   | From 0.4 mm to 1 mm (need to adjust the printing speed, the wider the nozzle the slower)<br>0.6mm recommended                        |
| <i>Layer thickness</i>               | 0.2mm (possibility to go from 0.1 to 1mm, need to adjust printing speed)   |
| <i>Printing speed</i>                | 20mm/s - 35mm/s  |
| <i>Debinding process :</i>           | Two-stage debinding process  |
| <i>1st step : chemical debinding</i> | 6 hours in an acetone bath at 40°C (it depends on the geometry of the part) → Mass loss > 5%<br>2 hours drying in ambient atmosphere |
| <i>2nd step : thermal debinding</i>  | Thermal debinding up to 500 °C with a 8°C/h ramp   |
| <i>Sintering</i>                     | 20°C to 1475°C with a 50°C/hour ramp<br>2 hour holding time  |
| <i>Shrinkage rate</i>                | 21.2%±1% (x, y and z)  |

### Printing instructions:

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 before a long print. To make sure that the printer is ready we recommend preheating the system and start extruding some material. If nothing comes out of the nozzle there might be a clog. Therefore, the nozzle must be replaced or cleaned.

We recommend the use of a wear resistant nozzle, for instance with a ruby or ceramic tip. We recommend printing the piece on a glass plate in order to obtain a good surface quality. The part can be detached from the build plate using an ultrasound bath.

## Printing parameters: Refers to the IdeaMaker parameters guidelines

*Scale (oversize factor):* 126.9%

*Printing speed:* from 20 to 35 mm/s depending on the shape of the part

*Layer height:* from 0.3mm down to 0.1mm

*Retraction:* 1mm at 20 mm/s

*Fan speed:* 100% (the higher the better the print quality)

*Wall line count:* at least two

*Infill:* any 2D pattern (triangles, grid, honeycomb, rectilinear)

*Infill density:* from 100% down to 5% (the top surfaces above the infill depends on the pattern infill density)

*Top/bottom surface number:*

- for a 0.1mm layer height: 10
- for a 0.2mm layer height: 5

*Supports structure:* Can be printed using the same material or a soluble material via a dual extrusion system. In order to have a great surface quality at least 3 dense top layers should be printed between the support structure and the part.

## 2- Debinding 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.
- At least 5% of the weight of the piece should be removed during the solvent debinding step (after drying).
- The duration is depending on wall thickness and part geometry but takes at least 2 hours.

#### Step 2: Drying

- Let the parts dry at the ambient air (the part can be placed on a tissue to absorb the water)
- The duration is depending on wall thickness and part geometry but takes at least 2 hours.
- This step is essential to measure the mass removed by the solvent debinding step

### Second step: thermal debinding

Place the parts in a crucible on a refractory powder bed to accommodate shrinkage and support the part during debinding.

The most reliable process consists of a heating rate of 8°C per hour from 20°C to 500°C. It takes 2 and a half days to complete the debinding.

For small parts the process can be as described below:

| segment | From (°C) | To (°C) | Heating rate (°C/h) | Dwell time (h) | Segment duration (min) | Duration in total (h) |
|---------|-----------|---------|---------------------|----------------|------------------------|-----------------------|
| 0       |           | 20      |                     |                | 0                      | 0                     |
| 1       | 20        | 125     | 35                  |                | 180                    | 3h                    |
| 2       | 125       | 200     | 50                  |                | 90                     | 4h30                  |
| 3       | 200       | 215     | 22                  |                | 40                     | 5h10                  |
| 4       | 215       | 250     | 11                  |                | 180                    | 8h10                  |
| 5       | 250       | 280     | 20                  |                | 90                     | 9h40                  |
| 6       | 280       | 320     | 8                   |                | 300                    | 14h40                 |
| 7       | 320       | 510     | 24                  |                | 480                    | 22h40                 |

## 3- Sintering Recommendations

Sintering in a high temperature furnace

Thermal cycle: 20 - > 1475°C with 50°C/h ramp, in 29h  
holding time 2h  
1475 - > 20°C with 100°C/h ramp, in 15h

Because of the shrinkage, there is a change of volume. Please modify the scale in the slicer before printing, as it is said in "Printing parameters".