CREATIVE & RESPONSIBLE CHEMISTRY

DESIGN GUIDELINES

USING SUPPORT GEL COPSIL 3D® ADD-GEL

Innovation at the heart of polymer chemistry

INTRODUCTION

At COP, we leverage our knowledge and expertise in polymer chemistry to design innovative solutions. In our R&D laboratory, our engineers and PhDs in chemistry have developed a new support solution for COPSIL 3D® silicones: COPSIL 3D® ADD-GEL.

3D printing of RTV-2 silicone elastomers

3D printing of RTV-2 silicone elastomers is particularly suitable for the manufacture of flexible parts with complex design or small series production (prototyping). Specific additive manufacturing equipment is required to process these materials that are liquid before crosslinking. We suggest using a support gel to produce parts with specific geometries.

COPSIL 3D® ADD-GEL is a new support developed by our company. We strongly recommend using it to print parts with overhangs greater than 45° or bridges longer than 5 mm. This technology complements other solutions on the market and allows us to solve specific printing problems. We can help you to identify the best support solution for your part.

This guideline has been exclusively designed for the combined use of COPSIL 3D® ADD-GEL with our COPSIL 3D® range. The series of good practices for support gel implementation that are described in this guide, are not contractual and do not guarantee the final production of the part.

**Please note: this document is a general guideline. Advice and recommendations should be adapted to the structure of the parts to be printed*

INTRODUCTION

Why use COPSIL 3D® ADD-GEL ?

COPSIL 3D® ADD-GEL is a support gel for RTV-2 COPSIL 3D® silicone elastomers which benefits are:

- Support complex structures,
- Improve final aspect of printed parts by liquid deposition (smoothing),
- Ready-to-use,
- Transparent (useful for supervising your printing in progress),
- Chemically inert with silicone,
- Water rinseable,
- No impact on mechanical properties of printed silicones,
- Neutral pH,
- No hazard pictogram.

Compatible silicones

COPSIL 3D® ADD-GEL* has been developed for our RTV-2 printable silicones. We have a range of compatible references available in various hardnesses:

- COPSIL 3D® 4025 (40 ShA)
- COPSIL 3D® 2525 (25 ShA)
- COPSIL 3D® 1025 (10 ShA)
- COPSIL 3D® 0525 (05 ShA)

*Please note that ***COPSIL 3D® ADD-GEL is not suitable for printing RTV-1 and LSR silicones.***

Compatible printers

COPSIL 3D® ADD-GEL and COPSIL 3D® silicones can be used on 3D printers fitted with two-component liquid printing systems with a static mixer and the possibility to add a needle.

SUMMARY

MODEL PART

To illustrate our point and best practices regarding the use of COPSIL 3D® ADD-GEL, we will use a model of an accordion-type part. This part is a perfect example of an element with specific geometries that are difficult to print without a printing support.

Figure 1 - 3D plan of the part

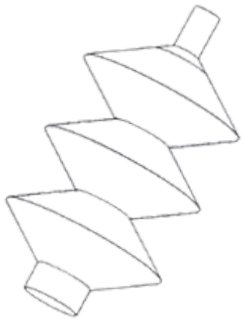


Figure 2- 3D drawing of the part
line version

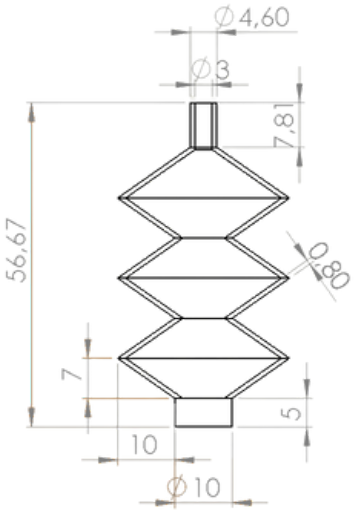
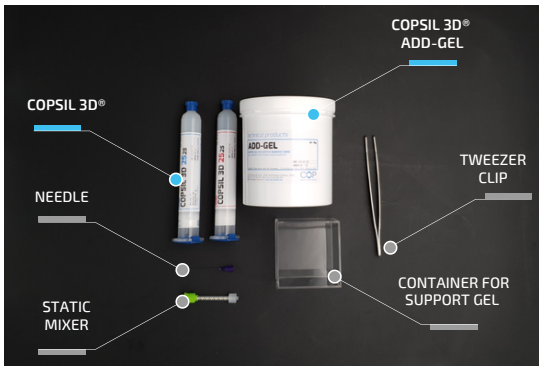


Figure 3 – 2D drawing

HOW TO USE THE SUPPORT GEL: MAIN RULES

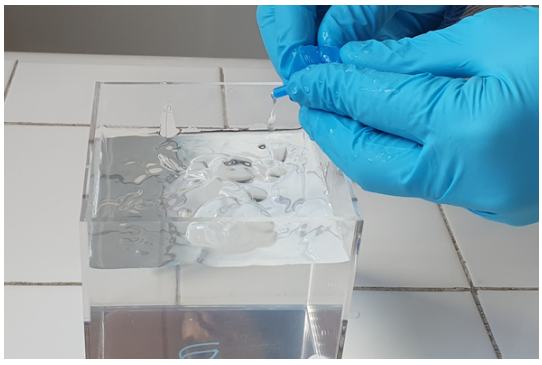
#1 - Make sure you have the right equipment



Before you start printing, do not forget any of the following items:

- COPSIL 3D® ADD-GEL,
- COPSIL 3D® Silicones cartridges ,
- A container for support gel,
- A static mixer,
- A needle,
- A tweezer clip

#2 - Anticipate gel entrapment



Hollow parts might trap some gel. Therefore, we recommend including, when designing the part, a feature that allows the gel to drain away. In this manner, you will be able to purge it once the part is cured.

#3 - Better make printing in an air-conditioned space at stable temperature

As the gel is sensitive to evaporation, we recommend using the carrier gel at temperatures not exceeding 25 °C.

STEP 1: PREPARE THE PART PRINTING

#1 - Set the length and width according to the printing plate and the container

Length and width should be adapted to the printing plate of the printer.

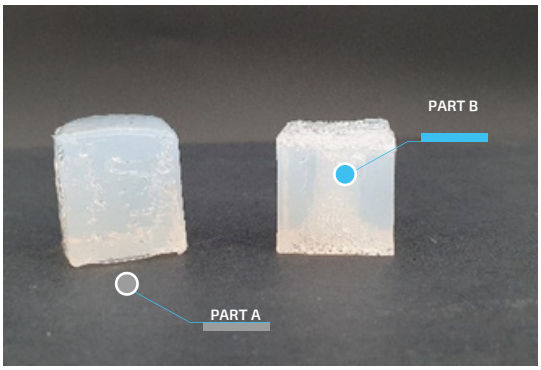
#2 - Limit the height of the part to a maximum of 150 mm

Maximum height is limited by the static mixer length, the needle length, and the container depth.

#3 - Leave a 10 mm minimum space between the printed part and the container

Margin prevents the printhead from hitting and moving the container during the printing process.

#4 - Compensate Z axis deformation



Gel back pressure changes the shape of the liquid bead by increasing its length on Z-axis while reducing it on X and Y axes. For a cube with a volume of 20 mm, a deformation of 3 mm on the Z axis can be observed (A).

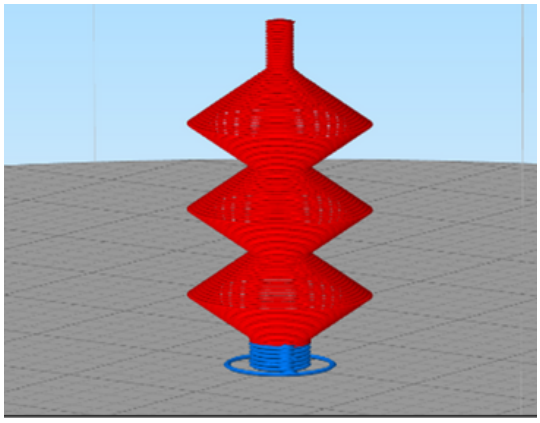
We recommend increasing the values of the dimensions on X and Y when designing the 3D plan, and/or compensating by changing the filling ratio to about 90% (B).

STEP 1: PREPARE THE PART PRINTING

#5 - Moves of the printhead in support gel

If possible, anchor the print starting point to the bottom of the container to stabilize the part and prevent it from rotating.

#6 - Use a slicer with a multiprocessing option



Silicone 3D printing with support gel requires the use of a slicer (slicing software) allowing multiprocessing.

We recommend using it to adapt settings to overhanging and unsupported areas.

On the model part, two processes were used. The first in blue and the second in red.

#7 - Homogenize motion and print speeds

We recommend limiting the motion and print speeds to 30 mm/s. The speeds for the model part have been defined as 30 mm/s for process 1 (blue part) and 10 mm/s for process 2 (red part).

STEP 1: PREPARE THE PART PRINTING

#8 - As possible, use spiralized "Vase" mode

This print move progressively the Z-axis during printing. This reduces speed variations, stops and restarts of the printing process.

#9 - Define heights according to the container

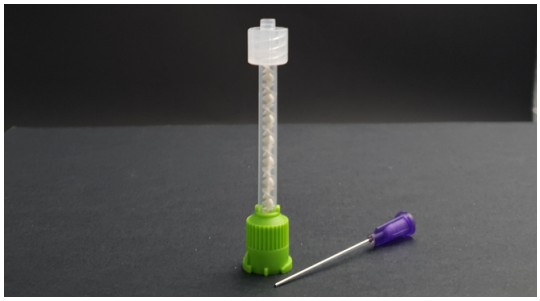
Calibrate nozzle or needle height according to height of the container base.

#10 - Provide 0.5 mm of elevation when moving the printhead

Set 0.5 mm minimum vertical shrinkage elevation height in the slicer to avoid impacting the layer being printed.

STEP 2: INSTALL THE MACHINE COMPONENTS

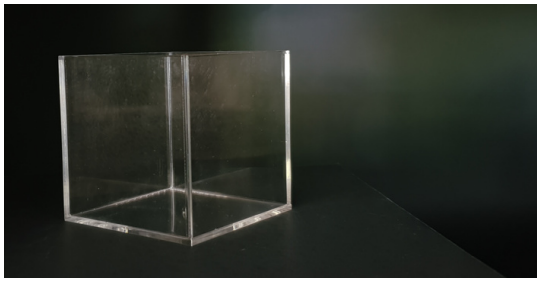
#1 - Use a needle with static mixer



RTV-2 silicone 3D printing in the support gel requires the use of a needle. Adapt needle length to the container height. The needle used for the accordion measures 34 mm.

STEP 3: PREPARE CONTAINER

#1 - Use a flat surface container



The container in contact with the printing plate must be flat. The 3D silicone parts must be anchored on a flat surface, with no level or curvature irregularities.

#2 - Centre the container on the printing plate

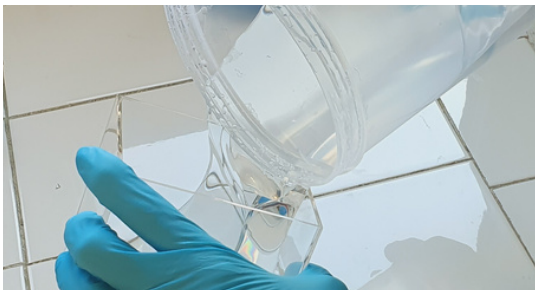
We recommend printing in the centre of the printing plate. Adjust the container position accordingly.

STEP 4: IMPLEMENTATION OF SUPPORT GEL

#1 - Leave room for overflow in the container

Printed part volume will add to support gel volume. Gel could move out of the container. Although there is no risk (the gel does not flow), we recommend providing a larger container volume.

#2 - Pour the support gel softly to avoid air bubbles



Air bubbles generated by pouring may alter quality of part (entrapped bubbles, holes). Be sure to pour the product gently to avoid any defects in the part. Replace the support gel when loaded with bubbles, while pouring or after printing.

STEP 5: START PRINTING

COPSIL 3D® ADD-GEL transparency allows you to supervise the printing process to control that the process settings are well adapted.

STEP 6: STOP PRINTING

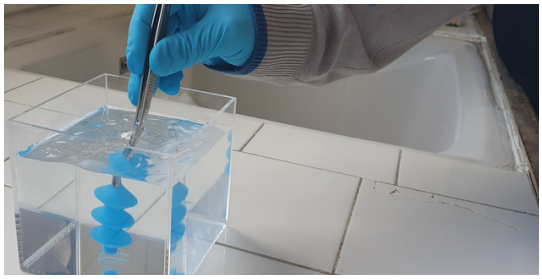
#1 - Close container

To increase support gel shelf-life of and avoid evaporation during the part curing time, we recommend closing or covering the container when not used.

#2 - Leave the part rest for 2 hours minimum before removing it from the container

The part can be use after 2 hours of rest in gel.

#3 - Use tweezers to remove part without damage

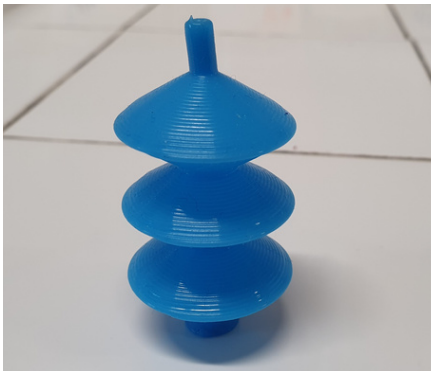


The use of tweezers allows the printed parts to be removed from the gel carrier without damage.

#4 - Drain part and flush it with water

Using support gel COPSIL 3D® ADD-GEL

Chemically inert, COPSIL 3D® ADD-GEL, can be flushed with water without damaging your part. If the support gel does not contain too many bubbles, it can be re-used.



YOUR PART IS NOW READY FOR USE

CREATIVE & RESPONSIBLE CHEMISTRY

Innovation at the heart of polymer chemistry

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