Application Note

# VasKit

## Description

The VasKit perfusable device is a bioreactor developed for channel perfusion and visual inspection of fully or partially bioprinted tissues. It has four female Luer lock connectors serving as either inlet or outlet points, each leading to a gel connector.

## Kit Components

VasKit device:

- Bounding box dimensions: 36*85*19 mm
- Maximal build volume: 6 CC
- Distance between channel and glass: 1 mm.
- Materials: USP Class VI Biocompatible SLA resin, Glass, EPDM 70, Stainless Steel, medical device grade silicone, Nylon

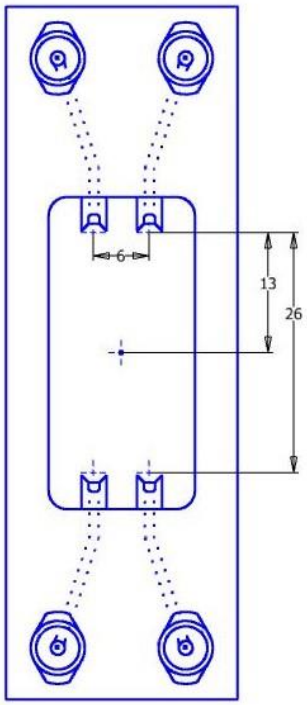


Figure 1. Distance between channel

The VasKit device is reusable. Sterilization methods: UV, 70% EtOH, autoclavable at 121°C for 15 minutes.
*Make sure to unscrew Luer connectors before autoclaving*
Other Components available for order:

- 1.5 mm Allen Key
- GelMA C (2 x 3 mL), photoinitiator: LAP 0.25%
- $CaCl_2$ Crosslinking Agent
- CELLINK PLURONICS (2 x 3 mL)
- Luer Female/Female Connectors (2 pcs)
- Stopcocks (4 pcs)

Unsterile consumables to autoclave:

- Nozzles, 5 pcs of each type:
  16G, Grey, ID 1.19 mm
  18G, Green, ID 0.85 mm
  20G, Pink, ID 0.6 mm
  22G, Blue, ID 0.4 mm
  25G, Red, ID 0.25 mm
- Luer Plugs (4 pcs)
- Luer Female to barb connectors

## Storage

All bioink components should be stored at 4-8°C. Protect the bioink from light and avoid temperature fluctuations. The shelf life of GelMA C is 4 months. The shelf life of CELLINK PLURONICS is 12 months. The valid expiration date is always stated on the package. Ensure the cartridges are capped prior to storage to prevent drying. Do not freeze GelMA C and CELLINK PLURONICS, it can adversely affect its printability.

## Bioprinting Vascular Channels

To print channels, an aqueous sacrificial ink composed of Pluronic F127 can be used. CELLINK PLURONICS can be easily printed at room temperature, then liquefied below 4°C and removed by suction.

For the infill material, we recommend GelMA C, a material composed partly of gelatin methacryloyl (GelMA), which is a gelatin-derived semi-synthetic hydrogel. This component retains important biological properties based on integrin-binding sequences and metalloprotease digestion sites, which are necessary for cellular adhesion, growth and proliferation. The modification with methacryloyl side groups makes it possible for the GelMA molecule to undergo rapid crosslinking when subjected to UV light in the presence of a photoinitiator (0.25 % LAP for 405 nm or 365 nm UV light), resulting in new covalent bonds that make the gel stiff enough for incubation. To retain the gel shape during incubation and perfusion, the infill material has been supplemented with nanocellulose and alginate. These ingredients are biocompatible and contributes with printability and the option of crosslinking using $CaCl_2$ containing Crosslinking Agent. The resulting material, GelMA C is printable at room temperature, as well as castable at 37°C, it forms a stiff and relatively shape stable gel.



## Suggested bioprinting methods

When using a 3D bioprinter, it can be a challenge to precisely layer a CELLINK PLURONICS filament on top of a hydrogel. The CELLINK PLURONICS display a slippery behavior that would sometimes result in failure in achieving the desired geometry. It is therefore extra important that the casted bottom layer is as flat as possible and to position the nozzle at correct height.

*Printing CELLINK PLURONICS on GelMA C*

A way of printing channels embedded in GelMA C is to cast a thin gel layer (at least 500 µL) of incubator warmed GelMA C on the bottom of the flow device and knock it gently against the desk to generate a flat surface. Let the gel cool for a short while to gel. Then print a CELLINK PLURONICS channel between two inlets/outlets. Cast another layer of warm GelMA C in order to cover the CELLINK PLURONICS. UV crosslink and evacuate the PLURONICS by gently flushing with chilled water. Gravity is often enough to pull cold liquefied out when tilting the device. Make sure not to use excessive forces.

*Coaxial printing*

Another channel printing method is to use co-axial needles where CELLINK PLURONICS is situated in the filament core, surrounded by GelMA C at the periphery. On the bottom of the VasKit device, a thin layer of GelMA C can be casted. When printing between two gel connectors, only CELLINK PLURONICS would be extruded at the start and end points, whereas both CELLINK PLURONICS and GelMA C would be extruded along the channel path. Full channel embedding can be done by casting GelMA C over the channel filament and start/end points, followed by UV light crosslinking and CELLINK PLURONICS evacuation by gently flushing with chilled water.

Our website Bioverse is a source for STL files and G-codes.