Printing Microfluidic Channels with GrabCAD Print Pro™

Overview:

Microfluidic fabrication traditionally involves time-consuming, multi-step manual assembly using machined or etched layers. Stratasys PolyJet™ 3D printing—specifically with J5 and J8 series printers—offers a cost-effective, repeatable, and scalable method to create complex internal microfluidic channels with high precision and minimal post-processing.

Importantly, this technique enables the rapid prototyping of functional microfluidic devices, allowing designers and researchers to iterate quickly and validate performance before committing to more expensive and time-consuming production methods.

This method is ideal for researchers, engineers, and labs that need high-quality prototypes with embedded channels, controllable geometries, and compatibility with bioanalytical workflows.

Practical Applications include:

- Lab-on-a-Chip Biomedical Devices
- High-Throughput Surface Plasmon Resonance (HT-SPR)
- Environmental Monitoring Sensors
- Reaction Flow Studies Single-Cell Sorting with Surface Acoustic Waves
- Microfluidic-Based Processors

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Required Supplies and Tools:

- Stratasys Polyjet J8/J5 Series Printer
- GrabCAD Print Pro utilizing “Air” channel assignment and pausing capability
- Printed Agilus or Elastico squeegee
- IPA wipes for squeegee cleaning
- 90/10 Glycerol/IPA solution (temporary support material)
- PolyJet waterjet part cleaner or low-PSI compressed air

Printed Agilus/Elastic Squeegee

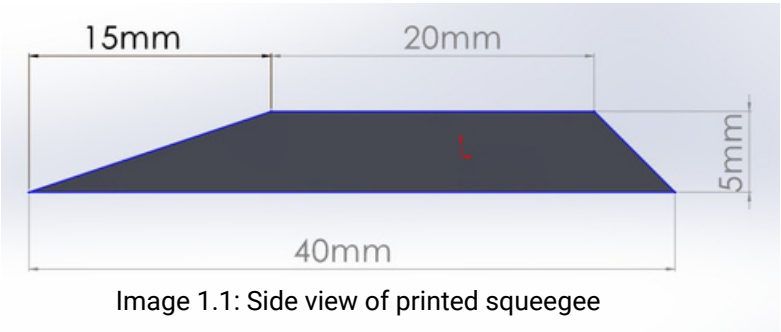

Image 1.1: Side view of printed squeegee

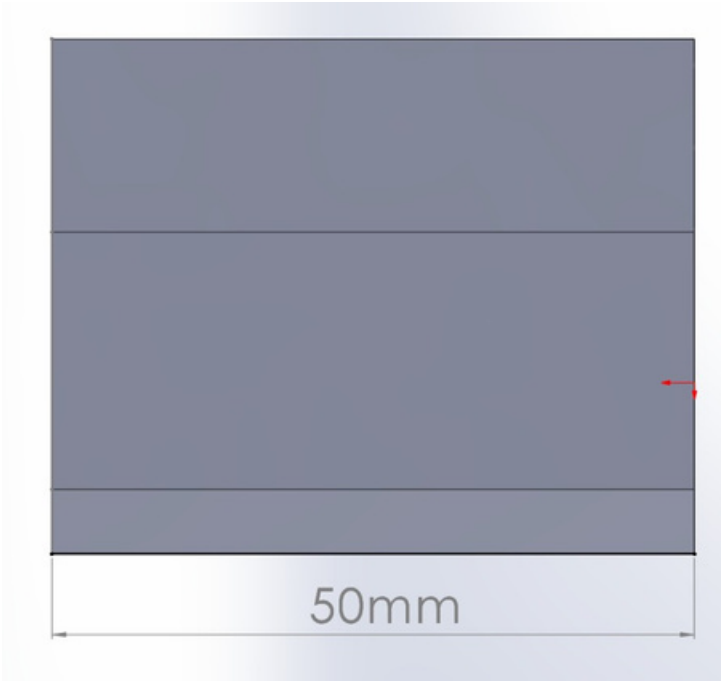

Image 1.2: Top view of printed squeegee

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Design Guidelines:

1. **CAD Modeling:**
   - Model microfluidic channels as separate CAD bodies to ensure correct assignment in GrabCAD Print Pro.

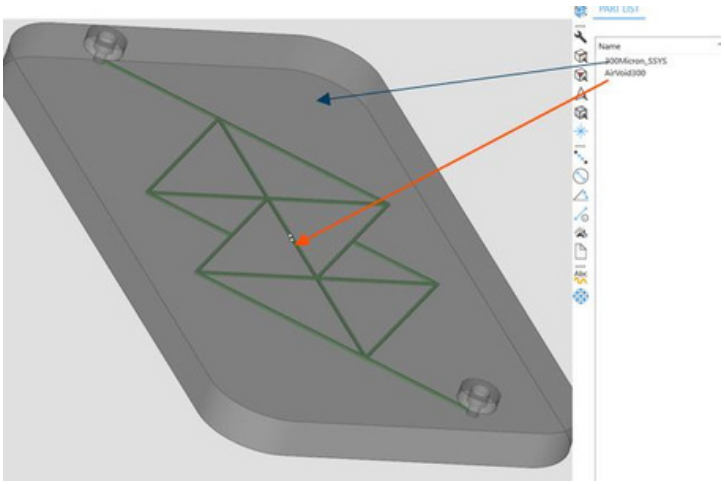

Image 2: Separate CAD body created for channel

   - Include positive 2-4° draft angles on vertical channel walls to reduce the risk of collapse during capping.

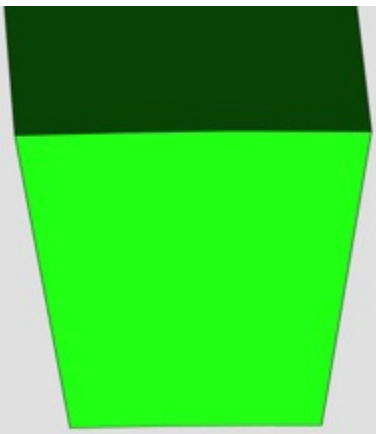

Image 3: Cross-section of 300micron channel with positive draft angle.

   - Maintain minimum channel width of 300 µm for reliable, repeatable results.

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Design Guidelines:

1. **CAD Modeling**: *Continued*
   - For features requiring optical detection, design the cover layer in a transparent material such as VeroClear™.
   - For ports or connections, use rubberlike materials such as Agilus or Elastico™ to enable pressure sealing and tubing integration.
   - Design inlet and outlet geometry to minimize support material use. Where possible, face inlets and outlets vertically so that no support material is required. If inlets or outlets must be on a horizontal surface, design them so that approximately 0.5 mm of the opening is filled with support—enough to contain the IPA/Glycerol solution during the mid-print pause but still accessible for manual cleaning afterward.
   - Avoid overhang-heavy interior geometries to minimize print distortion.
2. **Material Assignment in GrabCAD Print Pro**
   - Assign microfluidic channel bodies as "Air" material.
   - Use Glossy finish for the part body to aid in optical transparency

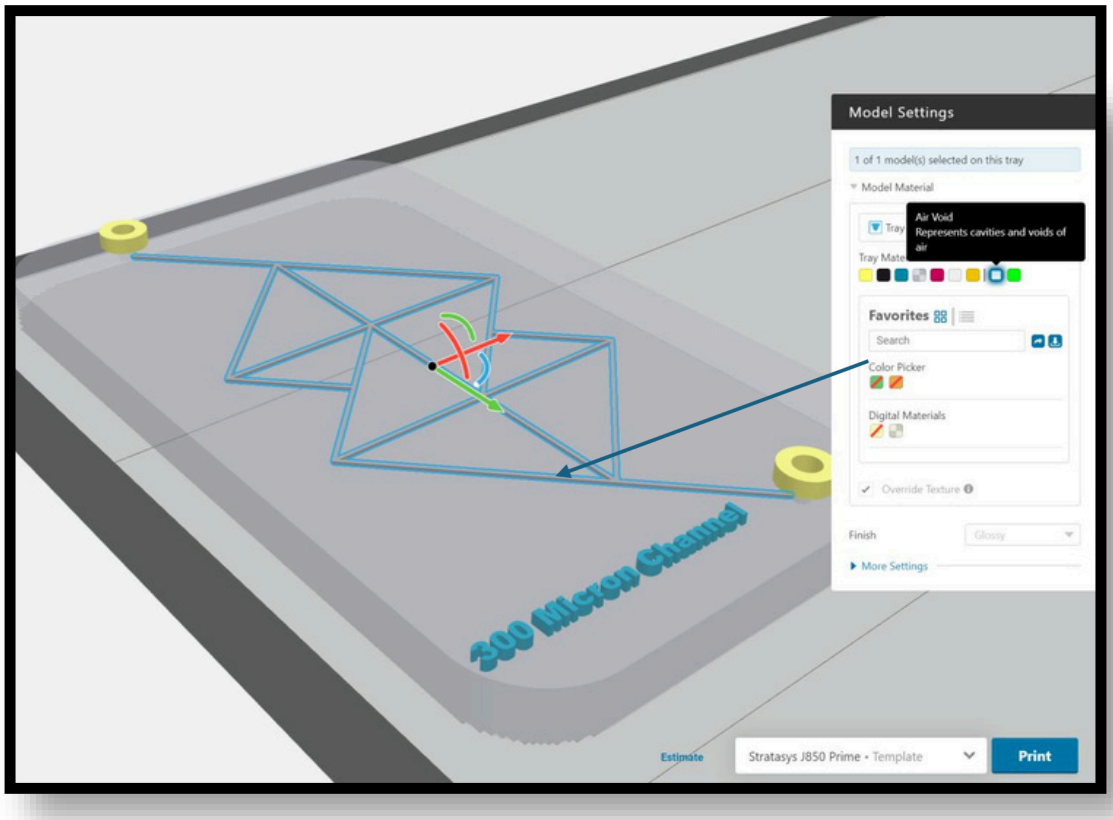

Image 4: Channel CAD body assigned as “air” in GrabCAD PrintPro

Printing Microfluidic Channels with GrabCAD Print Pro

Design Guidelines: *Continued*

3. **Material Assignment in GrabCAD Print Pro**
    - Insert a pause just before the capping layer is printed over the air voids.
    - Note: Native CAD Program should be used to determine the Z pause height for the top of the channel.

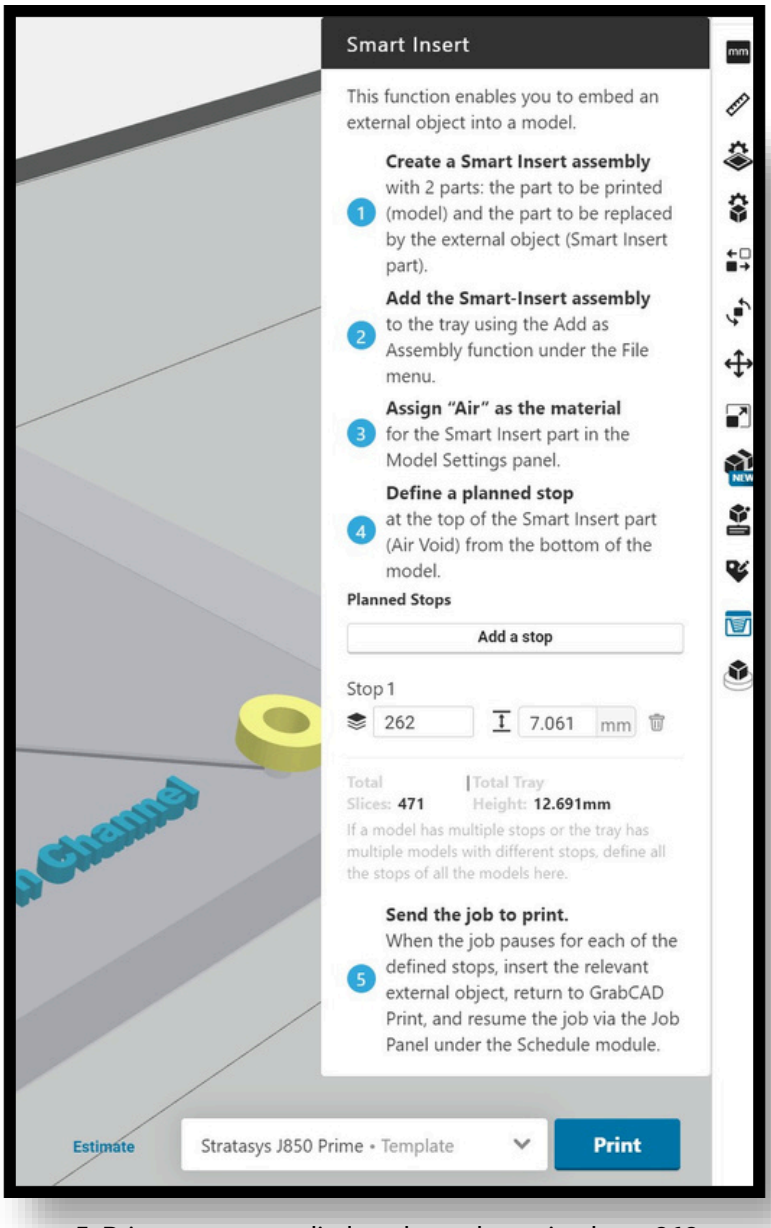

Image 5: Printer pause applied to channel capping layer 262 or at a print height of 7.061mm

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Fabrication Process:

1. **Printing Setup**
    - Ensure channels are marked as Air in GrabCAD Print Pro.
    - Set layer pause immediately before the capping layer of the microchannel.
2. **Mid-Print Procedure** - When the printer pauses
    - Do not clean the part surface.
    - Apply a few drops of the IPA/Glycerol solution directly over the exposed channels.
    - Using the printed Agilus squeegee, push the solution into the channels, ensuring full penetration.
    - With the flat edge of the squeegee, gently pull across the surface to remove any excess fluid.
    - Clean squeegee with IPA rag between passes.

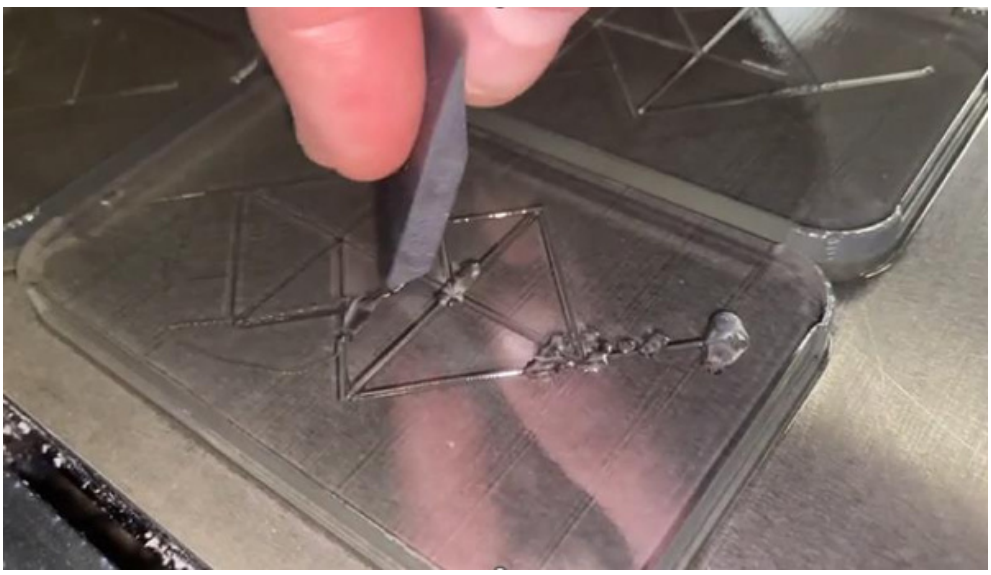

Image 6: Glycerol/IPA solution being squeegeed into channels during printer pause

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Fabrication Process: *continued*

3. **Resume Print**
    - Resume the print so the next layer seals the filled channels, creating a watertight cap over the voids.
4. **Post-Processing**
    - Once the part is printed, remove the temporary IPA/Glycerol support solution using:
        - PolyJet waterjet cleaner (recommended)
        - OR low-pressure compressed air

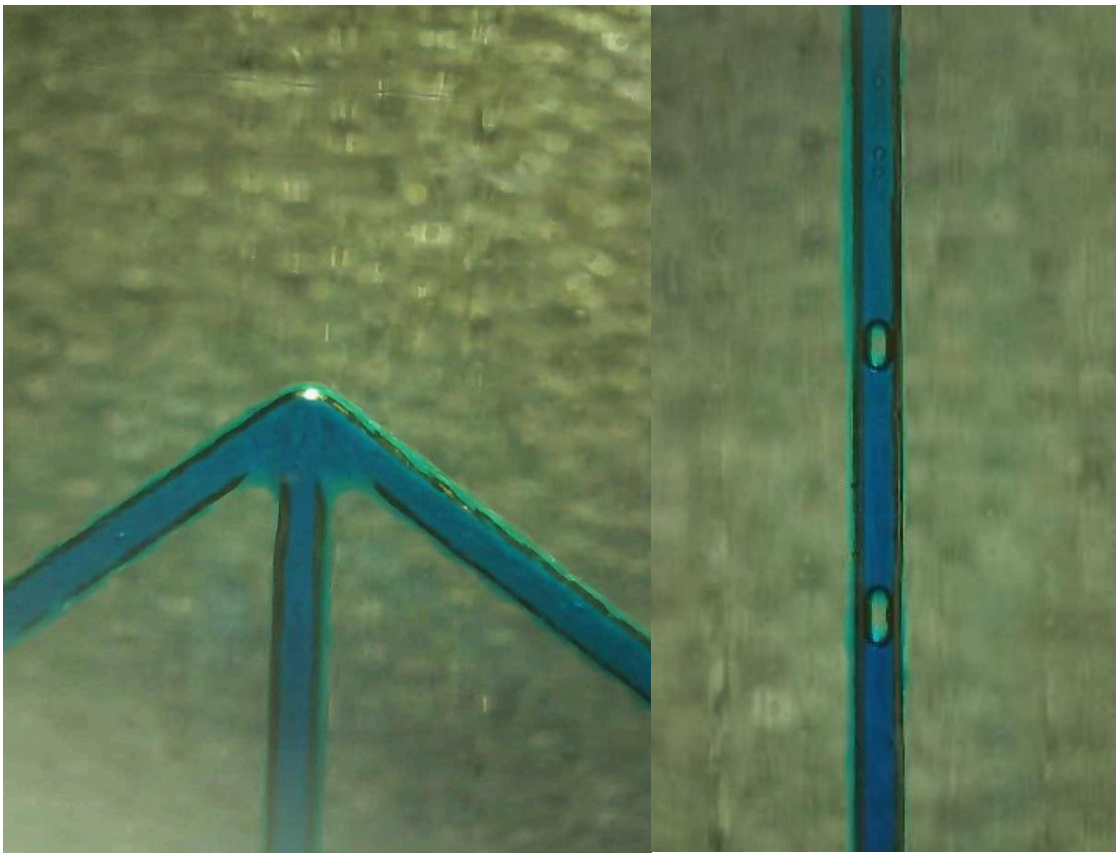

Image 7: 300-micron channels cleared of glycerol/IPA solution now with dyed water flowing through