REV	AUTHOR	PUBLISHED
-	JST	11/27/2023
A	New Picture	12/07/2023

Instructions to Fabricate Fly Bubble Cartridges

Tools, Parts, and Materials Needed:

- 3D-Printed Frame
  - FB FAC V3 – Frame Rigid
  - FB FAC V3 – Frame Flexible
- 3D-Printed Insert
  - FB FAC V3 – Insert
- 3D-Printed Scratch Guard
  - FB FAC V3 – Scratch Guard
- Lasercut Acrylic Window
  - FB FAC V3 – Window
- ¼”-Wide Sticky-Back Teflon Tape
  - https://catalog.cshyde.com/item/all-categories-tapes-with-adhesive-ptfe-tapes/categories-tapes-with-adhesive-super-smooth-ptfe/r233-25-18
- 7X 4-40x0.5” 82° Flat Head Screws
  - https://www.mcmaster.com/91771A110/
- 4-40 Thread Cutting Tapping Tool
  - Recommended: https://www.mcmaster.com/2522A665/
- 90° Countersink Tool
  - Recommended: https://www.mcmaster.com/3013A42/
- Drill Press and/or powered hand drill
- Box cutter/X-Acto knife/other sharp precision blade
- Needle file set

Part Preparation:

- Included with these instructions are the STP/STL files needed to have the printed parts for the cartridges fabricated by an outside vendor. All STLs were exported in millimeters.
- Also included with these instructions are the DXF/PDF files needed to have the lasercut window fabricated by an outside vendor. The drawing should be correctly scaled when opened by any software, but in case it is not, it should be 120.4mm x 127.0mm (4.742” x 5.000”).
- It is recommended to order extra inserts and acrylic windows as these are the part most likely to become damaged over time with use. No more than one extra insert and window per cartridge should be needed for years of continuous research.
- All images in this document have been included as individual PNG files for easier legibility.

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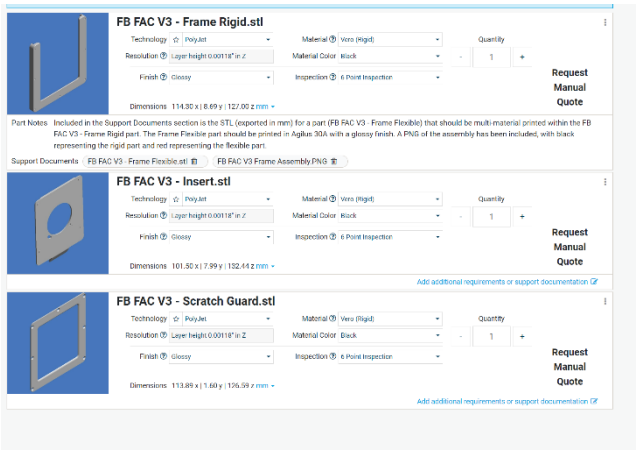
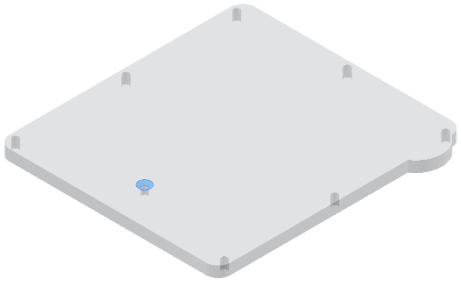
- The frame part is composed of two individual files (one rigid, the other flexible) that need to be printed together in one part (called “multi-material” printing) for the frame to operate correctly. We printed frames on a Stratasys J8 PolyJet printer, with the rigid section of the part composed of “VeroUltraBlack” resin and the flexible section of “Agilus 30A resin”. Any vendor with multi-material printing capabilities should be able to print the two sections of the part together from resin with similar enough characteristics, but it is recommended to seek out vendors with Stratasys’s PolyJet printing capabilities to guarantee success – any rigid resin should work for the rigid section of the part, and any flexible resin with a hardness rating close to Shore 30A should work. Regardless, it is recommended to submit these parts to Stratasys Direct Manufacturing as they have the capabilities to print with the specified resins. See the picture included in this section for the options chosen in the quote submission form for Stratasys Direct Manufacturing (pay attention to the “Finish” option as a glossy texture is desirable for certain faces of these parts.



- The frame will need all 7 mounting holes fully tapped with 4-40 threads. Chucking the tapping tool in a powered hand drill will make the job a lot quicker, but take care not to break the frame (water is an effective lubricant for this material).
- The acrylic window (FB FAC V3 – Window) will need to be lasercut from 6mm or ¼” acrylic. It will also need a single hole chamfered with the 90° countersinking tool. SendCutSend will be able to perform the lasercutting operation, but it’s likely you will need to take care of the chamfering yourself. The chamfered hole allows for easier insertion of the flies into the cartridge. The picture to the right shows the chamfer highlighted in blue on the top face of the part – the bump-out on the right side of the part will help orient the part. The rigidity of a drill press will make chamfering quicker and cleaner, but a powered hand drill will also work.



- It is assumed you are planning to have or already have a stack of Fly Bubbles. If not, then please find the instructions to fabricate those as it’ll be helpful to have a bubble around when aligning the cartridge during assembly.

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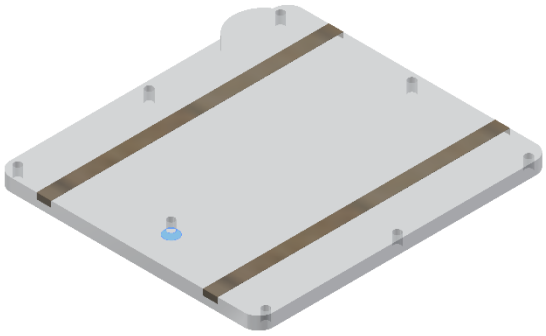
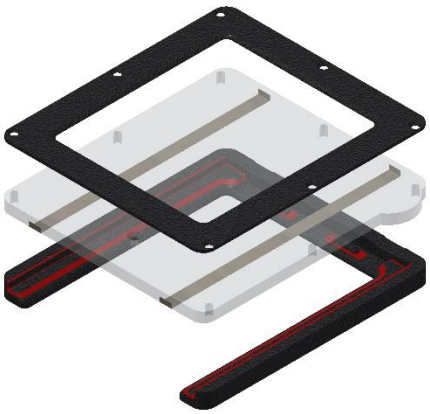
Assembly Procedure:

- Teflon tape is needed to reduce friction between the window and bubbles. Adhere two strips of Teflon tape to the interior face of the window. The strips should run in the same direction as the bubble is inserted. The outside, long edge of each strip should be ~3/4” from the nearest edge of the acrylic window. The head and tail of each strip should wrap around the edges of the window to reduce the chance that the tape will get caught and peel up as bubbles are inserted. It is recommended to start by adhering the free end of the tape roll to the front or back lasercut face of the window. Wrap the tape around the edge and along the large, interior face of the window, tensioning the tape as it’s pressed down to ensure straightness and parallelism with the sides of the window. The tape can then be wrapped around the opposing edge and adhered to the opposing lasercut face. Trim excess tape. The picture above shows the final result. Notice the tape and the chambered edge do not share the same face of the window.



- The scratch guard, taped window, and frame need to be assembled together. Some adjustment will need to be peformed after assembly to ensure a snug fit with the bubble and insert. Stack the scratch guard, taped window, and frame as shown in the picture to the right (note the orientation of the window in the assembly). The holes through the scratch guard feature countersinks on one side – these should face upward to accept the head of the screws. Insert, and lightly tighten, all seven screws through the assembly.



- The cartridge assembly now needs to be adjusted to ensure a solid fit. Stack the insert and a fly bubble together. The four bumps protruding out from the insert should align with holes in the fly bubble – the fitment between the bumps and holes may or may not be enough to securely hold the fly bubble to the insert. Slide the insert and bubble into the cartridge assembly, as shown in the images below. The bubble should

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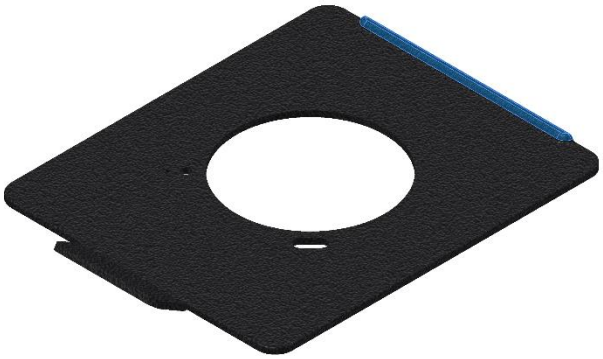

project away from the acrylic window and through the large hole of the insert. Squeeze the sides of the cartridge so there is some resistance between the insert and frame as the insert is slid in and out – tighten the screws down as you're squeezing to lock this fitment in place. If the insert feels like it's rubbing or wiggling more than it should at points as it's inserted, then readjust just the screw nearest to the point of concern. Additionally, the insert should click satisfyingly into position when fully inserted. If your insert is not inserting fully or the detent requires too much force to overcome, remove the insert and gradually scrape or file away material from the top face of the raised ridge at the rear of the insert (highlighted in the picture above) until the click of the detent is satisfyingly clicky.

- Your cartridge is now ready for use. Inserts should never be swapped between cartridges as the fitment will vary among cartridges and inserts. It is recommended to label each insert/cartridge pair to ensure they do not become swapped.