ARTICLE

Supplemental Information

Cutting Rig

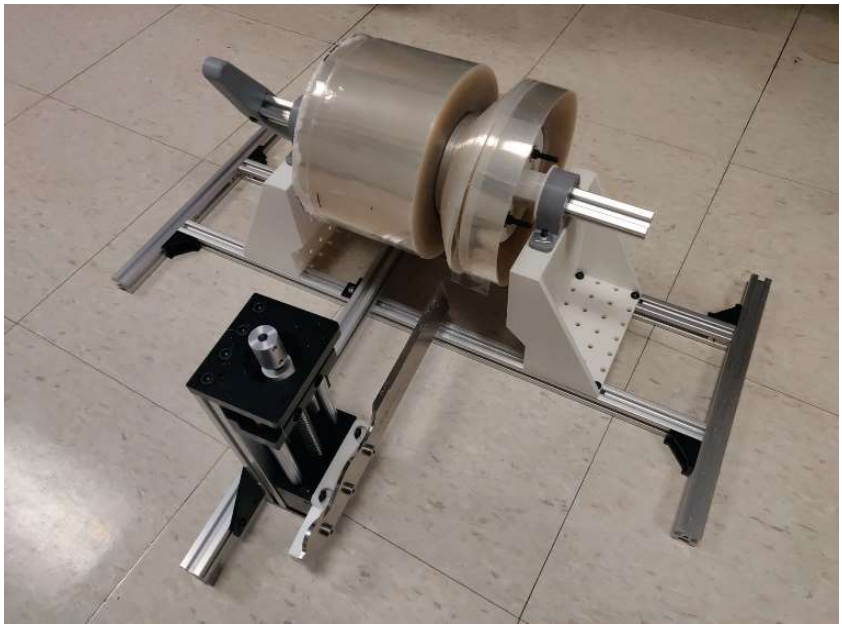


Figure S1: A cutting rig which is used to cut the PDMS to exactly 60mm width.

Automated Manufacturing System Performance

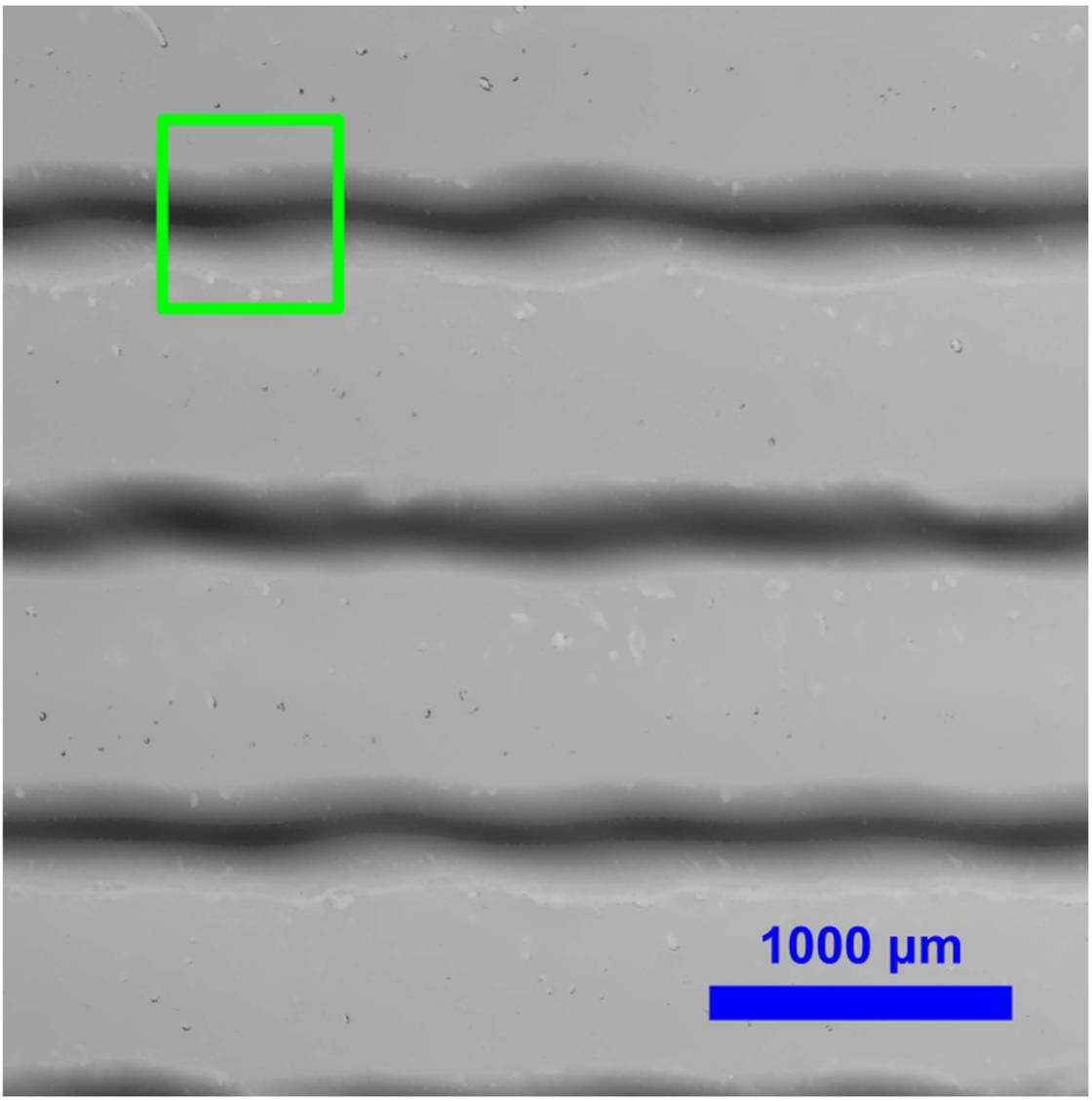


Figure S2A: 3D-profile of three channels on a Olympus OLS 4000 LEXT confocal microscope. Height profile has been converted to greyscale, with darker pixels being deeper and lighter pixels being shallower. Black pixels represent a height of 6 µm and white pixels represent a height of 165 µm. The green square represents the location where Figure 11A is taken.

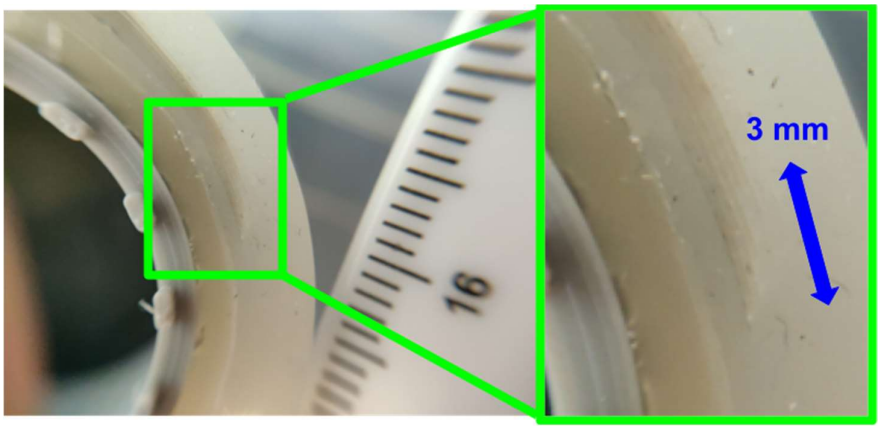


Figure S2B: A cross-sectional profile of a core showing layer-to-layer registration.

Housing Model and Caulking Technique

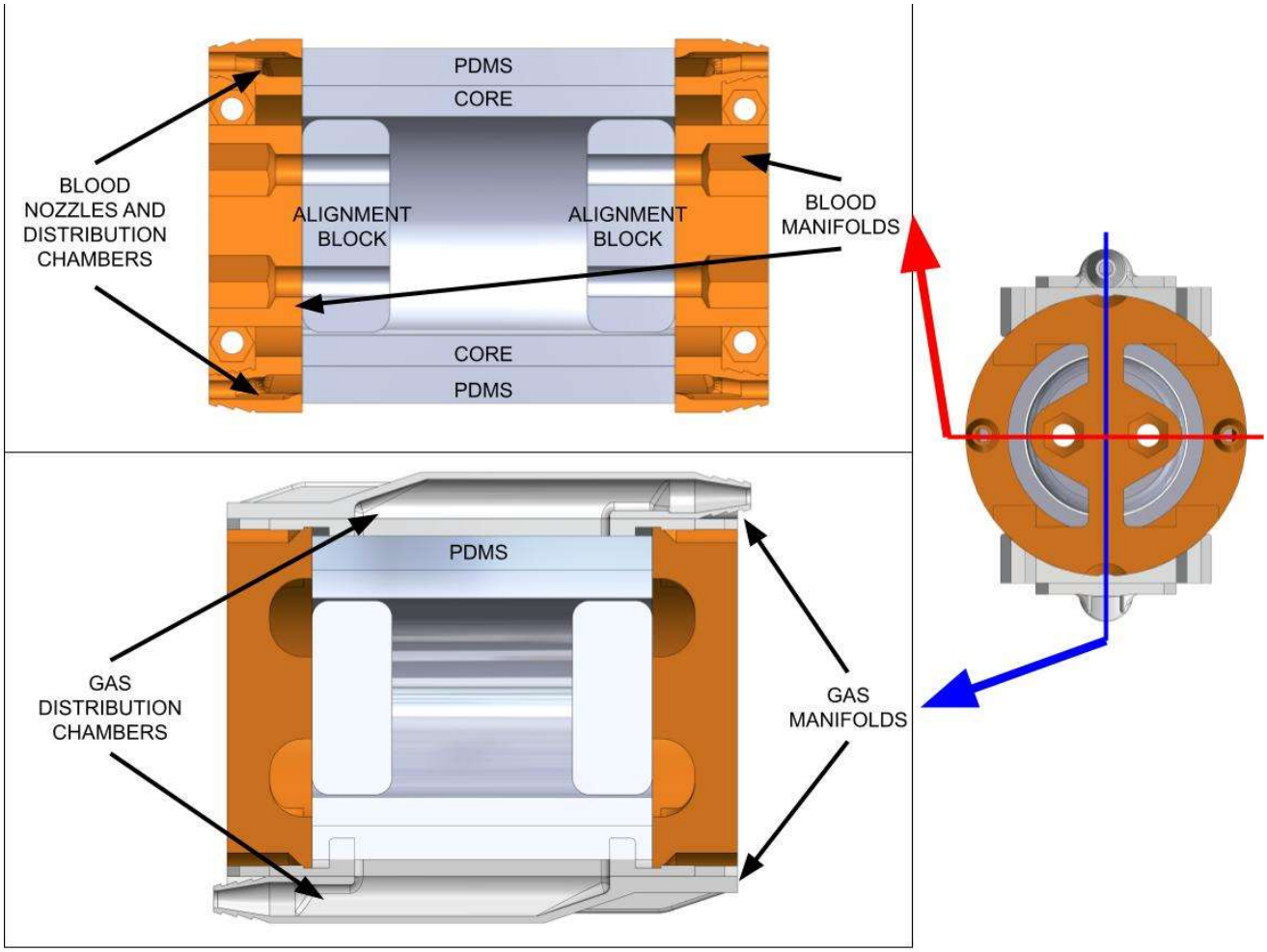


Figure S3A: Housing CAD model for Device B and C

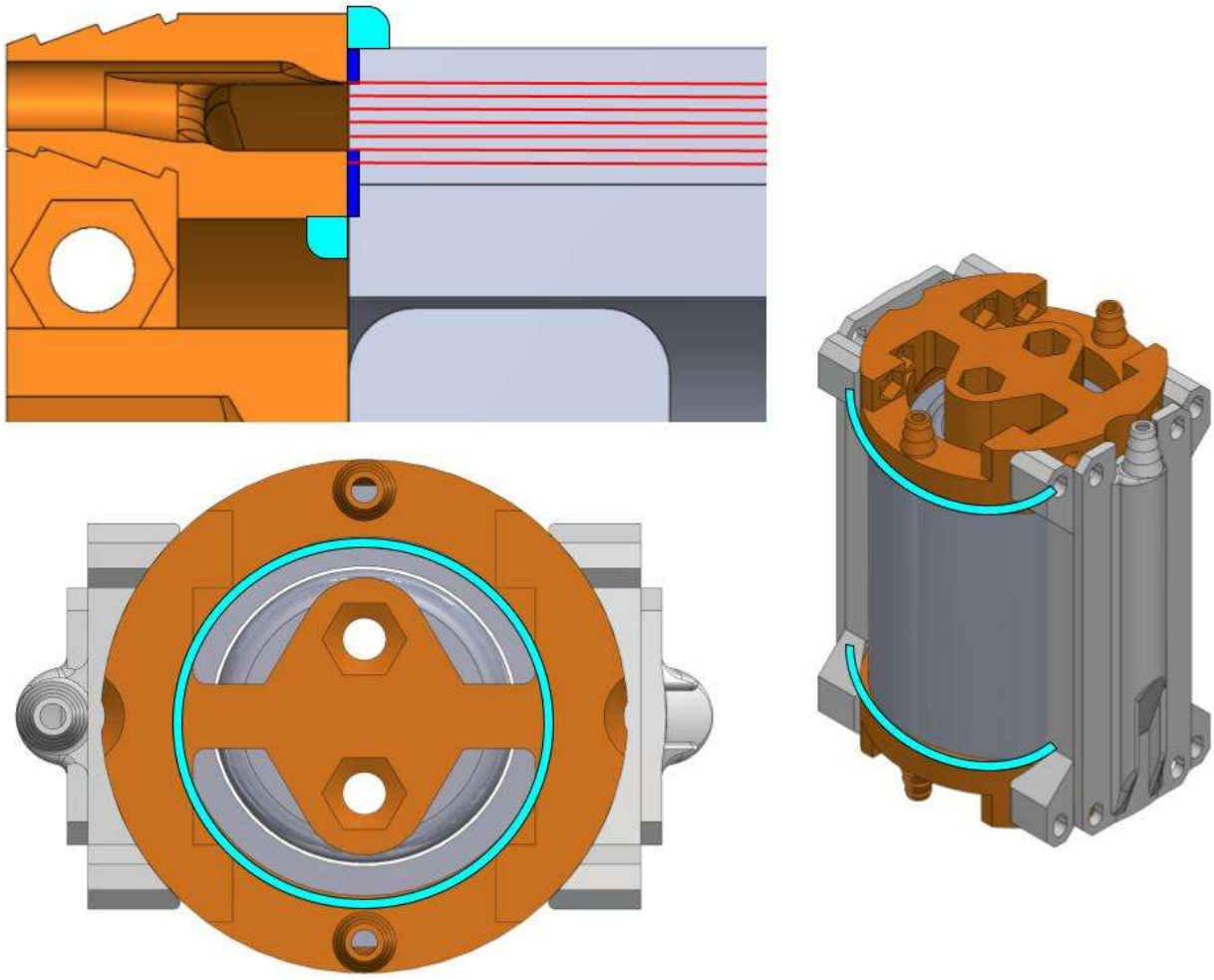


Figure S3B: Housing and Caulking Technique for Device B and C, blood phase.
Caulking is applied to the corners denoted in cyan. Capillaries (red) mostly feed into the empty chamber in the housing. The area denoted in blue represents the area where the core comes in contact with the housing. Unlike the caulking technique used for Device A, there is no silicone caulking in this area. Since caulking does not spill into the flowpath, the number of capillaries available is not a function of the caulking, but only by the number of patent capillaries facing the blood distribution area in the housing.
For Device A, the gaps where silicone caulking could be applied to the points in cyan did not exist. Therefore caulking was applied to the equivalent location in blue. The caulking would spill out into the blood distribution, blocking many of the capillaries.

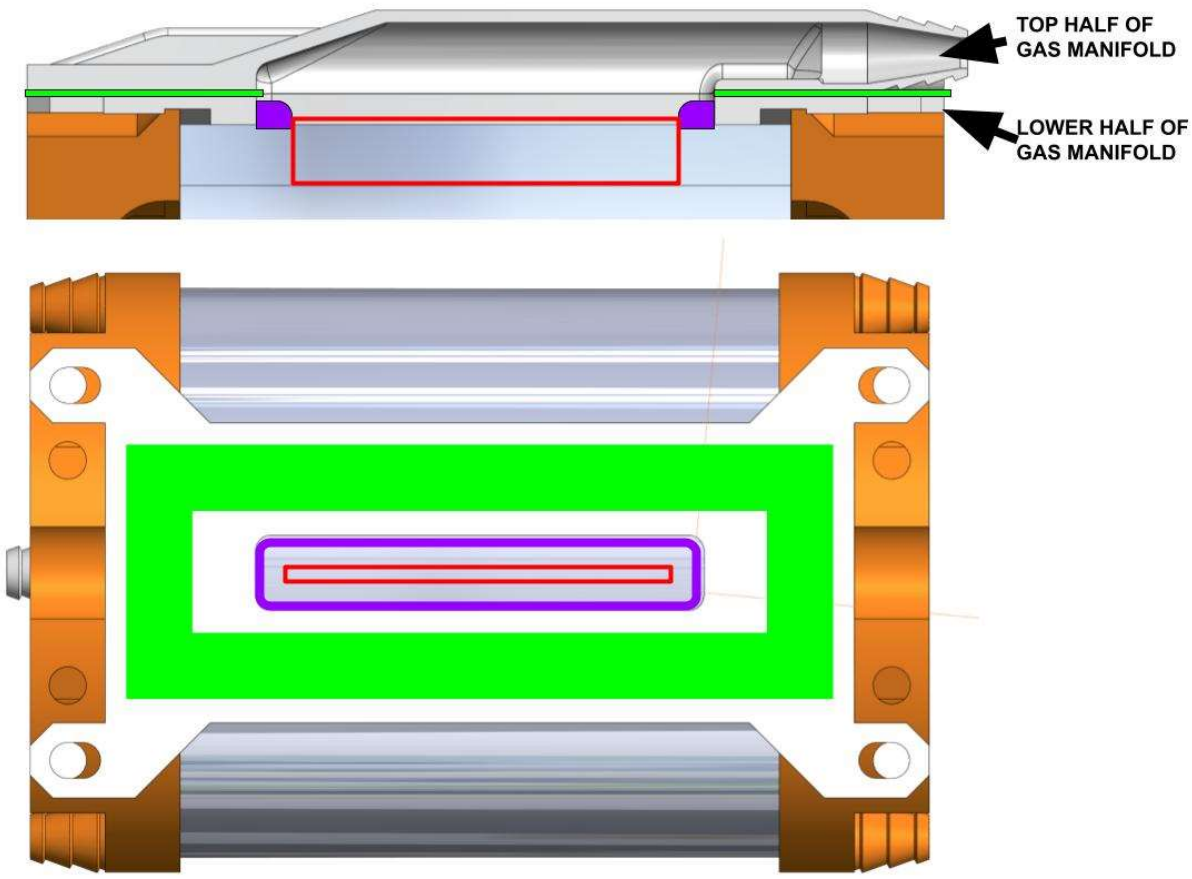
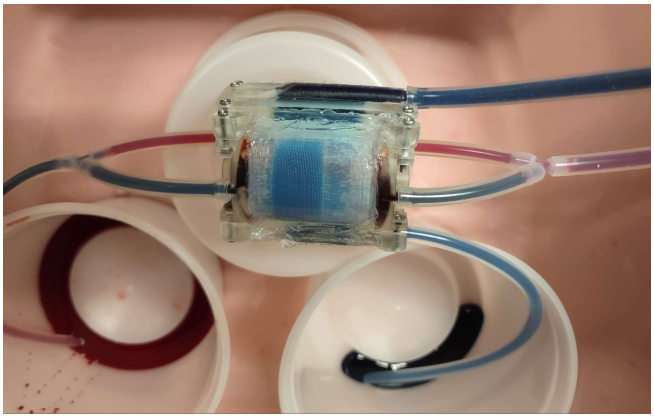


Figure S3C: Housing and Caulking Technique for Device B and C, gas phase, and scheduling of assembly.
Day 1: The caulking for the blood phase (Figure S3B) is applied and allowed to cure.
Day 2: The lower half of the gas manifold is installed. Silicone caulking is applied at the locations denoted in purple and allowed to cure. This serves the dual purpose of keeping the gas phase sealed and preventing the device from coming apart in the next step.
Day 3: A razor is used to cut downwards into the core (red) and through the gas capillaries which are traveling which run circumferentially around the diameter of the device and are passing perpendicularly to the plane of this incision. The tension of the PDMS pulls the core open where the incision is made, exposing these gas capillaries. Since the caulking has been given time to cure, this opening does not spread beyond the area encircled by the caulking (purple). Silicone caulking is applied to the area where the lower and upper halves of the gas manifold meet (green), and the top half of the gas manifold is installed.

Leak Testing Additional Photographs



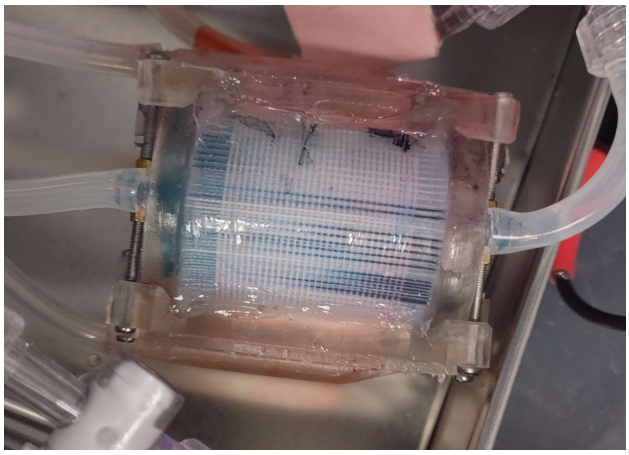
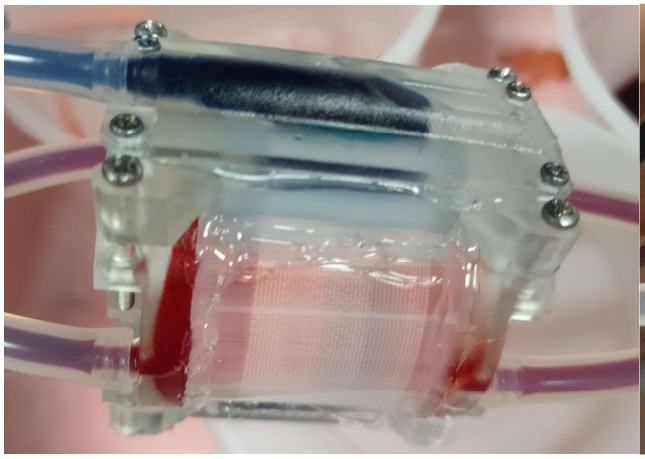


Figure S4A (left): Device A during leak testing. There is a leak between the blood phase and gas phase in one half of the device, resulting in blue dye entering the blood phase. That half of the device was blocked off.
Figure S4B (right): A closeup of Device A, showing some residual dye. Since Device A had channels that were further spaced apart, the channels are more visible.



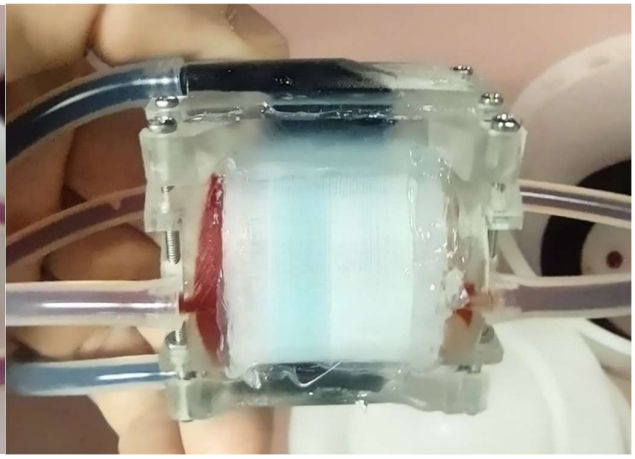


Figure S4C: A closeup of Device B during leak testing, with clearly visible blood and gas channels.
Figure S4D: Device C without overlying labels, showing a clear review of the gas exchange area

Full Water pH Results

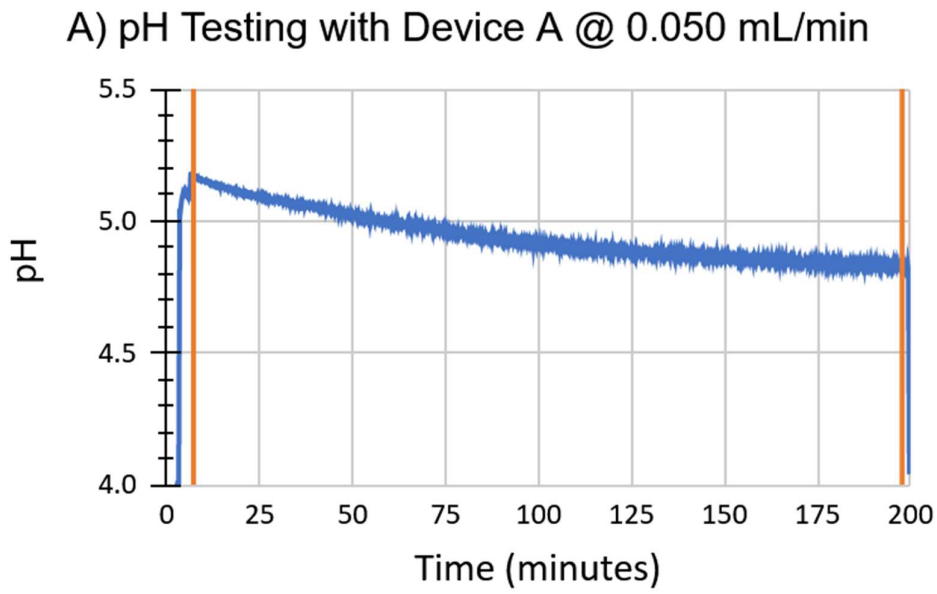


Figure S5A: The full length of the water pH testing for Device A. Low values can be seen at the beginning and end of the test, and represent the values that the sensor reads when it is not in solution. For Device A, there was no attempt to calibrate the sensor. There is also no attempt to condition the water, nor remove CO_2 after it is added. 100% CO_2 is applied for the entire duration of the test.

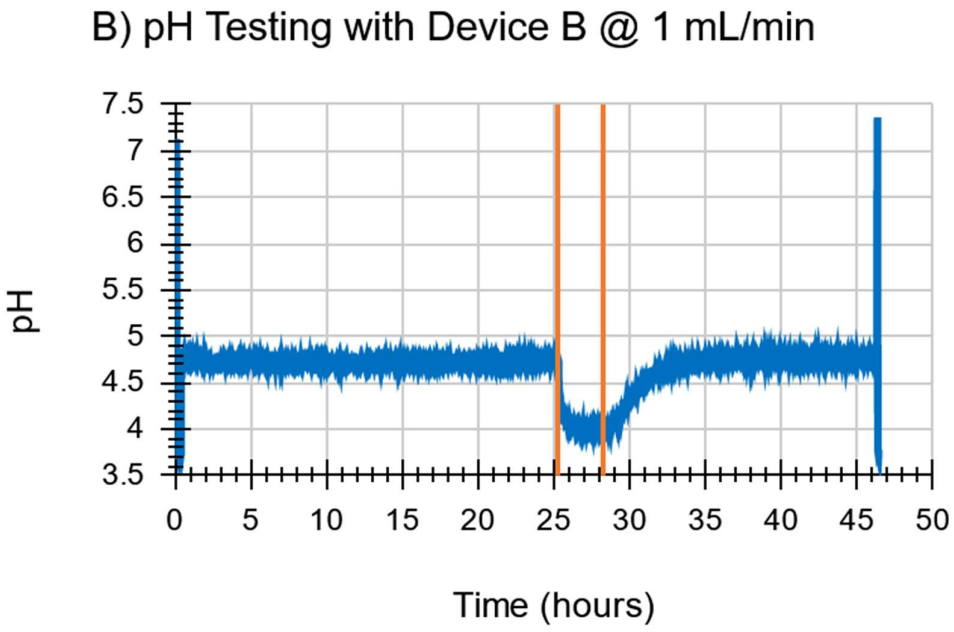


Figure S5B: The full length of the water pH testing for Device B. The system is given 24h to stabilize. The area between the two orange lines represents when the CO_2 is set to 100% for 3 hours, and a corresponding drop and then rise in pH can be seen. High values can be seen at the beginning and end of the test. This is the result of calibration. In retrospect, the attempt to calibrate the sensor was futile since there were too many other variables for quantitative consistency, hence why the graphs should be interpreted qualitatively.