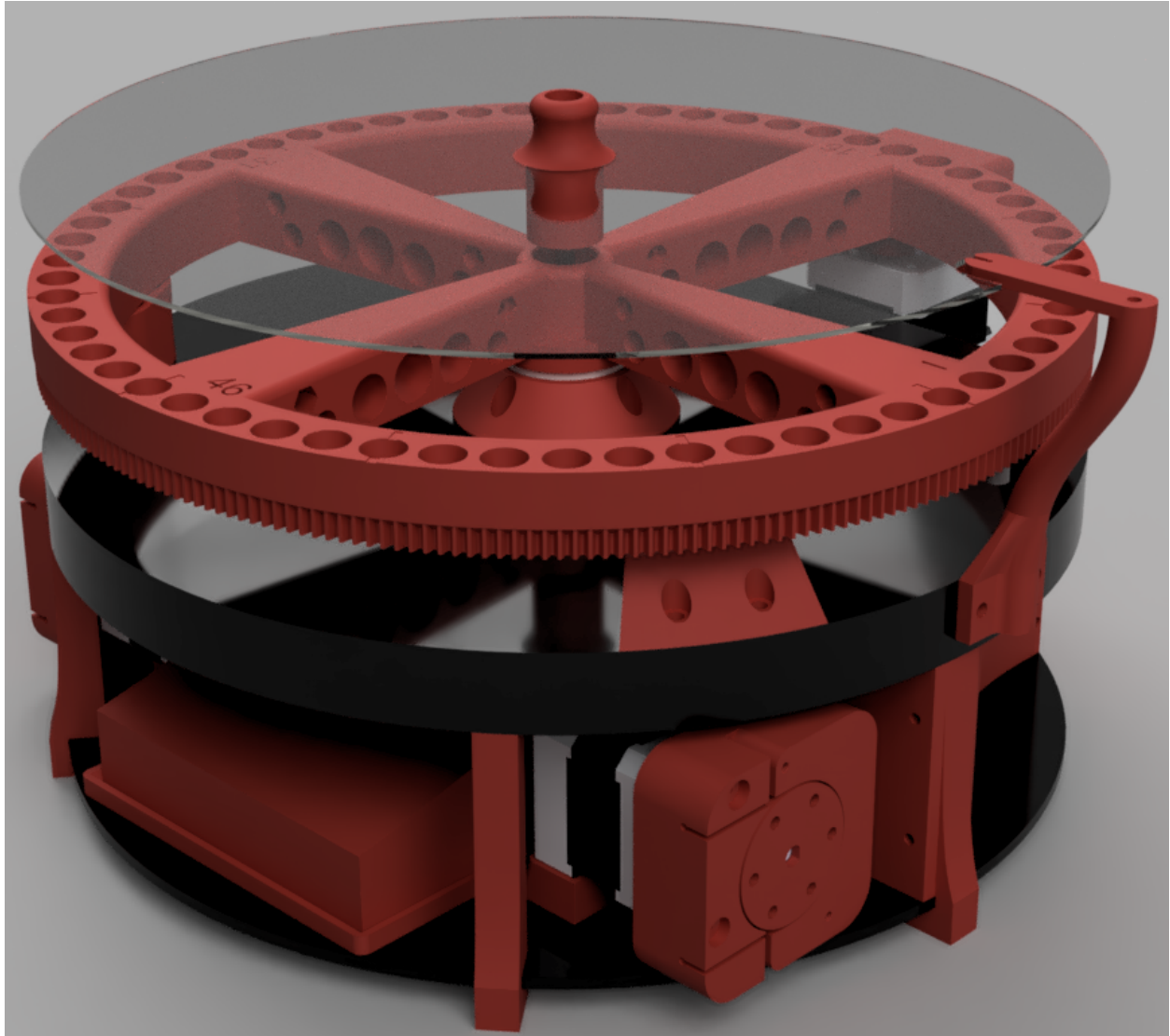


Constant Volume Fractional Collector 1.0



By: Paul Kudyba, III
8/30/18

General Operation

- **Description of Operation**

- This device is used to sample at user given intervals from a blood bag or other sample container while keeping constant volume in the sample container. It can also be used to fill or empty a container to a set amount. Before each sample it will purge the dead volume from the sample tubing ensuring that samples taken are discrete. The controller interface is an LCD display with rotary encoder and push button for ease of operation.

- **Powering the device**

- The device is powered by a 12v power brick. USB is provided for updating the firmware only.

- **Loading sample tubes**

- With the top cover removed, place the tubes with the top facing outwards. If desired, you can alternate whether the top is facing inside or outside to help keep track of purge and sample tubes. If the mast is blocking the tube you would like to load/unload, then use the *Tray Advance* function.

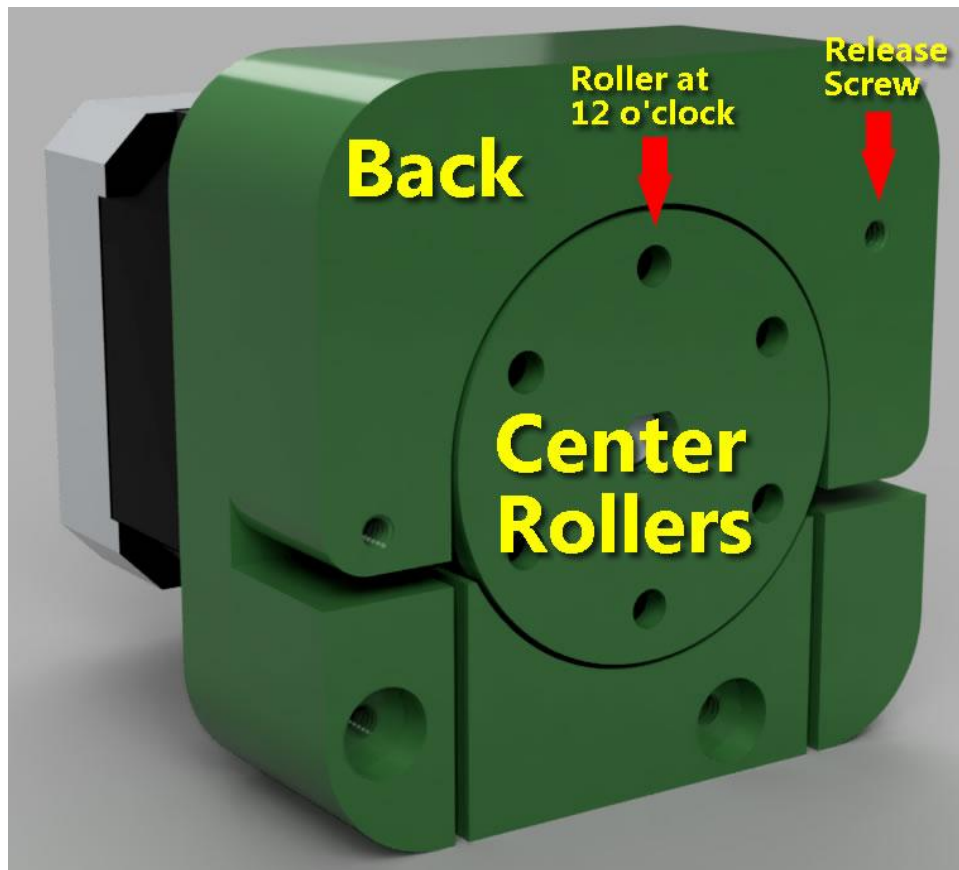
- **Purge and Sample**

- The device will first purge and then sample. Therefore, each sample will be in an even numbered location.

- **Menu Options**

- Start
 - When all options are set. Depress the Knob to start the sampling operation. There is a delay of 15 seconds to provide time if an error in setup is made.
- Reset Total Samples
 - This is used to reset the number of samples back to zero. This will set both run and total sample counts back to zero. When used the machine will rehome and start from the first sample tray effectively starting over.
- Tray Advance
 - When loading/unloading, you may need to retrieve an eppendorf that is currently under the mast or move the tray to make it easier to load/unload. This moves the tray one position.
 - If used during a pause. It will resume where it left off after it rehomes. (Ex after taking 5 samples, you pause and advance the tray. When you resume it will resume taking sample 6 where sample 6 is normally taken.)
- Fill Bag
 - This fills the bag to a set amount. This can be changed with Set Bag Volume.
- Empty Bag
 - This empties the bag the amount set. This can be changed with Set Bag Volume.

- Set Cycle Interval
 - This sets how often samples are to be taken
- Set Sample Volume
 - This sets how much you would like to sample
- Set Purge Volume
 - This sets how much is needed to clear the dead volume within the tubing, needle tip, and IV spike. (0.5mL being plenty for up to 4ft of tubing)
- Set Bag Volume
 - This set how much will be pumped in the fill bag and empty bag function.
- Set Sample Limit
 - This is used to take a set number of samples and then pause. The number is taken from the total samples taken number not the run number. (ex. for 10 samples per run this needs to be set to 10 for run one, then 20 and then 30 in between each run)
- Calibrate Input Pump
 - This runs a calibration routine. It will pump a set amount and ask for a measurement of this amount to calculate the difference and adjust for any deviation. For the input pump it is 90mL. This will take a few minutes to pump.
- Calibrate Sample Pump
 - This runs a calibration routine. It will pump a set amount and ask for a measurement of this amount to calculate the difference and adjust for any deviation. For the input pump it is 8mL. This will take a few minutes to pump.
- Set Clock Time
 - This allows for setting/adjusting of the clock.
- Stats
 - This will display total cycles run by each pump. This will help indicate current wear of the tubing. This is not persistent across power cycles. To reset simply power cycle the machine.



Changing the tubing

1. Find the release screw, and unscrew until the back of the pump can rotate out.
2. Remove and replace the tubing with the same size tubing required.
3. Close the back of the pump making sure the tubing is pulled taught and in the center of the channel. This is critical for the smaller sample pump.
4. While holding the pump closed so that the back is flat with the rest of the pump, tighten the screw. Do not continue to tighten if the screw is not seating in place.
5. Ensure that the hose is properly seated by:
 - a. On the larger (Input) pump pull on one side of the hose until you can see that it is drawing the other side into the pump.
 - b. On the smaller pump, pull until taught on both sides. Do not pull too hard or you may damage the small tubing.
6. Rotate the center rollers counter-clockwise until one of the rollers is at the twelve o'clock position. This ensures that you've not pinched the hose or have a bind in the pump. Having a roller at the 12 o'clock position ensures that no fluid will pass through the pump while at rest. This is where the roller "pinches" the hose.
7. Your pump is now ready for calibration.

Troubleshooting

- Under normal operation the pumps and tray will be powered off when not active and thus able to be moved manually. If you bump the tray in between sampling you can simply pause and use the tray advance function. It will rehome and continue from where you left off when you resume sampling.
- If the pumps are not at the 12 o'clock position then the pumps may not function as intended.
- To first prime the input pump you can run the *Fill Bag* routine. You can set the volume you wish to prime with *Set Bag Volume*. When the pump is primed you can unplug the machine, but will lose any calibrations! or wait for the routine to finish. Priming the sample pump is unnecessary due to the purge function.
- Calibration is currently stored in volatile memory and therefore is lost when power is cut. If the device loses power then it must be calibrated before sampling is resumed.
- If the sample limit (*Set Sample Limit*) is reached then it must be increased or the total samples reset (*Reset Total Samples*) otherwise the device will just pause again when told to sample due to its limit being reached.

Silicone tubing Specifications

Sample Pump: 1.5mm OD, 0.5mm ID

Input Pump: 4mm OD, 2mm ID

Needle tip

Blunt 22 gauge at least 0.5in

Eppendorf Specifications

1.5mL capacity micro centrifuge tubes

Default Pump Calibrations

Input pump: 39.3095uL per 1/6 rotation

sample pump: 2.20239uL per 1/6 rotation

BOM Link

https://docs.google.com/spreadsheets/d/1MYyxMttSNWKxErDTZDmeEtySJJO_4VXljwuw_aIDuVE/edit?usp=sharing

Firmware Code

https://drive.google.com/file/d/1aw9PEniRBlol2bpzdIY7CREgvx_vjx7f/view?usp=sharing

STL Files (Pumps and Fractional Collector)

https://drive.google.com/file/d/1LXug6uyhkMV_s8yWWPx-mD0cbzIMRUWw/view?usp=sharing

STL Files (IV Bag Adapters)

https://drive.google.com/file/d/1MMP1FGXNb9iqxeFYemUpdmFml8zt_3Np/view?usp=sharing

Assembly Drawings

<https://drive.google.com/file/d/1KUkplYkBTQmoT0WgEx9ByRFT1yGoU6eH/view?usp=sharing>

Dead Volume Calculations

https://docs.google.com/spreadsheets/d/1AhHszSA9m7Kb7Sqf_vfh5iA0tXgWszb41xrvR_gTXpM/edit?usp=sharing

