

# Quattroport Assay

## assembly and use guide

Basrur\_Vosshall, et al.

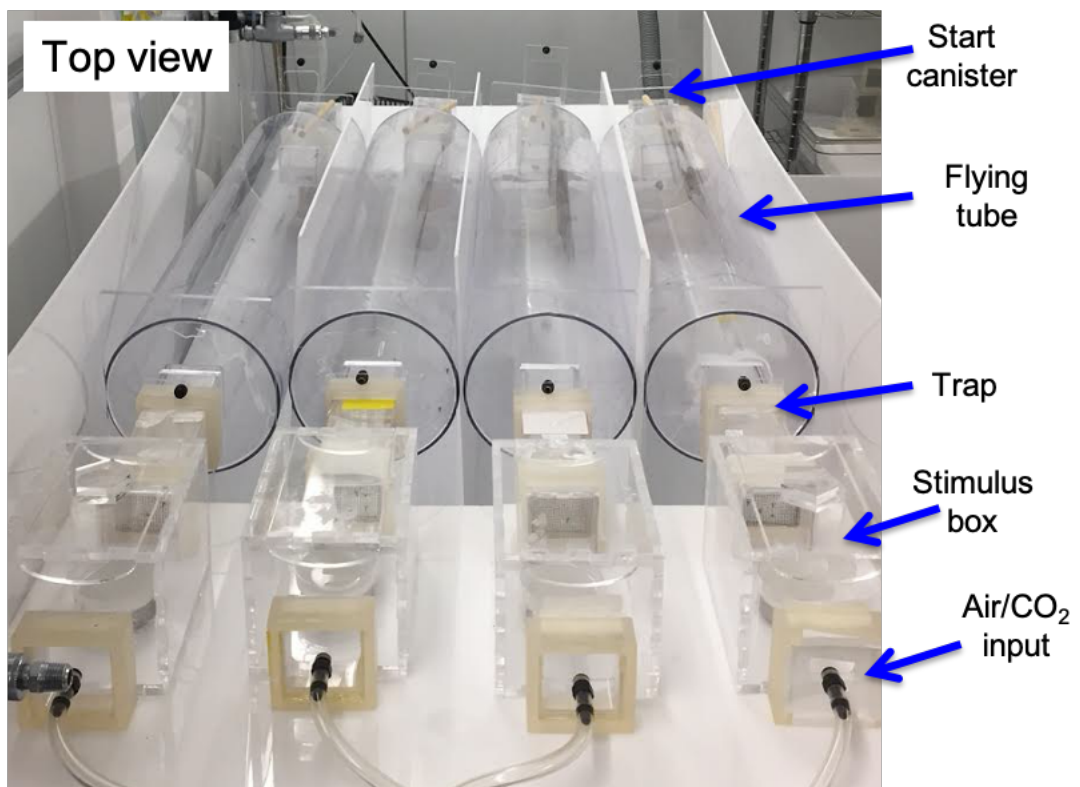
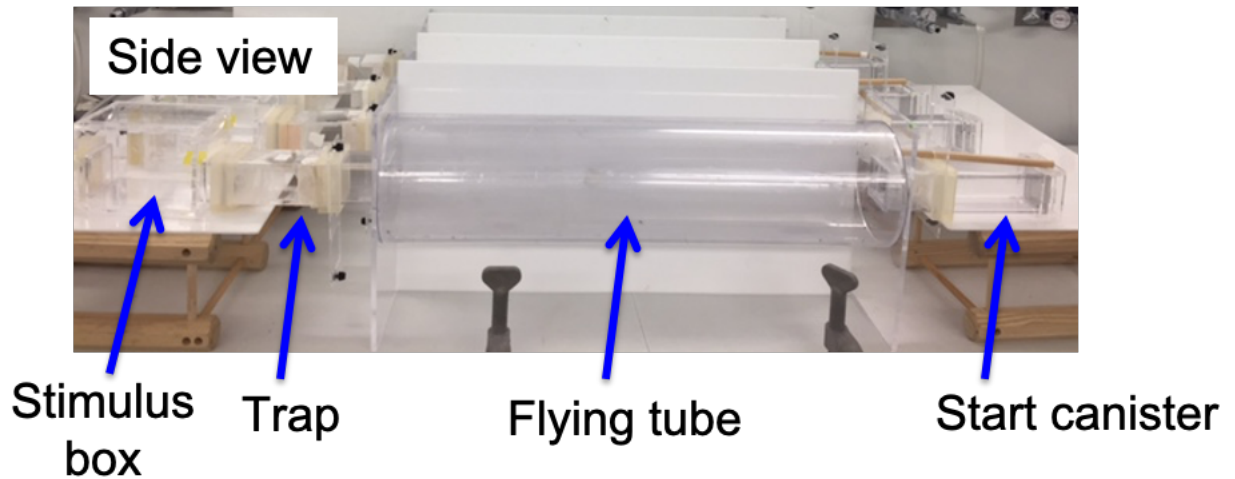
created by: Maria Elena De Obaldia

[https://github.com/VosshallLab/Basrur\\_Vosshall2020](https://github.com/VosshallLab/Basrur_Vosshall2020)

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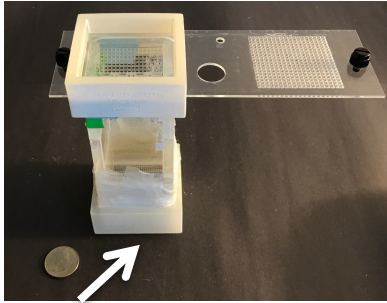
# Assay overview



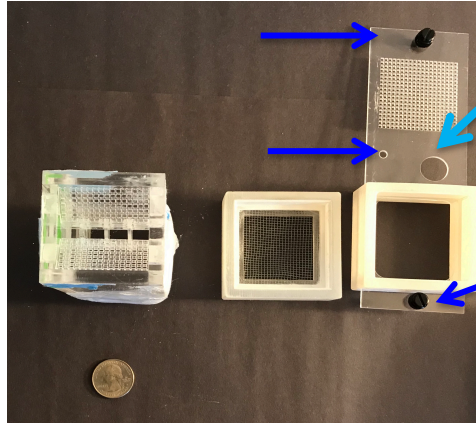
- The Quattroport has 4 "ports", each can be used to test mosquito attraction to a single stimulus. The assay sits on a picnic table (part B005CLO68E), and uses 2 wooden wine racks (part B0000DDUFO, covered with white acrylic part 8505K742) to elevate the start canisters and stimulus boxes 5.75" above the table, so that they can connect with the flying tubes. The stands for the flying tubes sit on the table. The air flow setup sits on the table in front of the stimulus boxes. White acrylic sheets are used to block visual cues, as shown above.
- The Quattroport is modular. It is assembled for one day of use and then disassembled for cleaning at the end of the day.
- All parts are washed with soap and water (or in a dishwasher using baskets part B000096ONX). Once clean, all parts should be handled with gloves.

# Parts overview> 3D printed “Stops” and “Sliders”

- Square 3D printed joins are used throughout the assay to connect acrylic and polycarbonate parts. Parafilm and/or white duct tape is placed between 3D joins and other parts, to create a snug fit.
- “Stops” have mesh inside to prevent mosquitoes from going through.
- “Sliders” hold sliding doors which can be opened and closed, to control mosquito movements (these interface with traps and start canisters)



Trap with 3D printed stop and slider on either end



Top view of trap, stop, & slider (with door)

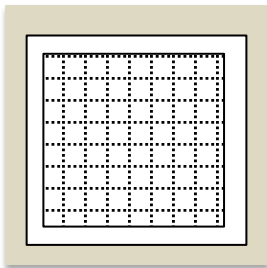
Insert wood dowel here to keep door open

The door has 3 small holes (arrows), that should be threaded (10/32 thread size) to accommodate a small black plastic screw (see parts list).



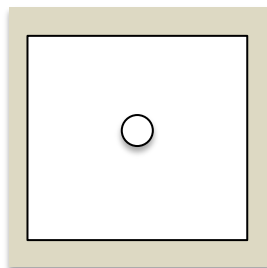
## 3D printed slider

- Need 4+ for trap entrances
- Need 20+ for individual start canisters



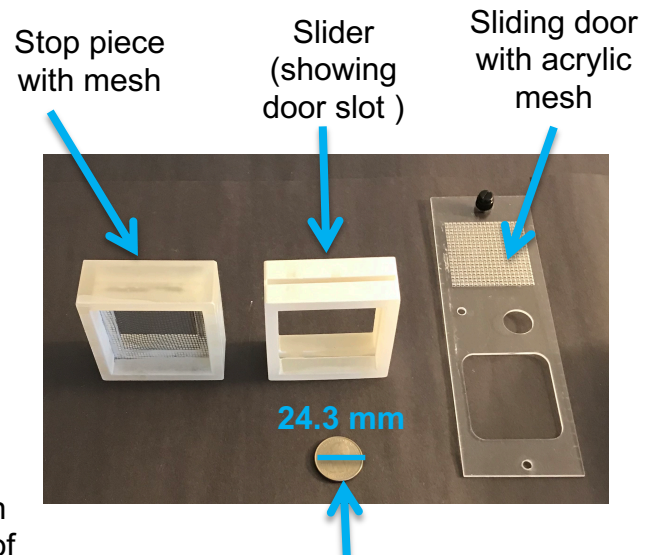
## 3D printed stop with mesh

- Need 4+ for interface b/t trap & stimulus box
- Mesh is sandwiched w. acrylic glue between 2 acrylic “square within a square” pieces, and then super-glued to the side of the 3D printed Stop piece with less “bite”/depth.



## 3D printed stop w. acrylic

- Need 4 to connect stimulus box to air supply tubes
- ¼” acrylic square is connected to the Stop with epoxy, attach acrylic on the side of the piece that has less “bite”/depth.
- Hole is threaded (1/8 NPT) and Female Quick Turn Coupling (Part 9198T17) is inserted here to attach Flexible Tubing “A” (3/8” ID) using the corresponding male Quick Turn Coupling (part 9198T16)

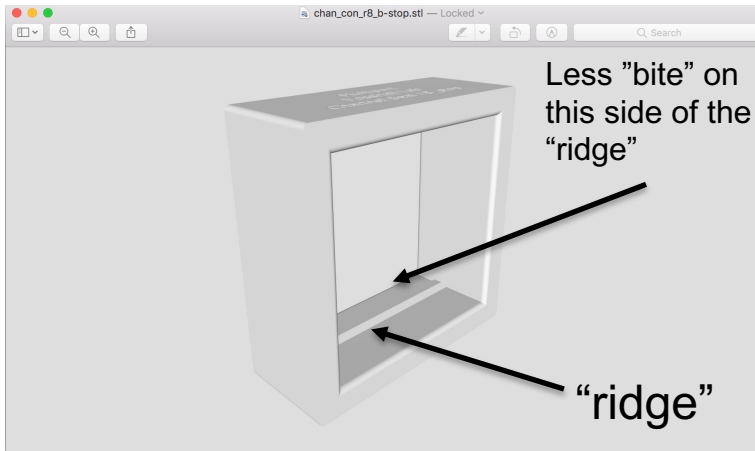


U.S. Quarter for size reference

# Parts overview> 3D printed “Stops” and “Sliders”

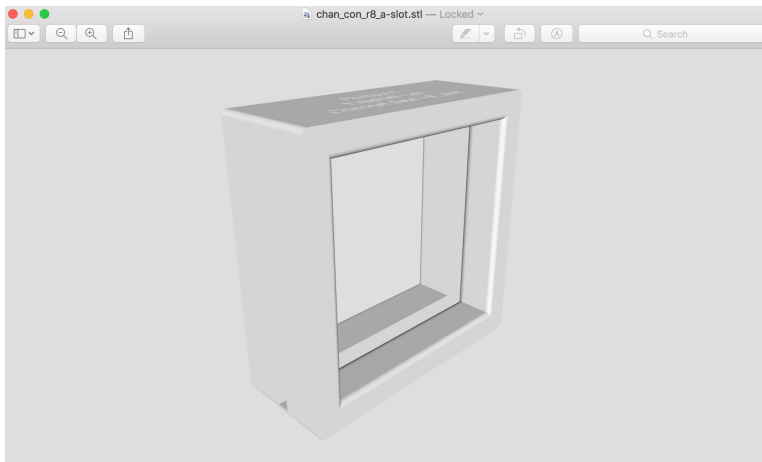
**(2 files)**

## 3D printed stop piece



chan\_con\_r8\_b-stop.stl

## 3D printed slider



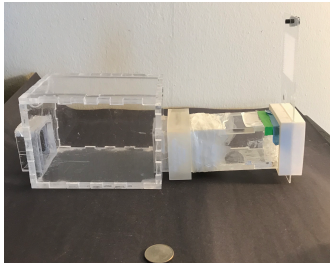
chan\_con\_r8\_a-slot\_slider.stl

## Notes:

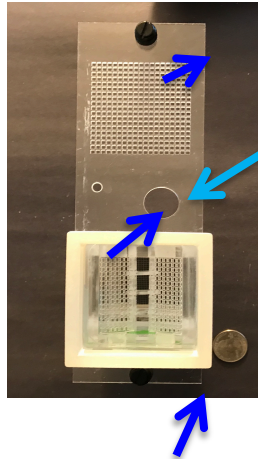
- In the middle of the stop piece, there is a raised ridge, which is used to attach acrylic parts to the 3D printed piece.
- The stop piece is asymmetrical around this ridge. There is more "bite"/depth on one side of the ridge than the other side.
- The side with more "bite" is used to attach the stop to hard polycarbonate tubing, such as on the stimulus box.
- Thus, it is important to glue acrylic parts to the the side of the Stop piece that has less "bite".

# Parts overview > Trap and sliding door

- Traps are made from laser cut acrylic (1/4", 1/8", and 1/16")
- The trap has 4 interlocking walls, plus some smaller pieces that make the entrance of the trap (see below)

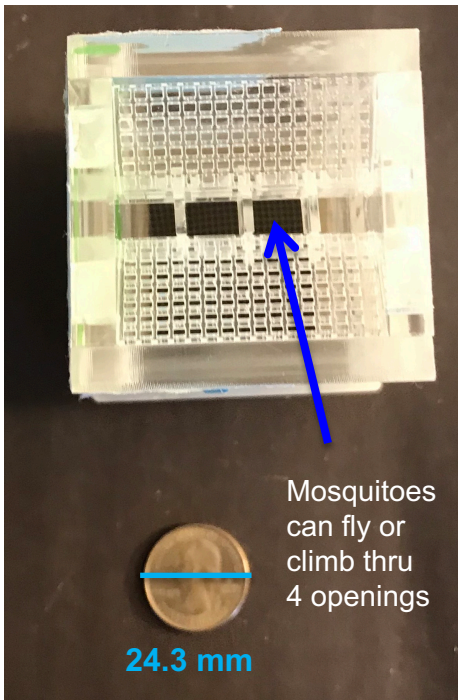


Trap (side view) with sliding door open (mesh above trap)



Insert wood dowel here to keep door open, remove dowel to close the trap

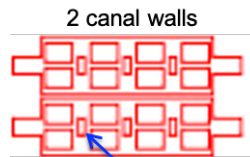
Screws keep the door inside the slider, and the middle screw can be used to keep the door shut in the closed position for transport of live mosquitoes in the trap or start canister.



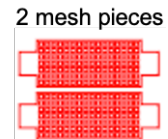
Mosquitoes can fly or climb thru 4 openings

24.3 mm

- The trap entrance is delicate, assemble it first:
  - Connect 2 canal walls using 3 cross pieces (see below)., it looks like a ladder when assembled.
  - Use acrylic glue to secure & let dry.
  - Insert the 2 prongs of the "ladder" into the 2 small parallel holes on the side of the 1<sup>st</sup> outer trap wall.
  - Then insert 2 mesh pieces into angled slots on the trap wall, creating the "funnel" part of the entrance
- Then connect the other 3 outer walls of the trap. It takes some finesse to get the trap entrance pieces to connect to trap walls on both sides at the same time.
- Once you achieve this, secure the outer walls with tape and then use acrylic glue to attach everything permanently.

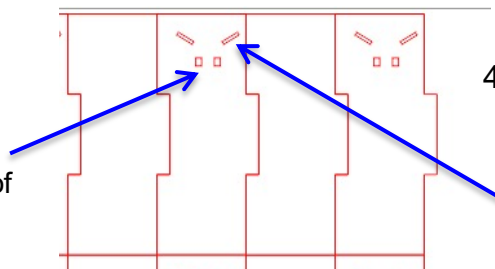


Insert crosses here



Trap entrance (top view)  
US Quarter for size reference

Insert 2 prongs of "ladder" here in parallel slots

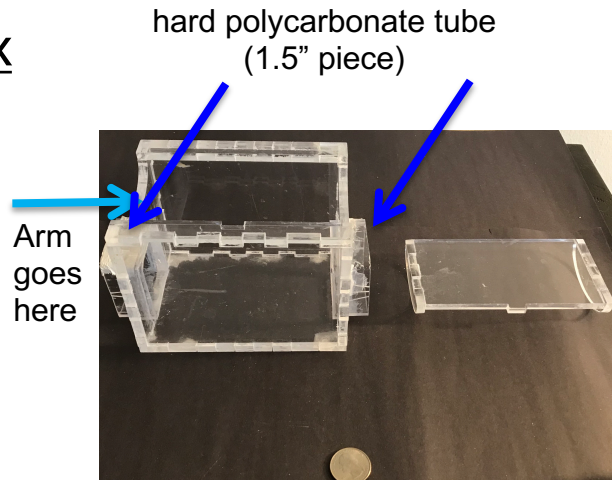


4 outer walls of trap (interlocking)

Insert prongs of mesh pieces in angled slots

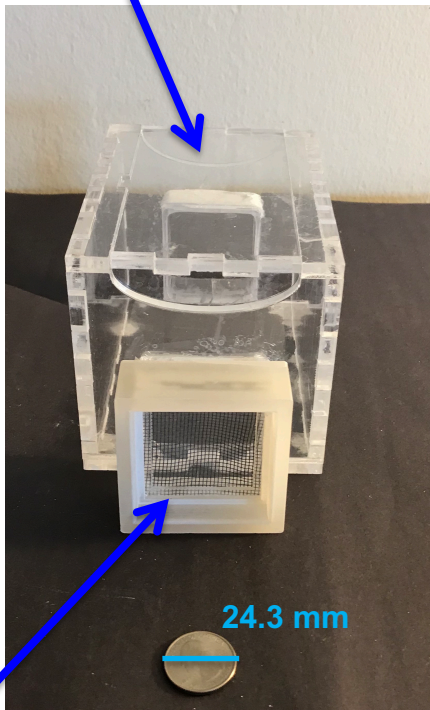
# Parts overview > Stimulus box

- Stimulus boxes are made of ¼" thick clear acrylic plus two 1.5" pieces of hard polycarbonate tubing (part 3161T41), which should be cut with a band saw and sanded with the deburring tool, then glued with acrylic glue to either end of the stimulus box. This hard tubing interfaces with 3D printed stop/slider pieces.
- When open, the stimulus boxes are designed to hold a human forearm
- Other stimuli can be placed in the box and covered by the lid



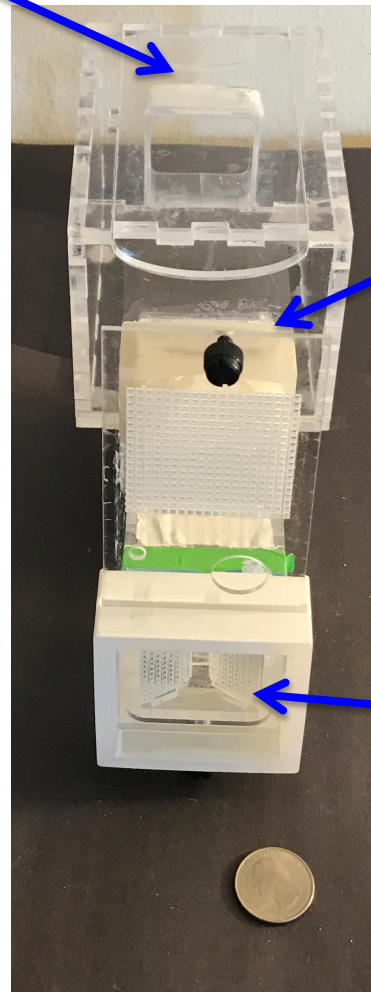
Stimulus box (side view) with cradle to hold human forearm (and lid for when arm is not inserted)

Air/CO<sub>2</sub> input this end (3D printed stop piece for air input not shown)



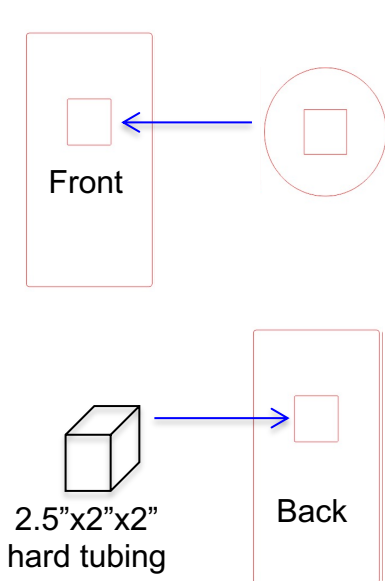
Stop with mesh at this end before trap

U.S. Quarter for size reference

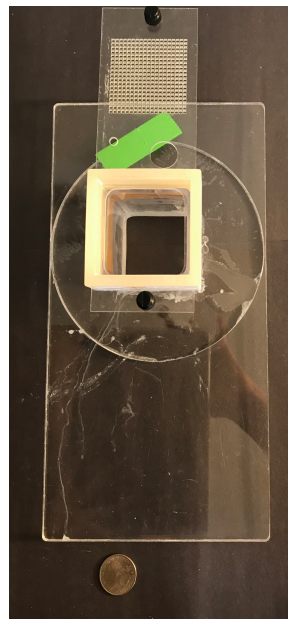


# Parts overview > Support stands for flying tubes

- A total of 8 support stands are needed (2 for each of 4 flying tubes)
- Each stand is made of 2 pieces of ¼" laser cut acrylic (see below) and 1 short piece of hard tubing, which interfaces with 3D printed sliders
- This hard tubing on the support stand connects to the slider on the start canister, providing a conduit for mosquitoes to enter the flying tube.
- Another slider connects the trap to the hard tubing on the stand, providing a conduit for mosquitoes to exit the flying tube and enter the trap.



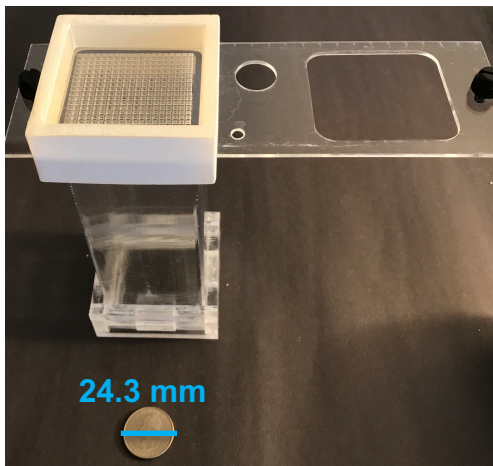
- The 2 pieces of acrylic (rectangle and circle) should be taped together so that the square holes align perfectly. **Don't glue it yet, because it matters which side of the circle is glued down (see pro tip below).**
- Then, cut a 2.5" piece of 2x2" rectangular hard tubing (part 3161T41) with a band saw. Use deburring tool to file its edges & insert it into the hole on the opposite side of the rectangular piece, (i.e. not same side as the circular piece – see photo). Secure w. acrylic glue.
- *Pro tip: the two sides of any laser cut acrylic will be slightly different, because the side that faces the laser melts more than the other side. So, one side of the laser-cut circular piece will fit snugly into the 5.75" ID polycarbonate flying tube (part 8585K58), but the other may not. Check that the side of the circle you have exposed fits into the flying tube before gluing it down. The flying tube edges may also need to be sanded with the deburring tool, before the circle part of the stand will fit inside it.*
- A rubber mallet/hammer is used to attach/detach the flying tubes to/from the stands during routine assembly and disassembly of the assay



## Parts overview > Start canisters

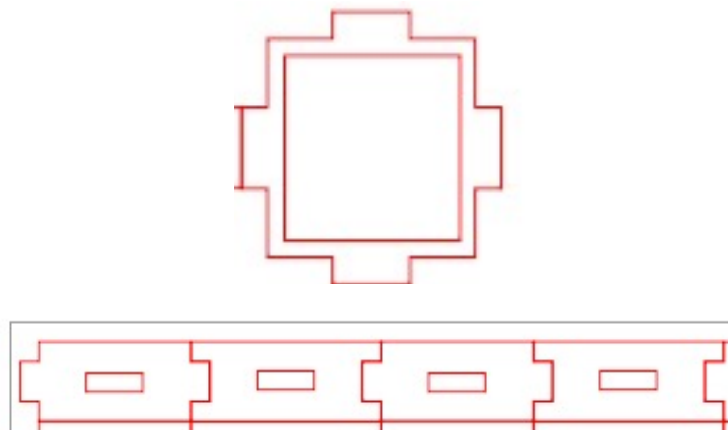
- Mosquitoes are loaded into the start canister the day before the assay is run, so you will need 1 start canister and 1 slider top for each trial you plan to run.
- The start canister is made from a 5.5" piece of 2"x2" square impact-resistant polycarbonate square tubing (Part 3161T41). This hard tubing needs to be cut with a band saw.
- The stop piece at the bottom of the start canister is made from interlocking pieces of laser cut acrylic (see below),
- The sliders used in the start canisters are the same as the sliders that interface with the traps.

Start canister with slider (top) and acrylic stop (bottom)

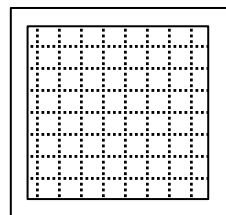


US Quarter for size reference

Laser cut acrylic stop parts



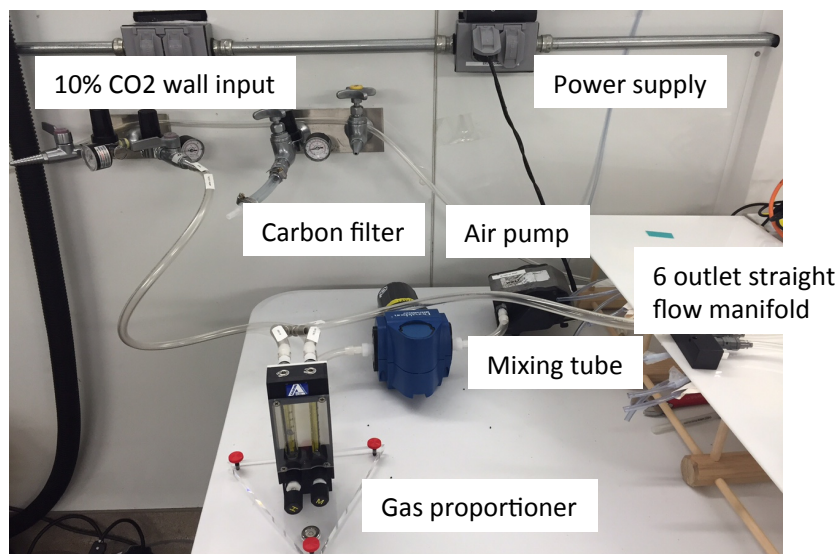
These 4 interlocking pieces have a hole in the center, which is used to snap them onto the acrylic stop square above.



Mesh is sandwiched w. acrylic glue between 2 acrylic "square within a square" pieces (1/16" acrylic), and then attached to the acrylic stop piece with acrylic glue

# Quattroport Airflow Explainer - Overview

- The Quattroport uses carbon-filtered humidified room air (RH=80%) mixed with 10% CO<sub>2</sub> (Praxair).
- A flow meter (or gas-proportioner) with 2 flowtubes is used to control the rate of CO<sub>2</sub>-containing air into the assay.
- A manifold splits a single source of CO2-containing air into the 4 assay ports.
- Besides this common input source, the assay ports are independent of each other. Each of 4 air streams passes over 4 different stimuli in the stimulus boxes, and then is conveyed through the trap into the flying tube where the mosquitoes are.



 **Linear Diaphragm**

6015  
6025



Pressure									
MODEL	MOTOR CAPACITY		FLOW l/min @ mbar					MAXIMUM PRESSURE mbar	
	VOL TAGE	TYPE*	0	100	200	300	400	CONTINUOUS	INTERMITTENT
6015SE (150098)	115/60/1	LM	31.1	10.5	-	-	-	140	140
6025SE (150057)	115/60/1	LM	58.0	44.6	26.9	10.1	-	280	280
6025SE (150058)	230/50/60/1	LM	60.3	46.5	30.8	8.4	-	280	280
6025SE (150108)	12	LM	42.5	28.0	12.5	2.1	-	280	280
6025SE (150109)	24	LM	42.5	28.0	12.5	2.1	-	280	280

\*LM = Linear Magnetic, 230/50/60/1 Model Flow reported at 60 Hz  
 Note: Minimum release quantities or regional availability may apply. Consult factory.

# Quattroport - Airflow Explainer

To deliver air and CO<sub>2</sub> into the Quattroport assay consistently, you will need to buy a set of 2 flow tube meters (also called Rotameters or Variable Area Flow meters) from Aalborg. A floating metal ball or “float” is pushed upward, indicating the amount of flow. One needs to consider the material the float is made from to get accurate readings.

## Flowmeter Ordering Information:

- Go to Aalborg.com, Select Products>Product Configurator>Rotameters>Model P
- Choose settings and Tube sizes shown below. A higher resolution PDF is available on Github>Quattroport parts info>Flowmeter purchasing instructions.pdf

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Model P

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- model Px multiple flow tube meters
- model P single flow tube rotameter for low flow rate measurement
- model Px multiple flow tube rotameter for low flow rate measurement

Part Number: P26A1-BA2

Continue

Configure your product

Number of Tubes: ☐ One ☒ Two ☐ Three ☐ Four ☐ Five ☐ Six

Tube Size: ☐ 150 mm ☒ 65 mm

1. 064-63-TA 2. 365-02 ST

Housing Material: ☒ Aluminum ☐ Stainless Steel

Valve: MFV™ valve at inlet, with flow tube

Seals: Buna-N (Standard on Aluminum or Brass Models)

Fittings: 1/8 inch FNPT (Standard)

Manifold: ☐ None (Standard) ☒ Top (outlet)

Tube end-seals: ☐ Viton-A® ☒ Buna-N

The configuration above, of housing material and seals uses Viton-A for the flow tube end-seals (packings) by default. All other seals (o-rings) are as selected. If your application requires otherwise, you may change this to Buna-N by making that selection here.

Part Number: P26A1-BA2

Continue

Tel: +1 (845) 770.3000 - Fax: +1 (845) 770.3010

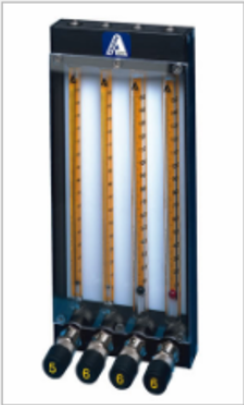
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# Quattroport - Airflow Explainer

## Flowmeter Ordering Information (cont'd):

All Products » Back to the configurator » SKUW-521123

SKUW-521123



\$413.00 USD

P26A1-BA2

P-METER 2-TUBE 65mm ALUMINUM MFV INLET BUNA-N SEALS 1/8" FNPT TOP MANIFOLD

O64-63-TA-BA

MILLIMETER SCALE TANTALUM BUNA-N SEALS

365-02-ST-BA

MILLIMETER SCALE STAINLESS STEEL BUNA-N SEALS

VM7-BB

HIGH RESOLUTION VALVE #7 BRASS BUNA-N SEALS

VM5-BB

HIGH RESOLUTION VALVE #5 BRASS BUNA-N SEALS

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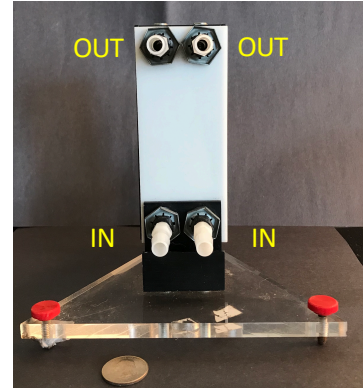
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# Quattroport - Airflow Explainer

## Setup instructions

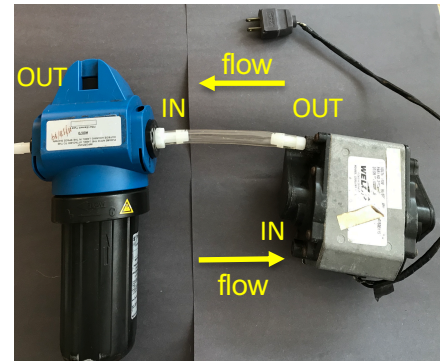
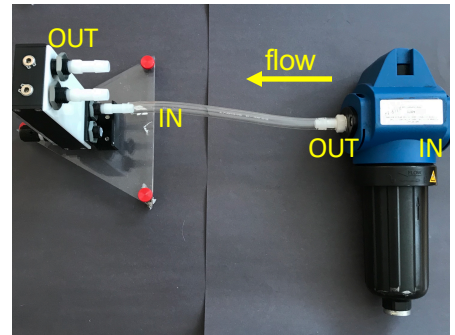
### 1. Setup flowmeter:

- Attach flowmeter (part P26A1-BA2) to tripod stand (part TP2). Note that each individual glass flow tube is labeled w. its part number.
- Screw 4 "K25" male tube fittings (part 2808K25) into the inlets (bottom) and outlets (top) of the flow meter. You will attach 4 pieces of "T16" tubing (part 6546T16) to these fittings in the next three steps below.



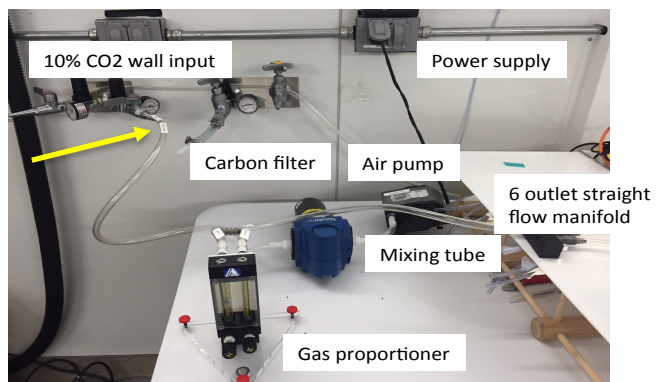
### 2. Connect blue filter housing to the flowmeter, and gray air pump to the blue filter housing:

- Insert the Carbon filter into the blue Donaldson air filter housing, according to instructions included with filter (not shown).
- Attach 2 "K28" male fittings to either side of the blue Donaldson air filter housing. (An arrow on the blue filter housing indicates direction that air should flow through the filter.)
- Attach a "K25" male tube fitting (part 2808K25) into the outlet of the Thomas Air pump (labeled OUT). Make sure the inlet of the Thomas Air pump is not blocked during assay operation. *Note: Some assembly/soldering is required to connect the Grainger power source to the Thomas air pump – please consult the suppliers, Thomas/Grainger, for more info if needed.*
- Attach approx. 9" of "T16" tubing between the K28 fitting on the outlet of the blue filter housing and the K25 fitting in the inlet(bottom) of the flowmeter that supplies the "065" flowtube for AIR).
- Attach approx. 5" of "T16" tubing between the K28 fitting in the inlet of the blue filter housing and the "K25" fitting in the outlet of the Thomas air pump



### 3. Connect 10% CO<sub>2</sub> source to flowmeter:

Attach approx. 2.5 feet of tubing between the fitting in the inlet (bottom) of the flowmeter that supplies the "365" CO<sub>2</sub> flowtube and the 10% tank source (a wall spigot in the photo at right



# Quattroport - Airflow Explainer

## Setup instructions (cont'd)

### 4. Connect flowmeter to manifold with "mixing tube":

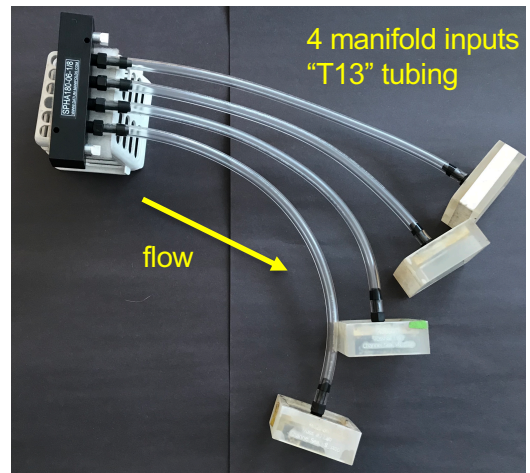
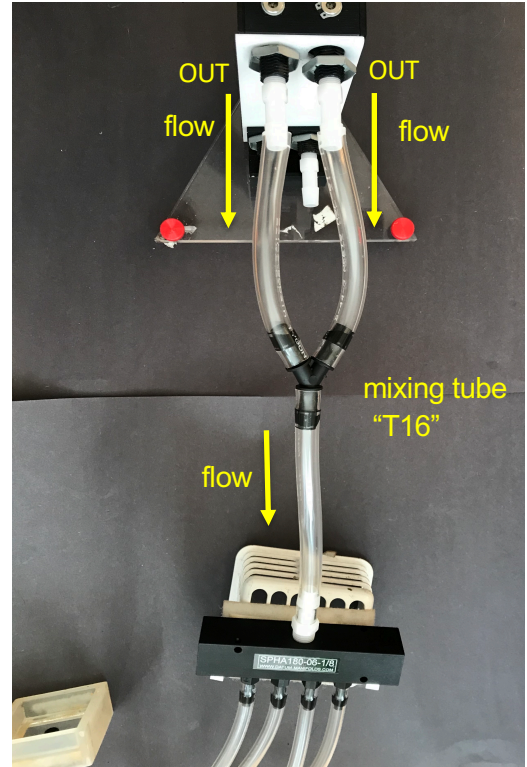
- Attach two 5" pieces of "T16" tubing to the K25 fittings at the top of the flowmeter (outlets).
- Then connect these two pieces of tubing to the Wye-tube fitting (part 5463K725), as shown here.
- Attach a 6" piece of "T16" tubing to the remaining spot on the Wye-tube fitting, this is "the mixing tube".
- Attach a "K25" male tube fitting to the inlet of the 6 outlet manifold (part 1023N14), and then connect this fitting to the "mixing tube."

### 5. Setup the manifold and air/CO<sub>2</sub> inputs:

- Screw silver square plug "K382" fittings into the outer 2 outlets of the manifold (these will not be used.)
- Screw 4 "K24" fittings (part 2808K24) to the middle 4 outlets of the manifold. They will not screw in all the way.
- Note: In the final setup, the manifold sits on a 2.5" high piece of plastic on the table and the 3D printed stops with tubing extend up onto the platform on the wine rack – where the stimulus boxes are.*

### 6. Prepare n=4 3D printed Stop pieces with air inputs:

- Laser cut 4 "stop with air input" parts from 1/4" thick clear acrylic. (See "Guide to 3D printed Stops and Sliders" in this PDF.)
- Then thread the hole in the center of this part using an 1/8 NPT tap (part 2525A169).
- Epoxy the laser cut part inside the 3D printed Stop pieces, allow to dry overnight.
- Then screw a "K24" fitting into each acrylic square.
- Attach 4 pieces of "T13" tubing (part 6546T13; length = 13" each) on the manifold between the K24 fittings on the manifold and the K24 fittings on the stop pieces.
- Note: in the final setup, these Stop pieces with air inputs will attach to the back end of the 4 stimulus boxes.*



# Quattroport - Airflow Explainer

## Fittings guide

Full product specs uploaded to:  
[https://github.com/VosshallLab/Basrur\\_Vosshall2020](https://github.com/VosshallLab/Basrur_Vosshall2020)



Super-Flow Barbed Fitting for Food and Beverage  
 Plastic Adapter for 1/4" Tube ID x 1/8 NPT Male \$6.64 per pack of 10  
 2808K24



K24

Need 4 for 3D stop air inputs  
 Need 4 for manifold output

Super-Flow Barbed Fitting for Food and Beverage  
 Plastic Adapter for 3/8" Tube ID x 1/4 NPT Male \$10.53 per pack of 10  
 2808K25



K25

Need 4 for flowmeter  
 Need 1 for outlet of Thomas air pump

Super-Flow Barbed Fitting for Food and Beverage  
 Plastic Adapter for 3/8" Tube ID x 1/4 NPT Male \$7.11 per pack of 10  
 2808K28



K28

Shape	Straight
Type	Adapter
For Use With	Beverage, Food

Need 1 for manifold input

Super-Flow Barbed Fitting for Food and Beverage  
 Plastic Adapter for 3/8" Tube ID x 3/8 NPT Male



K32

☐ Packs of 10

In stock  
 \$8.42 per pack of 10  
 2808K32

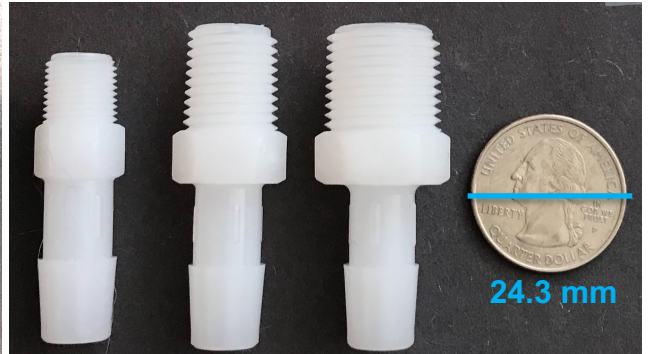
ADD TO ORDER

Need 2 for Blue air filter housing

1/8 NPT 1/8 NPT 1/4 NPT 3/8 NPT  
 1/4" tube ID 3/8" tube ID 3/8" tube ID 3/8" tube ID



K24



K25

K28

K32

24.3 mm

Plastic Barbed Tube Fitting for Air and Water  
 Tight-Seal, Wye Connector, for 3/8" Tube ID \$15.79 per pack of 10  
 5463K725

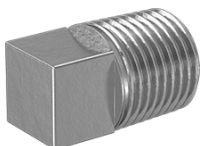


K725

Shape	Wye
Type	Connector
For Use With	Air, Water
Tube Connection	
Connection Style	Barbed
Barbed Connection	

Need 1 for "mixing tube"

Low-Pressure Aluminum Pipe Fitting  
 Plug with External Square Drive, 1/8 NPT Male \$2.78 Each  
 44705K382



K382

Need 2 for manifold

## Quattroport - Airflow Explainer

Operation instructions: The standard airflow conditions for the Quattroport are as follows:

- Before beginning, make sure the tripod holding the flowtubes is level.
- Before starting experimentation, adjust the pressure gauge of 10% CO<sub>2</sub> coming out of the wall source, and the CO<sub>2</sub> flowmeter knob (the one with tube number “365”), such that when the CO<sub>2</sub> spigot is turned on, the floating ball reaches the level of “30”.
- Mosquito acclimation period (10 min): Air ON (“064” flowmeter reads “15”), CO<sub>2</sub> off (turn off at wall spigot., “365” flowmeter reads “0”)
- Assay start (1<sup>st</sup> 30 sec): Air ON (“064” flowmeter reads “15”), CO<sub>2</sub> stays OFF, stimuli are placed in stimulus boxes during the first 30 seconds of the assay
- Assay duration: Air ON (“064” flowmeter reads “15”), CO<sub>2</sub> ON (“365” flowmeter adjusted to reach “30” when CO<sub>2</sub> spigot on the wall is turned on

## Quattroport - Airflow Explainer

### Flow rate calculation guide:

- The standard operating settings for the Quattroport are flowmeter readings of “15” for AIR, “30” for CO<sub>2</sub>. These settings provide a total flow rate of 17,393 ml/min of 1.1% CO<sub>2</sub> or ~10,392 ppm above ambient conditions. (See yellow highlighted conditions in table below.)
- Flow rate specs for these flow tubes (with the specified float materials) are reproduced on the following 2 pages from Aalborg’s website.
- The table below shows how to calculate the amount of CO<sub>2</sub> delivered using this combination of flowmeter tubes and a 10% CO<sub>2</sub> tank. Using a constant air reading of “15” the % CO<sub>2</sub> delivered can range from 0.05% to 4% (868-23,254ppm), depending on the CO<sub>2</sub> reading used.

Row	Constant air flowmeter reading (mm)	Air flowmeter 064-63-TA flow rate (ml/min)	Reading (mm)	CO2 flowmeter 365-02 ST flow rate (ml/min)	Total Flow (ml/min)	Fraction of total input from 10% CO2 tank	Final [CO2] fraction	Final % CO2	ppm CO2	ppm CO2 above ambient
1	"15"	15422	"5"	284	15706	0.018	0.002	0.18%	1808	868
2	"15"	15422	"10"	572	15994	0.036	0.004	0.36%	3576	2636
3	"15"	15422	"15"	952	16374	0.058	0.006	0.58%	5814	4874
4	"15"	15422	"20"	1304	16726	0.078	0.008	0.78%	7796	6856
5	"15"	15422	"25"	1645	17067	0.096	0.010	0.96%	9638	8698
6	"15"	15422	"30"	1971	17393	0.113	0.011	1.13%	11332	10392
7	"15"	15422	"35"	2311	17733	0.130	0.013	1.30%	13032	12092
8	"15"	15422	"40"	2657	18079	0.147	0.015	1.47%	14697	13757
9	"15"	15422	"45"	3043	18465	0.165	0.016	1.65%	16480	15540
10	"15"	15422	"50"	3475	18897	0.184	0.018	1.84%	18389	17449
11	"15"	15422	"55"	3947	19369	0.204	0.020	2.04%	20378	19438
12	"15"	15422	"60"	4373	19795	0.221	0.022	2.21%	22091	21151
13	"15"	15422	"65"	4922	20344	0.242	0.024	2.42%	24194	23254

Table adapted from Aalborg product specs

[See these Product sheet PDFs for more info \(on Github\):](#)

- [Aalborg 064-63-TA air tube flow specs.pdf](#)
- [Aalborg 365-02-ST CO2 flow specs.pdf](#)
- [Aalborg Flow meter instructions.pdf](#)

# Quattroport - Airflow Explainer

PDF below included on Github, filename:  
Flowmeter\_en\_Aalborg\_EM20200310\_Technical\_Information.pdf

## TECHNICAL INFORMATION

### TABLES OF STANDARD FLOW CAPACITIES P, PX, T, TX AND S METERS

TABLE 6 150mm Flow tubes (See Table 8 for Gas Flow Capacities)				
FLOW TUBE MAXIMUM FLOW RATES				
FLOW TUBE NUMBER	AIR		WATER	
	[sL/min]	[scfh]	[sL/min]	[gph]
042-15-GL	18.3	0.040	0.18	0.002
042-15-SA	29.1	0.070	0.37	0.005
042-15-ST	58.7	0.130	0.91	0.014
042-15-CA	103.4	0.234	1.84	0.029
042-15-TA	118	0.220	2.06	0.032
032-41-GL	46.6	0.098	0.50	0.007
032-41-SA	73.1	0.154	0.99	0.015
032-41-ST	138.3	0.293	2.36	0.037
032-41-CA	239.1	0.506	4.60	0.072
032-41-TA	258.7	0.548	5.10	0.080
062-01-GL	91.6	0.194	1.13	0.020
062-01-SA	144.3	0.306	2.19	0.035
062-01-ST	262.2	0.556	4.97	0.079
062-01-CA	431.7	0.915	9.23	0.146
062-01-TA	467.1	0.990	10.15	0.161
112-02-GL	370.6	0.784	5.71	0.090
112-02-SA	513.3	1.087	10.00	0.158
112-02-ST	816.0	1.729	19.2	0.301
112-02-CA	1216.9	2.579	31.6	0.500
112-02-TA	1291.7	2.738	34.1	0.540
082-03-GL	817	1.731	15.2	0.240
082-03-SA	1093	2.316	24.9	0.394
082-03-ST	1665	3.528	44.3	0.702
082-03-CA	2405	5.096	69.0	1.094
082-03-TA	2558	5.420	74.1	1.175
092-04-GL	2214	4.690	49.9	0.792
092-04-SA	2975	6.300	77.7	1.234
092-04-ST	4494	9.520	132.5	2.092
092-04-CA	6467	13.70	203.2	3.218
092-04-TA	6979	14.79	219	3.471
102-05-GL	3780	8.00	89	1.411
102-05-SA	4942	10.47	134	2.124
102-05-ST	7467	15.82	226	3.582
102-05-CA	10780	22.84	343	5.437
102-05-TA	11287	23.92	361	5.722
034-39-GL	8555	18.12	200	3.170
034-39-SA	11140	23.60	301	4.771
034-39-ST	16493	34.94	498	7.893
034-39-CA	23001	48.73	736	11.67
034-39-TA	24540	51.99	784	12.43
044-40-GL	23105	48.95	579	9.177
044-40-SA	29410	62.30	833	13.2
044-40-ST	42860	90.80	1339	21.22
044-40-CA	60212	127.5	1972	31.26
044-40-TA	65625	139.0	2144	33.98

\*SUFFIX REFERS TO FLOAT MATERIALS;

GL = Black Glass  
SA = Sapphire (red)  
ST = 316 Stainless Steel  
CA = Carbonyl®  
TA = Tantalum

TABLE 7 65mm Flow tubes (See Table 9 for Gas Flow Capacities)				
FLOW TUBE MAXIMUM FLOW RATES				
FLOW TUBE NUMBER	AIR		WATER	
	[sL/min]	[scfh]	[sL/min]	[gph]
042-07-GL	6	0.013	0.07	0.001
042-07-SA	9	0.017	0.08	0.001
042-07-ST	19	0.036	0.28	0.004
042-07-CA	33	0.070	0.62	0.009
042-07-TA	36	0.072	0.66	0.010
032-15-GL	49	0.104	0.55	0.009
032-15-SA	74	0.153	0.98	0.016
032-15-ST	145	0.307	2.38	0.038
032-15-CA	246	0.528	4.60	0.073
032-15-TA	271	0.578	5.25	0.084
022-13-GL	104	0.22	1.24	0.019
022-13-SA	160	0.33	2.47	0.039
022-13-ST	296	0.62	5.75	0.091
022-13-CA	484	1.02	10.58	0.160
022-13-TA	523	1.10	11.61	0.180
012-10-GL	204	0.43	2.8	0.045
012-10-SA	303	0.64	5.3	0.079
012-10-ST	518	1.09	11.2	0.170
012-10-CA	809	1.71	19.5	0.302
012-10-TA	851	1.80	20.7	0.320
052-01-GL	1056	2.23	20.8	0.329
052-01-SA	1399	2.96	33.3	0.527
052-01-ST	2125	4.50	58.7	0.930
052-01-CA	3059	6.48	90.0	1.426
052-01-TA	3245	6.87	94.0	1.537
023-92-GL	1249	2.65	25	0.396
023-92-SA	1623	3.44	36.7	0.581
023-92-ST	2520	5.34	70.7	1.121
023-92-CA	3680	7.80	103.5	1.641
013-88-GL	2006	4.25	39.5	0.61
013-88-SA	2680	5.67	63.2	0.99
013-88-ST	4060	8.6	111.7	1.75
013-88-CA	5798	12.28	172	2.72
365-02-GL	2522	5.35	54.7	0.86
365-02-ST	4917	10.42	143	2.26
014-96-GL	6318	13.4	147	2.33
014-96-SA	8145	17.3	217	3.44
014-96-ST	12058	25.5	364	5.77
014-96-CA	16943	35.8	540	8.56
014-96-TA	18213	38.6	568	9.00
054-17-GL	12860	27.2	307	4.86
054-17-SA	16617	35.2	449	7.11
054-17-ST	24452	51.8	723	11.46
054-17-CA	34507	73.1	1049	16.63
054-17-TA	36466	77.2	1111	17.61
064-63-GL	21969	46.5	550	8.71
064-63-SA	28518	60.4	811	12.85
064-63-ST	41289	87.4	1297	20.56
064-63-CA	58348	123.6	1895	30.04
064-63-TA	61299	129.9	2000	31.70

CO<sub>2</sub>  
flow  
tube

Airflow  
tube

ELIETH 04/20/2015  
TECHNICAL INFORMATION

WWW.AALBORG.COM - E-MAIL: INFO@AALBORG.COM - PHONE: 845.770.3000 - TOLL FREE IN U.S.A. AND CANADA 1.800.866.3837 - ORANGEBURG N.Y. U.S.A.

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From: Aalborg website

# Quattroport - Airflow Explainer

Higher resolution PDFs (on Github):

Aalborg 064-63-TA air tube flow specs.pdf

Aalborg 365-02-ST CO2 flow specs.pdf

064-63

FLOW DATA

DOCUMENT No. 642

Tube Number: 064-63(GL, SA, ST, CA, TA)  
Units : std ml/min

Metering Temperature: 70 deg.F  
Metering Pressure : 14.70 psia

STD. Conditions : 1 atmos @ 70 deg.F  
Tolerance : ±2% F.S.

SCALE READINGS AT CENTER OF FLOAT

Float Material:	Glass (GL)	Sapphire (SA)	Stainless Steel (ST)	Carboloy (CA)	Tantalum (TA)
Float Density :	2.53 g/ml	3.98 g/ml	8.04 g/ml	14.98 g/ml	16.58 g/ml

AIR

Scale Readings	Flow [ml/min]	Scale Readings	Flow [ml/min]	Scale Readings	Flow [ml/min]	Scale Readings	Flow [ml/min]	Scale Readings	Flow [ml/min]
65 --- 21969		65 --- 28518		65 --- 41289		65 --- 58348		65 --- 61299	
60 --- 20535		60 --- 26292		60 --- 38443		60 --- 53751		60 --- 56645	
55 --- 18782		55 --- 24142		55 --- 35240		55 --- 49064		55 --- 51339	
50 --- 17112		50 --- 21940		50 --- 31814		50 --- 44650		50 --- 46686	
45 --- 15326		45 --- 19943		45 --- 28820		45 --- 40322		45 --- 42086	
40 --- 13626		40 --- 17579		40 --- 25804		40 --- 36102		40 --- 37859	
35 --- 11827		35 --- 15498		35 --- 22656		35 --- 32003		35 --- 33491	
30 --- 10240		30 --- 13362		30 --- 19517		30 --- 27617		30 --- 28863	
25 --- 8540		25 --- 11195		25 --- 16372		25 --- 23283		25 --- 24367	
20 --- 6933		20 --- 9105		20 --- 13198		20 --- 18883		20 --- 19725	
15 --- 5261		15 --- 7044		15 --- 10477		15 --- 14797		15 --- 15422	
10 --- 3747		10 --- 5046		10 --- 7570		10 --- 10967		10 --- 11609	
5 --- 2023		5 --- 3072		5 --- 4705		5 --- 6292		5 --- 6608	

WATER

Scale Readings	Flow [ml/min]	Scale Readings	Flow [ml/min]	Scale Readings	Flow [ml/min]	Scale Readings	Flow [ml/min]	Scale Readings	Flow [ml/min]
65 --- 530		65 --- 811		65 --- 1297		65 --- 1895		65 --- 2000	
60 --- 513		60 --- 746		60 --- 1198		60 --- 1744		60 --- 1839	
55 --- 467		55 --- 682		55 --- 1096		55 --- 1589		55 --- 1670	
50 --- 423		50 --- 618		50 --- 987		50 --- 1444		50 --- 1516	
45 --- 376		45 --- 556		45 --- 891		45 --- 1301		45 --- 1364	
40 --- 332		40 --- 490		40 --- 795		40 --- 1161		40 --- 1224	
35 --- 285		35 --- 429		35 --- 694		35 --- 1026		35 --- 1079	
30 --- 243		30 --- 366		30 --- 594		30 --- 881		30 --- 925	
25 --- 199		25 --- 302		25 --- 494		25 --- 738		25 --- 776	
20 --- 157		20 --- 241		20 --- 392		20 --- 592		20 --- 621	
15 --- 114		15 --- 181		15 --- 305		15 --- 456		15 --- 478	
10 --- 76		10 --- 123		10 --- 213		10 --- 329		10 --- 351	
5 --- 35		5 --- 68		5 --- 123		5 --- 176		5 --- 189	

Airflow  
tube:  
TA  
float

365-02

FLOW DATA

DOCUMENT No. 469

Tube Number: 365-02(GL,SA,ST,CA,TA)

Metering Temperature: 70 deg.F

STD. Conditions: 1 atmos @ 70 deg.F

Units : std ml/min

Metering Pressure : 14.70 psia

Tolerance : ±2% F.S.

SCALE READINGS AT CENTER OF FLOAT

Glass (GL)		Sapphire (SA)		Stainless Steel (ST)		Carboloy (CA)		Tantalum (TA)	
2.53 g/ml		3.98 g/ml		8.04 g/ml		14.98 g/ml		16.58 g/ml	
Scale Readings	Flow [ml/min]	Scale Readings	Flow [ml/min]	Scale Readings	Flow [ml/min]	Scale Readings	Flow [ml/min]	Scale Readings	Flow [ml/min]
AIR									
65 ---	2678			65 ---	4922				
60 ---	2378			60 ---	4373				
55 ---	2083			55 ---	3947				
50 ---	1850			50 ---	3475				
45 ---	1635			45 ---	3043				
40 ---	1429			40 ---	2657				
35 ---	1212			35 ---	2311				
30 ---	993			30 ---	1971				
25 ---	792			25 ---	1645				
20 ---	561			20 ---	1304				
15 ---	382			15 ---	952				
10 ---	195			10 ---	572				
5 ---	116			5 ---	284				
CO <sub>2</sub> flow tube: ST float									
WATER									
65 ---	52.0			65 ---	150.0				
60 ---	46.3			60 ---	135.0				
55 ---	40.0			55 ---	119.0				
50 ---	35.0			50 ---	105.0				
45 ---	30.0			45 ---	91.5				
40 ---	26.0			40 ---	78.3				
35 ---	21.7			35 ---	66.0				
30 ---	17.5			30 ---	54.4				
25 ---	14.0			25 ---	43.5				
20 ---	10.5			20 ---	33.7				
15 ---	7.4			15 ---	24.0				
10 ---	4.3			10 ---	15.0				
5 ---	1.5			5 ---	7.0				

CO<sub>2</sub> flow tube:  
ST float

AALBORG INSTRUMENTS & CONTROLS, INC

20 Corporate Drive, Orangeburg NY 10962 USA

Phone: +1 (845) 770-3000 or Toll-free 1-800-866-3837 \* FAX: +1 (845) 770-3010

## Laser cutting & 3D printing guide > Overview

All files needed are found here:

[https://github.com/VosshallLab/Basrur\\_Vosshall2020](https://github.com/VosshallLab/Basrur_Vosshall2020)

### Laser cutting files in 3 groups)

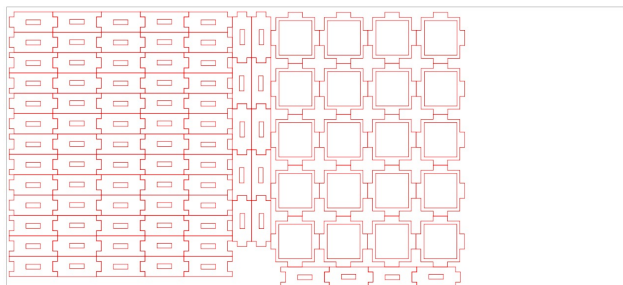
- 1/4" (6.35mm) clear acrylic sheets:
  - Flow tube stands (need 4 of these)
  - Stimulus boxes, with lids (Need 4+ of these)
  - Canister stop pieces (need 20+ of these)
  - Attraction trap walls (Need 4+ of these)
- 1/8" (3.175 mm) clear acrylic sheets:
  - Sliding doors
  - Attraction trap "funnel" parts
- 1/16" (1.5875 mm) clear acrylic sheets
  - Square within a square pieces (for traps)
  - Mesh pieces and crosses (for traps)

### 3D printing files:

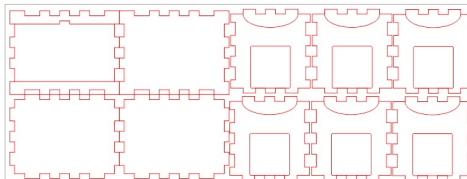
- Stop piece
- Slider piece

# Laser cutting guide >1/4" Acrylic

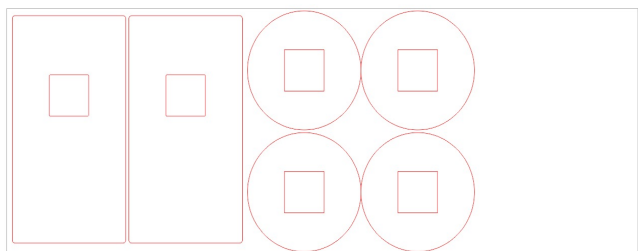
(6 files)



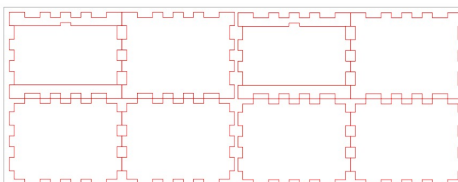
Canister stop pieces (n=20)



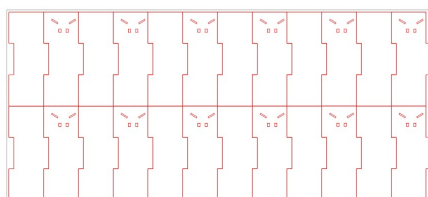
Stimulus boxes 1 of 2



Supports for flying tube (n=2)



Stimulus boxes 2 of 2



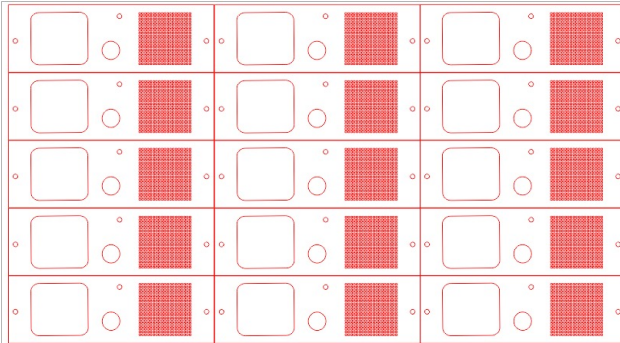
Trap outer walls (n=6x4)



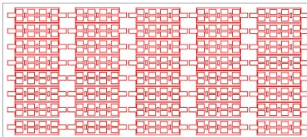
Stop with hole for air input (n=4)

# Laser cutting guide > 1/8" acrylic

(2 files)



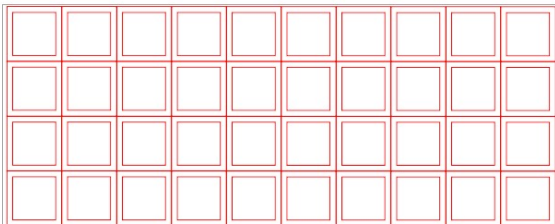
Sliding doors for canisters (n=15)



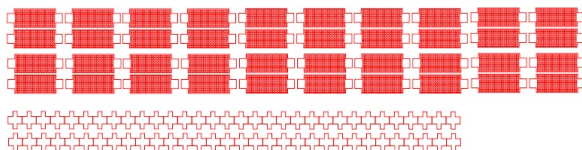
Trap canal walls (n=40)

## Laser cutting guide > 1/16" acrylic

**(2 files)**



“Square within a square”  
for stop pieces and canister bottoms (n=40)



Trap mesh pieces (n=20)

Crosses (n=64)

## Quattroport operation checklist

- Set up 4 ports, check for snug fit of 3D printed joints, put parafilm/tape between trap and 3D printed parts, if needed to achieve snug fit. Keep trap doors open with wood dowel.
- Turn on air pump switch— Flow meter reads “15” for air. CO<sub>2</sub> flow meter reads: “0”. Check that the tripod is level.
- Attach the 3D printed slider piece of the 4 canisters of mosquitoes (n=20 females per canister) to the 4 starting positions of the assay. Make sure these are snugly attached, place parafilm between start position and 3D slider piece if needed. Insert wood dowel into circular hole on sliding door, THEN remove black screw, record room humidity and temperature. Acclimate mosquitoes for 10 minutes (with air only, No CO<sub>2</sub>).
- To start trial, set timer for 5m30s. Start timer, turn on CO<sub>2</sub>; the level on the right flow meter should be set to “30” to deliver 1% CO<sub>2</sub>. Place stimulus in stimulus chamber.
- After 30s of CO<sub>2</sub> flow, remove wood dowels to allow sliding doors to open and release mosquitoes into the assay.
- After 5 minutes, turn off CO<sub>2</sub> off. Flow meter will read “0”. Close all 8 sliding doors, 4 in front of the traps, 4 in front of the star canisters, to keep mosquitoes in their position.
- Count mosquitoes in each section of the assay before vacuuming. Record the number of dead mosquitoes in the start canister. All mosquitoes that have left the start canister are considered “activated”, whether or not they entered the trap. Mosquitoes that entered the attraction trap are considered “attracted”.
  - If there are too many mosquitoes in the trap to count easily, label the trap with tape, and add a screw to secure the sliding door in the closed position. Then, carefully remove the trap from the assay (keeping the 3D stop and slider securely fitted on either end of the trap). Don't forget to vacuum the mosquitoes out of the start canister and flying tube before removing the trap. Bring the trap into the cold room, and count the mosquitoes after they have been immobilized.



# QUATTRO-PORT

Experiment: \_\_\_\_\_

Date: \_\_\_\_\_

Hatch date: \_\_\_\_\_

Starvation time: \_\_\_\_\_

Trial #	Port #	Stimulus	# in trap	# in flying tube	# in start canister
	1				
	2				
	3				
	4				

Notes:

Humidity

Temp:

Pressure:

Trial #	Port #	Stimulus	# in trap	# in flying tube	# in start canister
	1				
	2				
	3				
	4				

Notes:

Humidity

Temp:

Pressure:

Trial #	Port #	Stimulus	# in trap	# in flying tube	# in start canister
	1				
	2				
	3				
	4				

Notes:

Humidity

Temp:

Pressure: