Quattroport Assay

assembly and use guide

Basrur_Vosshall, et al.

created by: Maria Elena De Obaldia

https://github.com/VosshallLab/Basrur_Vosshall2020

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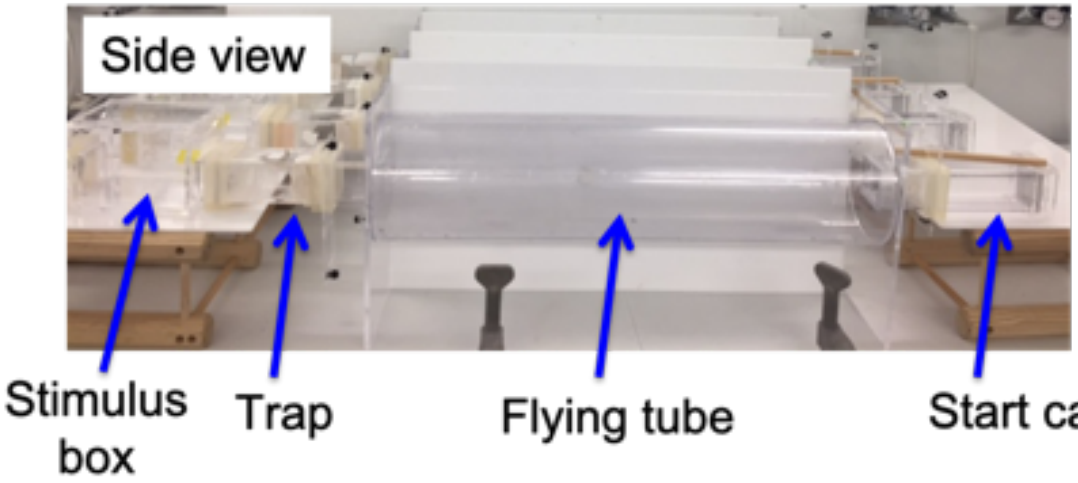
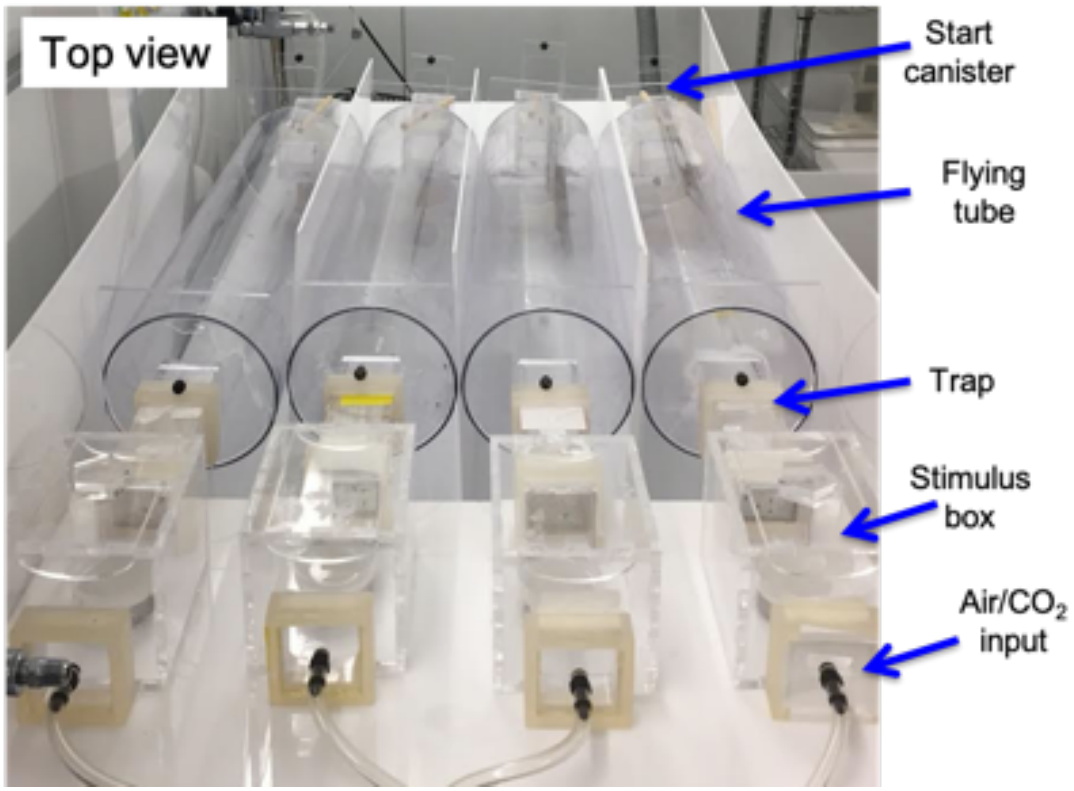
Assay overview

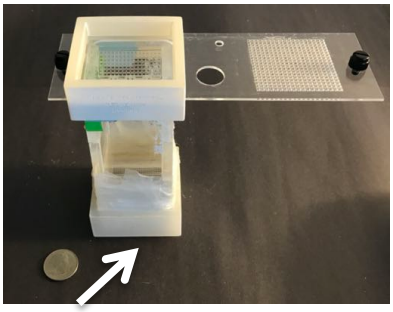




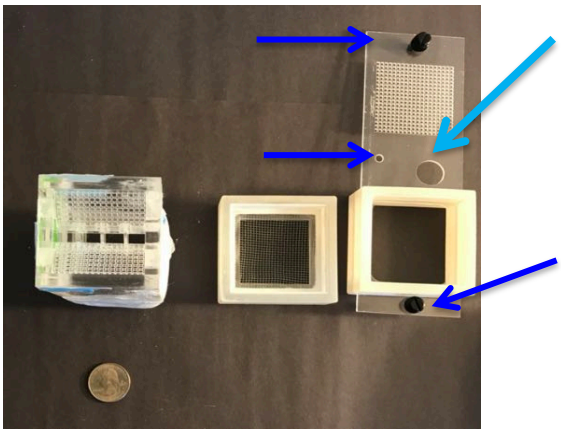
- The Quattroport has 4 ”ports”, each can be used to test mosquito attraction to a single stimulus. The assay sits on a picnic table (part B005CLO68E),and uses 2 wooden wine racks (part B0000DDUFO, covered with white acrylic part 8505K742) to elevate the start canisters and stimulus boxes 5.75” above 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



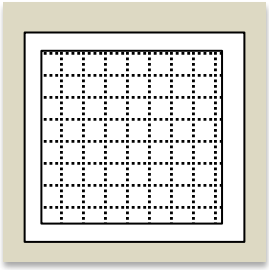
Top view of trap, stop, & slider (with door)

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



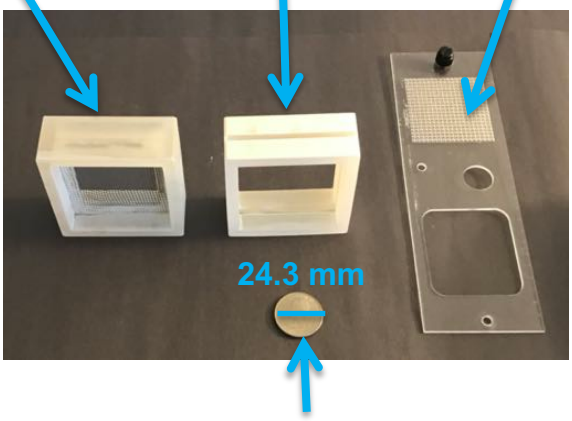
3D printed stop with mesh

- 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.

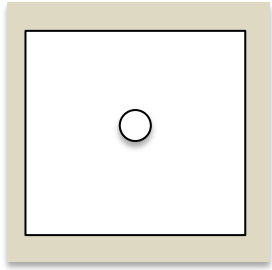
Stop piece with mesh

Slider (showing door slot)

Sliding door with acrylic mesh



U.S. Quarter for size reference



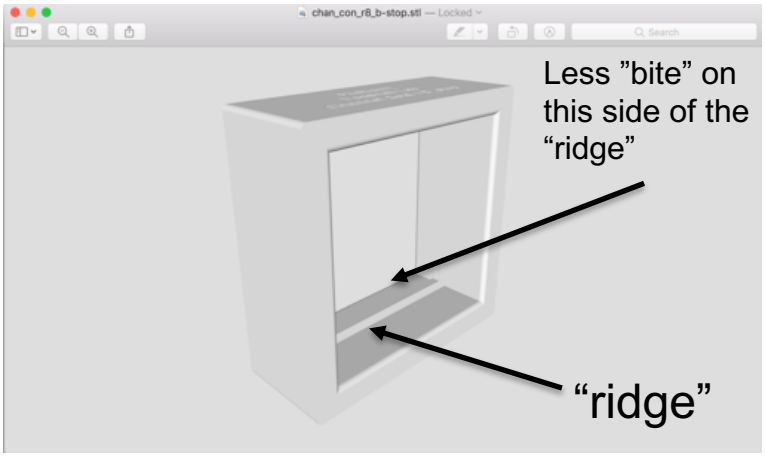
3D printed stop w. acrylic

- 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)

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

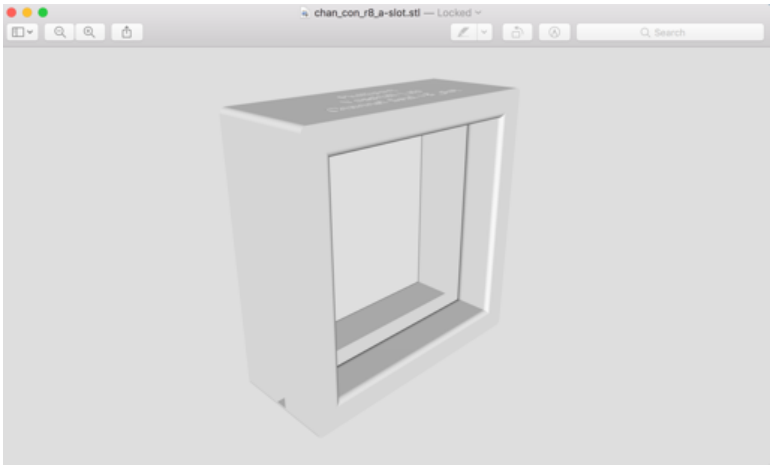
(2 files)

3D printed stop piece



chan_con_r8_b-stop.stl

3D printed slider



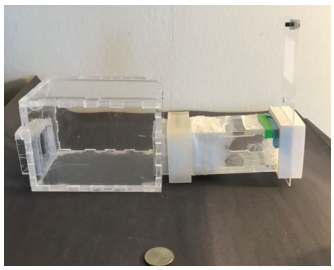
chan_con_r8_a-slot_slider.stl

Notes:

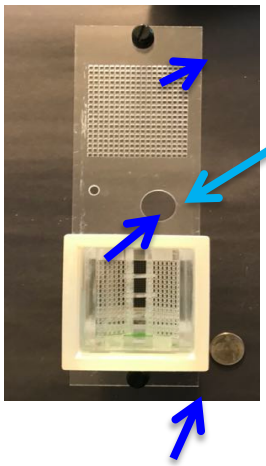
- In the middle of the stop piece, there is a raised ridge, which is used to attach acrylic parts to the 3D printed piece.
- The stop piece is asymmetrical around this ridge. There is more ”bite”/depth on one side of the ridge than the other side.
- The side with more “bite” is used to attach the stop 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)

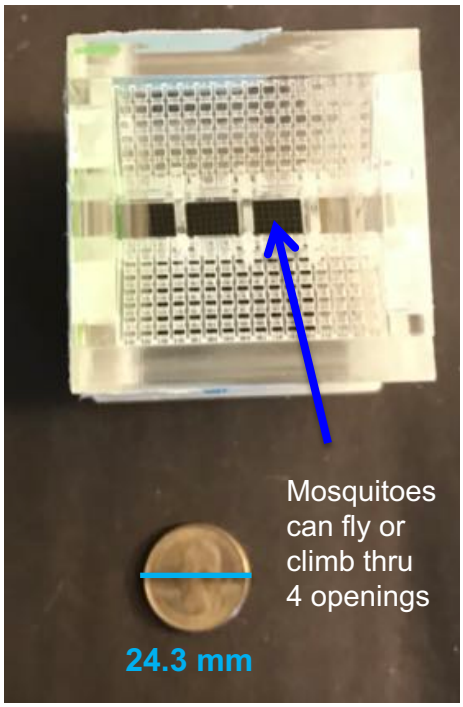


Trap (side view) with sliding door open (mesh above trap)



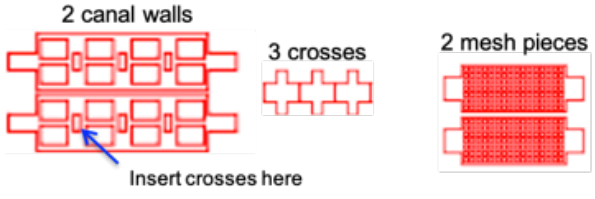
Insert wood dowel here to keep door open, remove dowel to close the trap

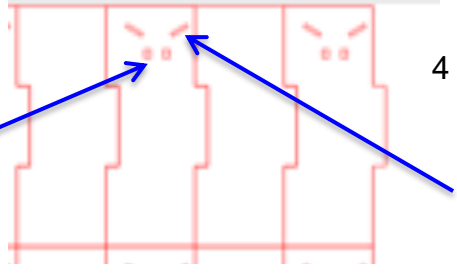
Screws keep the door inside the slider, and the middle screw can be used to keep the door shut in the closed position for transport of live mosquitoes in the trap or start canister.



Trap entrance (top view)
US Quarter for size reference

- 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 1st 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.





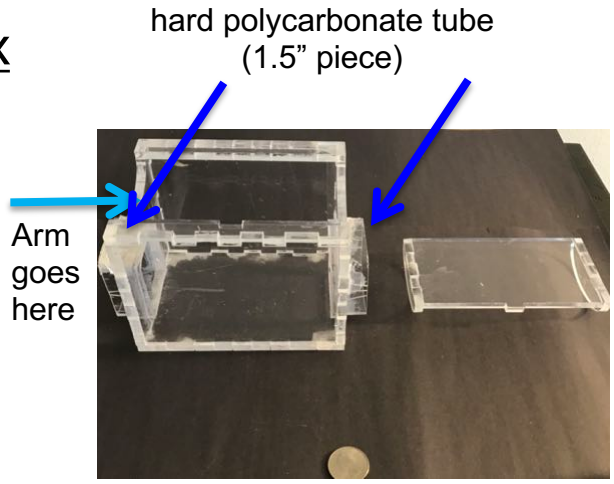
Insert 2 prongs of ”ladder”here in parallel slots

4 outer walls of trap (interlocking)

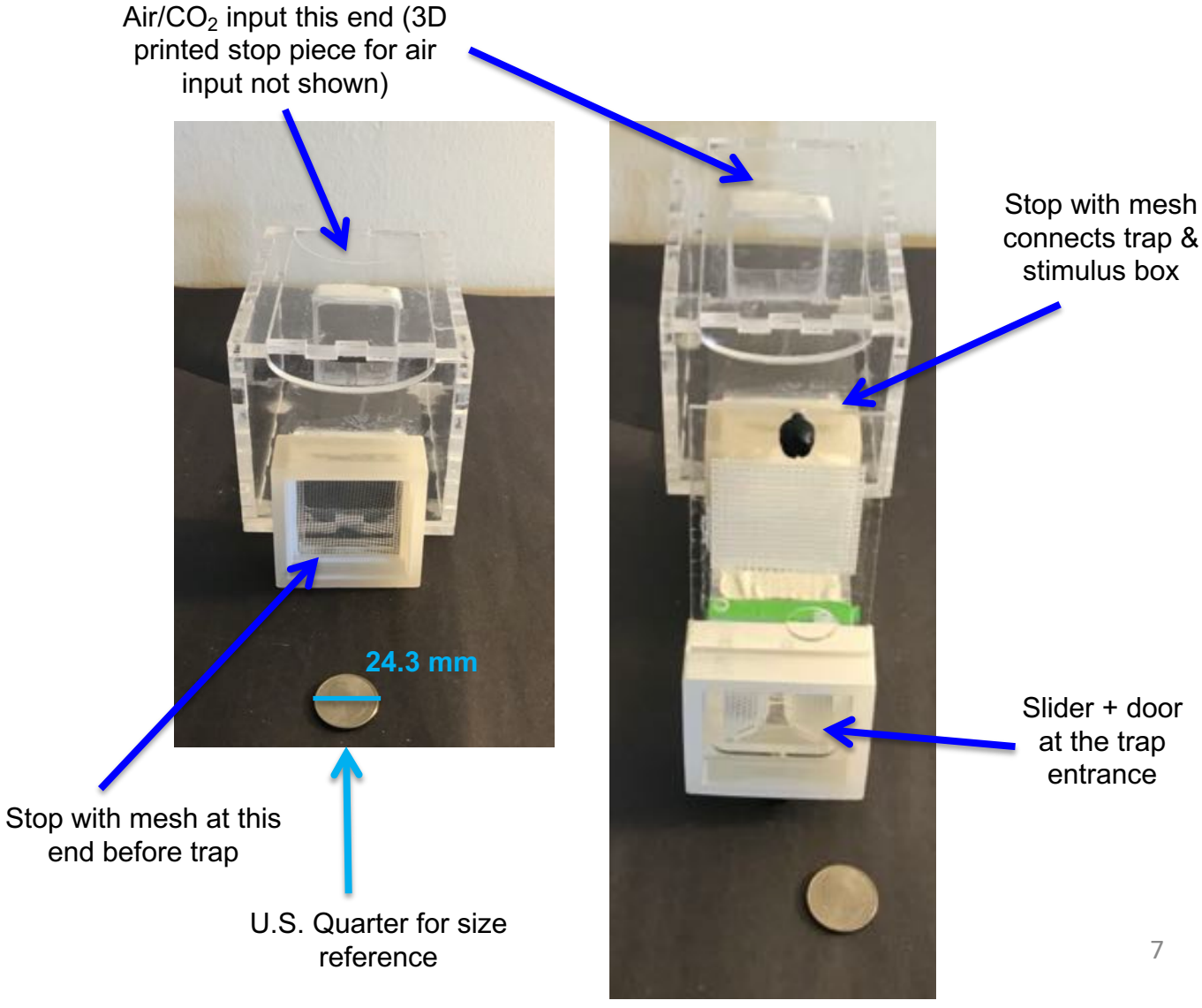
Insert prongs of mesh pieces in angled slots

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

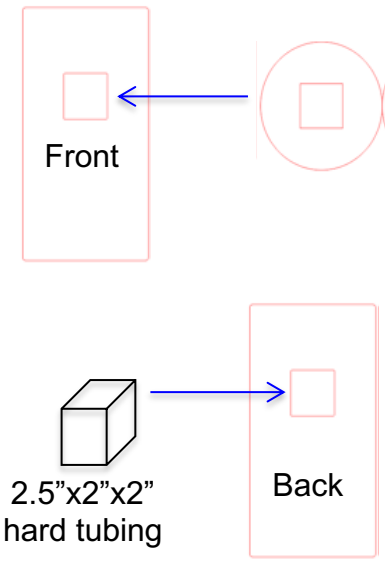


Stimulus box (side view) with cradle to hold human forearm (and lid for when arm is not inserted



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.



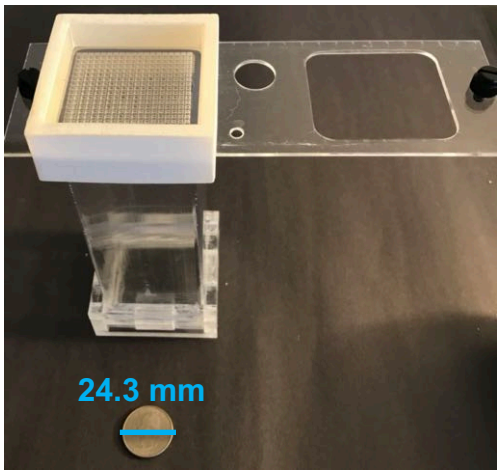
- The 2 pieces of acrylic (rectangle and circle) should be taped together so that the square holes align perfectly. **Don't glue it yet, because it matters which side of the circle is glued down (see pro tip below).**
- Then, cut a 2.5" piece of 2x2" rectangular hard tubing (part 3161T41) with a band 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

US Quarter for size reference

Parts overview > Start canisters

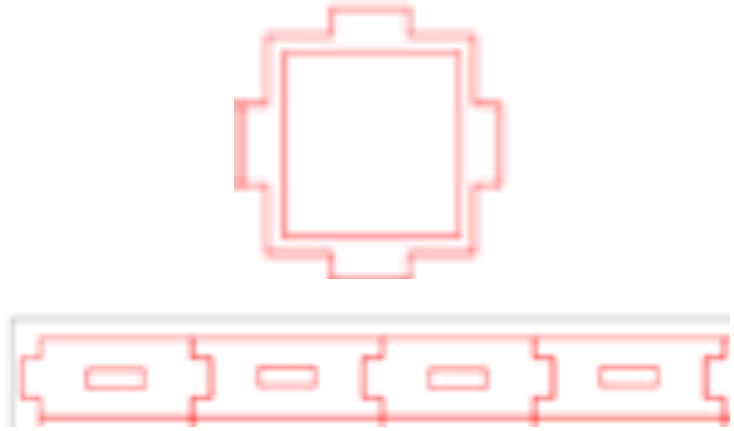
- Mosquitoes are loaded into the start canister the day before the assay is run, so you will need 1 start canister and 1 slider top for each trial you plan to run.
- The start canister is made from a 5.5” piece of 2”x2” square impact-resistant polycarbonate square tubing (Part 3161T41). This hard tubing 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)

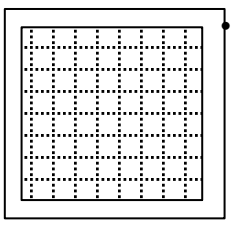


US Quarter for size reference

Laser cut acrylic stop parts



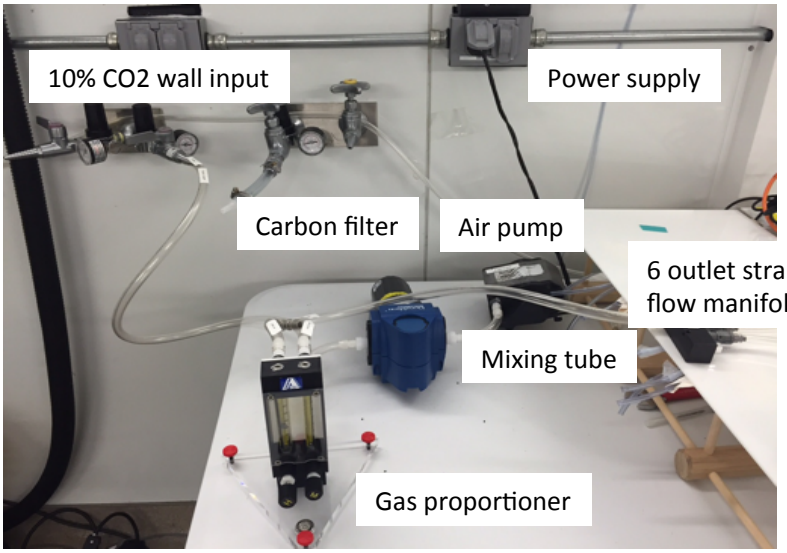
These 4 interlocking pieces have a hole in the center, which is used to snap them onto the acrylic stop square above.



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_2 (Praxair).
- A flow meter (or gas-proportioner) with 2 flowtubes is used to control the rate of CO_2-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.



6015
6025

Linear Diaphragm

Pressure

MODEL	MOTOR CAPACITY		FLOW L/min @ mbar					MAXIMUM PRESSURE mbar	
	VOLTAGE	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_2 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:

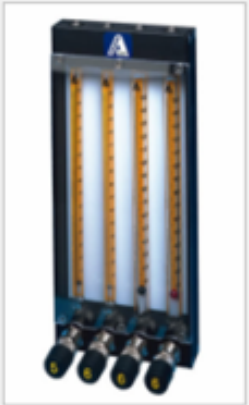
- Go to Aalborg.com, Select Products>Product Configurator> Rotameters>Model P
- Choose settings and Tube sizes shown below. A higher resolution PDF is available on Github>Quattroport parts info>Flowmeter purchasing instructions.pdf

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
064-63-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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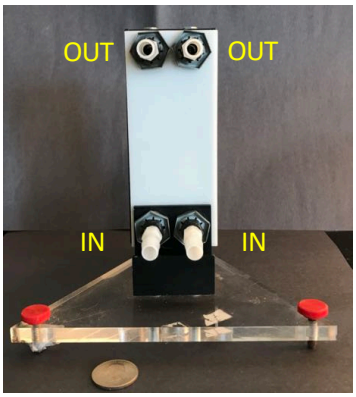
Quattroport - Airflow Explainer
Setup instructions

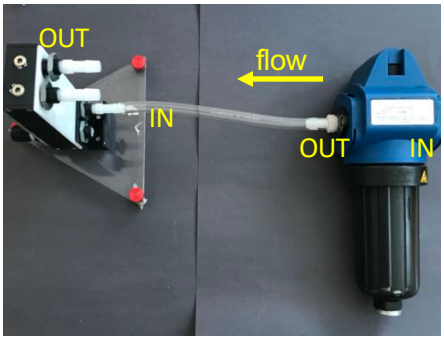


1. Setup flowmeter:

a) Attach flowmeter (part P26A1-BA2) to tripod stand (part TP2). Note that each individual glass flow tube is labeled w. its part number.

b) 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.

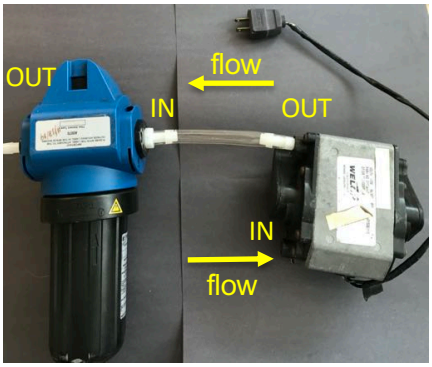
2. Connect blue filter housing to the flowmeter, and gray air pump to the blue filter housing:



a) Insert the Carbon filter into the blue Donaldson air filter housing, according to instructions included with filter (not shown).

b) 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.)

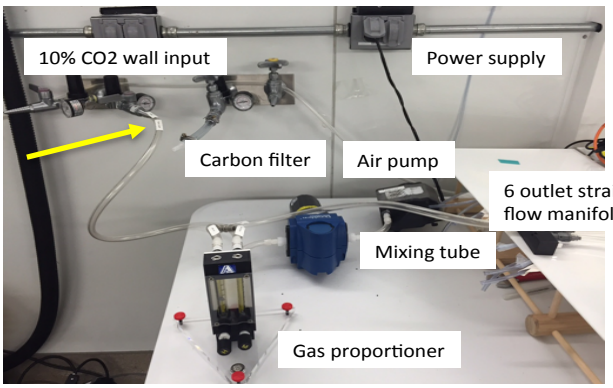
c) Attach a "K25" male tube fitting (part 2808K25) into the outlet of the Thomas Air pump (labeled OUT). Make sure the inlet of the Thomas Air pump is not blocked during assay operation. *Note: Some assembly/soldering is required to connect the Grainger power source to the Thomas air pump – please consult the suppliers, Thomas/Grainger, for more info if needed.*



d) 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).

e) 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

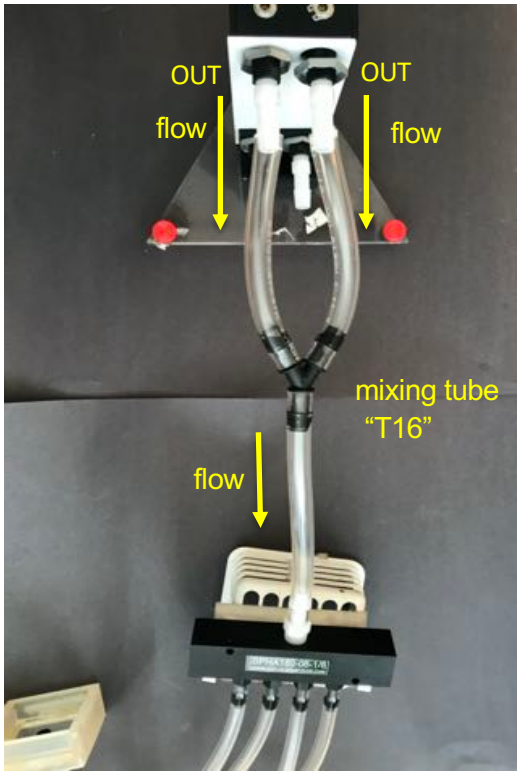
3. Connect 10% CO_2 source to flowmeter:
Attach approx. 2.5 feet of tubing between the fitting in the inlet (bottom) of the flowmeter that supplies the "365" CO_2 flowtube and the 10% tank source (a wall spigot in the photo at right



Quattroport - Airflow Explainer
Setup instructions (cont'd)

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

a) Attach two 5" pieces of "T16" tubing to the K25 fittings at the top of the flowmeter (outlets).
b) Then connect these two pieces of tubing to the Wye-tube fitting (part 5463K725), as shown here.
c) Attach a 6" piece of "T16" tubing to the remaining spot on the Wye-tube fitting, this is "the mixing tube".
d) 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."

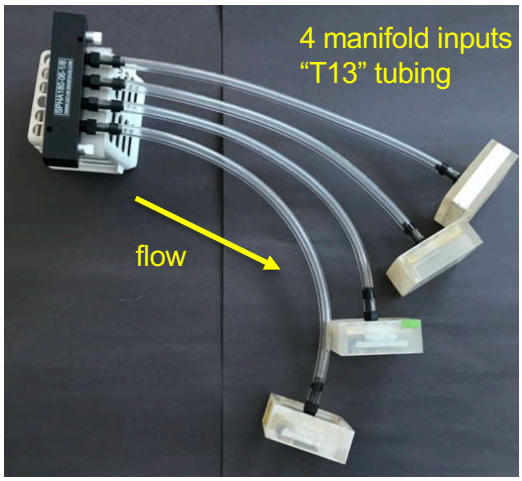


5. Setup the manifold and air/CO_2 inputs:

a) Screw silver square plug "K382" fittings into the outer 2 outlets of the manifold (these will not be used.)
b) Screw 4 "K24" fittings (part 2808K24) to the middle 4 outlets of the manifold. They will not screw in all the way.
c) 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:

a) Laser cut 4 "stop with air input" parts from ¼" thick clear acrylic. (See "Guide to 3D printed Stops and Sliders" in this PDF.)
b) Then thread the hole in the center of this part using an 1/8 NPT tap (part 2525A169).
c) Epoxy the laser cut part inside the 3D printed Stop pieces, allow to dry overnight.
d) Then screw a "K24" fitting into each acrylic square.
e) 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.
f) 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

McMASTER-CARR

Super-Flow Barbed Fitting for Food and Beverage
Plastic Adapter for 1/4" Tube ID x 1/8 NPT Male
$6.84 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 1/8 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

Shape	Straight
Type	Adapter
For Use With	Beverage, Food

K28

Need 1 for manifold input

1/8 NPT ¼" tube ID | 1/8 NPT 3/8" tube ID | 1/4 NPT 3/8" tube ID | 3/8 NPT 3/8" tube ID

K24 K25 K28 K32

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

Packs of 10
ADD TO ORDER
In stock
$8.42 per pack of 10
2808K32

K32

Need 2 for Blue air filter housing

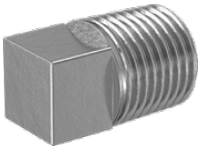
Plastic Barbed Tube Fitting for Air and Water
Tight-Seal, Wye Connector, for 3/8" Tube ID
$15.79 per pack of 10
5463K725

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

K725

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_2 coming out of the wall source, and the CO_2 flowmeter knob (the one with tube number “365”), such that when the CO_2 spigot is turned on, the floating ball reaches the level of “30”.

- Mosquito acclimation period (10 min): Air ON (“064” flowmeter reads “15”), CO_2 off (turn off at wall spigot., “365” flowmeter reads “0”)

- Assay start (1st 30 sec): Air ON (“064” flowmeter reads “15”), CO_2 stays OFF, stimuli are placed in stimulus boxes during the first 30 seconds of the assay

- Assay duration: Air ON (“064” flowmeter reads “15”), CO2 ON (“365” flowmeter adjusted to reach “30” when CO2 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_2. These settings provide a total flow rate of 17,393 ml/min of 1.1% CO_2 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_2 delivered using this combination of flowmeter tubes and a 10% CO_2 tank. Using a constant air reading of “15” the % CO_2 delivered can range from 0.05% to 4% (868-23,254ppm), depending on the CO_2 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

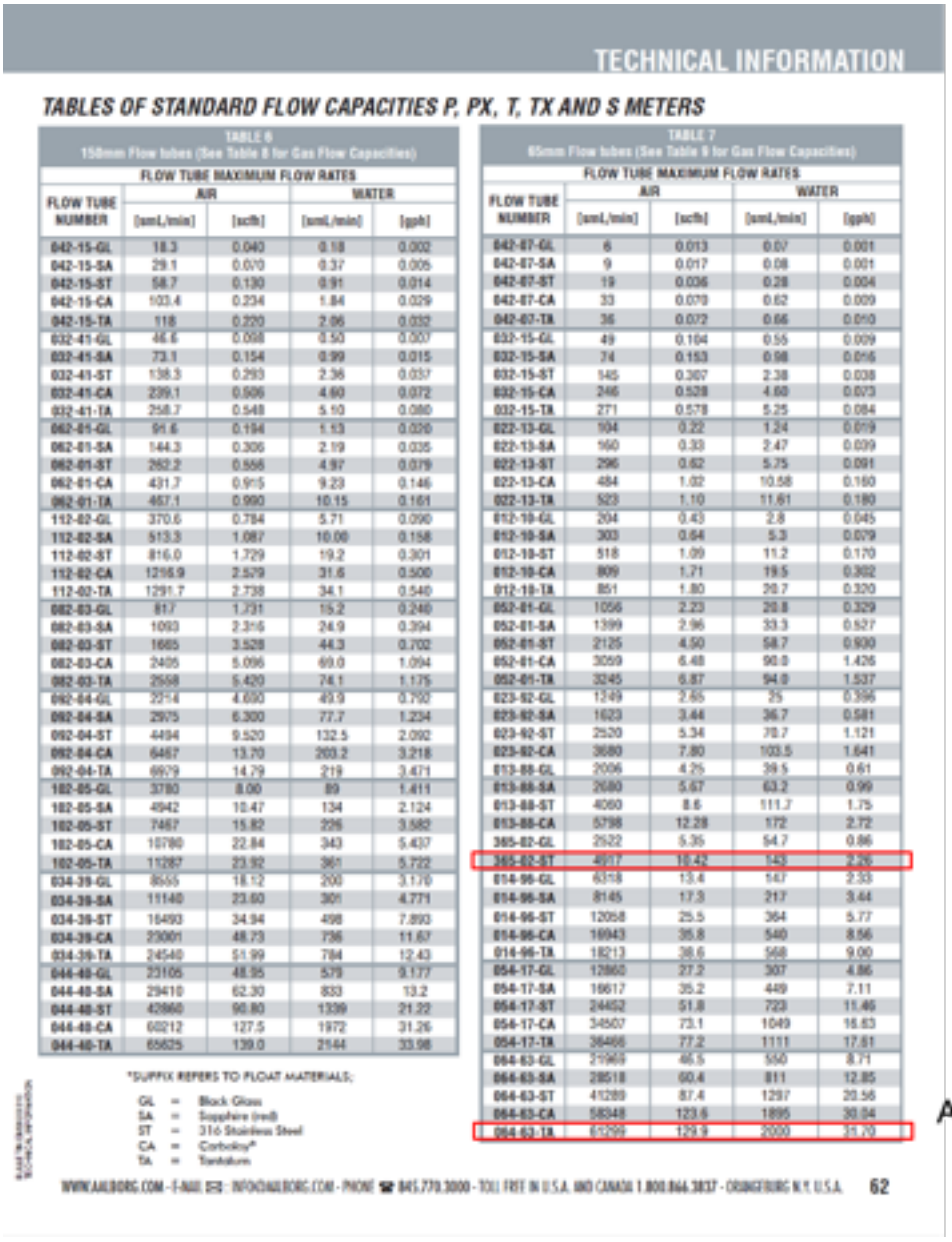
Table adapted from Aalborg product specs

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	
	[sml/min]	[scfh]	[sml/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	2.86	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	457.1	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	6929	14.79	219	3.471
182-05-GL	3780	8.00	89	1.411
182-05-SA	4942	10.47	134	2.124
182-05-ST	7467	15.82	226	3.582
182-05-CA	10780	22.84	343	5.437
182-05-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
044-48-GL	23105	48.95	579	9.177
044-48-SA	29410	62.30	833	13.2
044-48-ST	42960	90.80	1339	21.22
044-48-CA	60212	127.5	1972	31.26
044-48-TA	65625	139.0	2144	33.98

TABLE 7
85mm Flow tubes (See Table 9 for Gas Flow Capacities)

FLOW TUBE MAXIMUM FLOW RATES

FLOW TUBE NUMBER	AIR		WATER	
	[sml/min]	[scfh]	[sml/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
023-02-GL	1249	2.65	25	0.396
023-02-SA	1623	3.44	36.7	0.581
023-02-ST	2520	5.34	78.7	1.121
023-02-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	61799	129.9	2000	31.70

*SUFFIX REFERS TO FLOAT MATERIALS:

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

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CO_2 flow tube

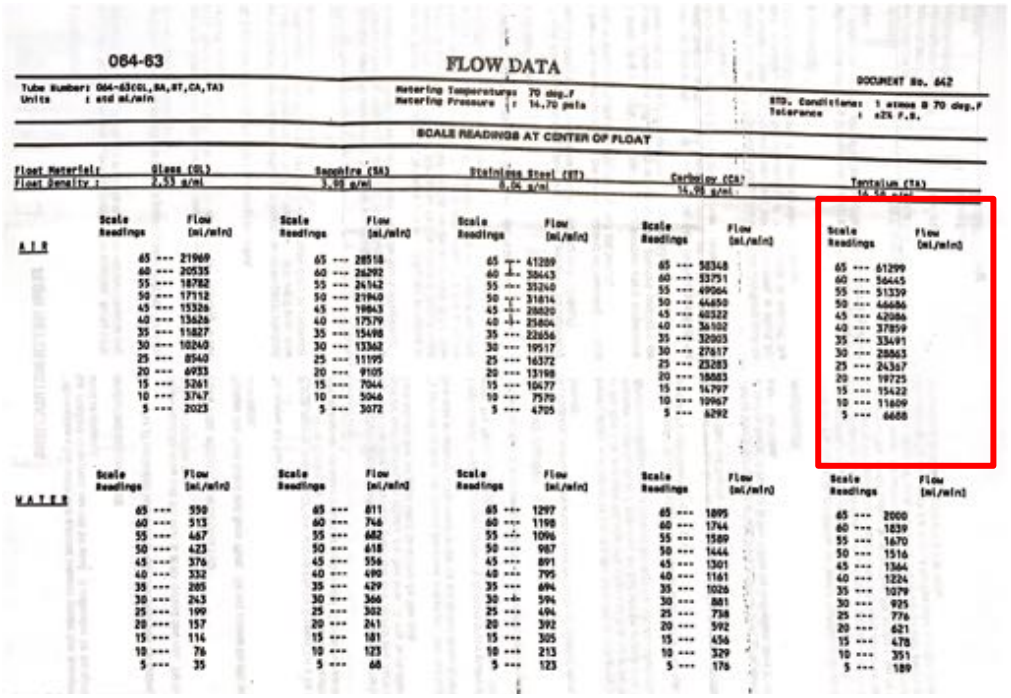
Airflow tube

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: 064-63CGL,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

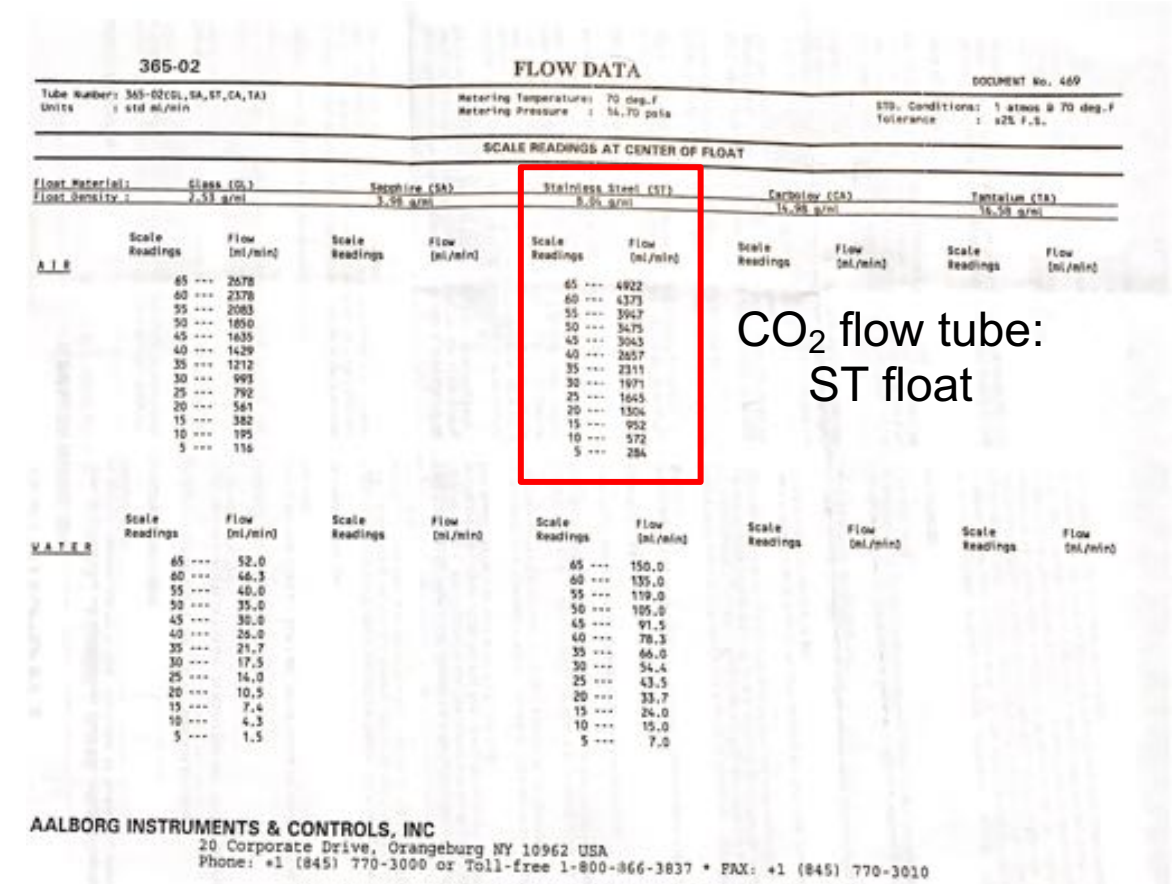
AIR

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	56445
55	18782	55	24142	55	35240	55	49064	55	51339
50	17112	50	21940	50	31814	50	44650	50	46686
45	15326	45	19843	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	18683	20	19725
15	5261	15	7044	15	10477	15	14797	15	15622
10	3747	10	5046	10	7579	10	10967	10	11609
5	2023	5	3072	5	4705	5	6292	5	6668

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	550	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	116	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: 365-02CGL,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	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				

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	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				

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CO_2 flow tube: ST float

Laser cutting & 3D printing guide > Overview

All files needed are found here:

https://github.com/VosshallLab/Basrur_Vosshall2020

Laser cutting files in 3 groups)_

- ¼” (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

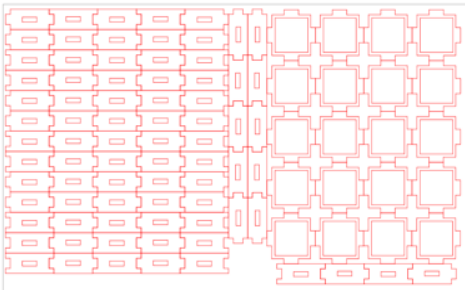
- 1/16” (1.5875 mm) clear acrylic sheets
  - Square within a square pieces (for traps)
  - Mesh pieces and crosses (for traps)

3D printing files:

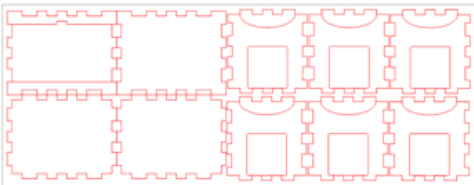
- Stop piece
- Slider piece

Laser cutting guide >1/4” Acrylic

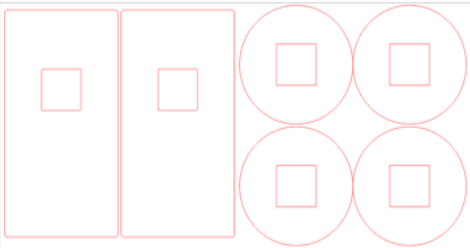
(6 files)



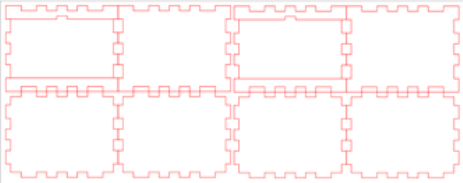
Canister stop pieces (n=20)



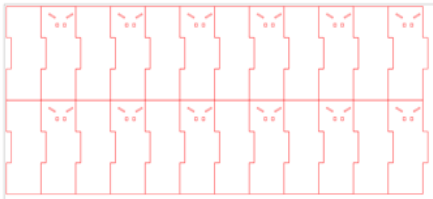
Stimulus boxes 1 of 2



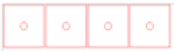
Supports for flying tube (n=2)



Stimulus boxes 2 of 2



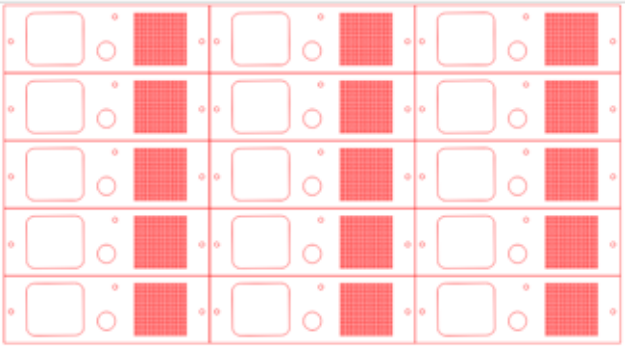
Trap outer walls (n=6x4)



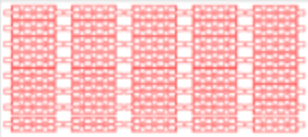
Stop with hole for air input (n=4)

Laser cutting guide > 1/8” acrylic

(2 files)



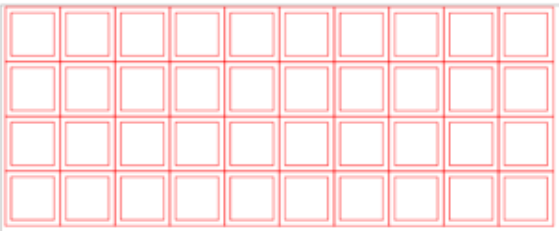
Sliding doors for canisters (n=15)



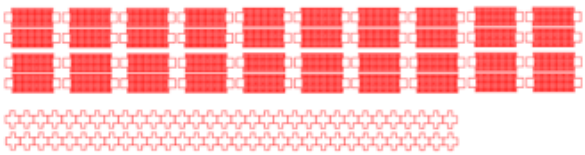
Trap canal walls (n=40)

Laser cutting guide > 1/16” acrylic

(2 files)



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

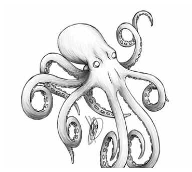


Trap mesh pieces (n=20)

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. CO2 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_2).
- To start trial, set timer for 5m30s. Start timer, turn on CO_2; the level on the right flow meter should be set to “30” to deliver 1% CO2. Place stimulus in stimulus chamber.
- After 30s of CO_2 flow, remove wood dowels to allow sliding doors to open and release mosquitoes into the assay.
- After 5 minutes, turn off CO_2 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:	

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