PanVent™-OS (Open Source)

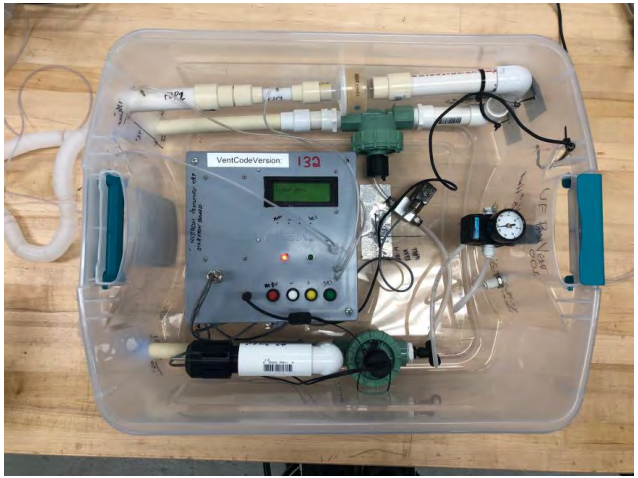
Assembly Sequence Provided by LifeMech

LifeMech unit #2 build

May 28, 2020

Modified by UF: August 28, 2020

V2.2



The following set of slides documents how the second LifeMech PanVent™ OS Emergency Use Ventilator was assembled.

This is a baseline set of instructions as a starting point for assembly of the PanVent™ OS device

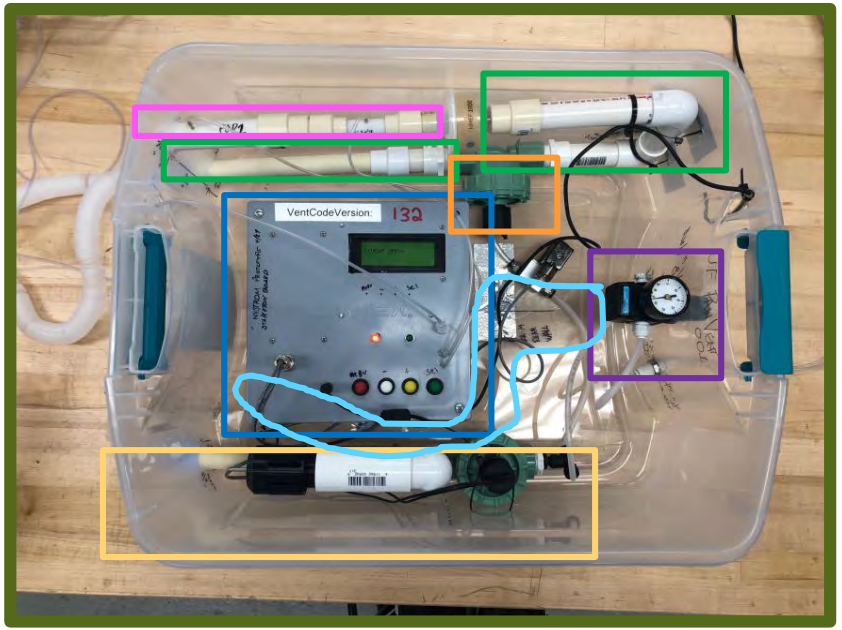
The part numbers in this slide deck coincide with those in an Excel BOM. The use of both of the assembly instructions and the BOM v 2.10 is critical to fully understand how to build and assemble the PanVent™.

Tools:

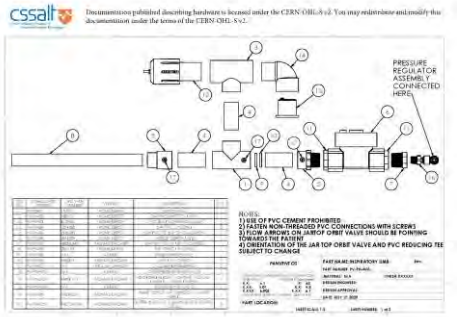
- Something to cut PVC with
  - Circular saw
  - Jigsaw
- Sander
- De-burring tool
- Calipers/precise measuring tool
- 7/64” bit
- 9/64” drill bit
- 5/32” bit
- 11/64” drill bit or slightly larger
- ½” bit
- #47 drill bit
- #55 drill bit
- #60ish drill bit
- 150 grit sandpaper
- 400 grit sandpaper
- Philips head screwdriver
- Permanent marker
- Scissors
- Mallet
- Laser cutter
- Teflon tape
- Small hammer
- X-Acto knife
- 3M industrial strength double-sided tape
- Wire crimping tool
- Plastic bonder (PV-PN-223, and PV-PN-224)
- Glue (PV-PN- 204)
- Silicon adhesive (PV-PN-229)
- Multipurpose synthetic grease (PV-PN-215)
- Compass
- Superglue (PV-PN- 206)

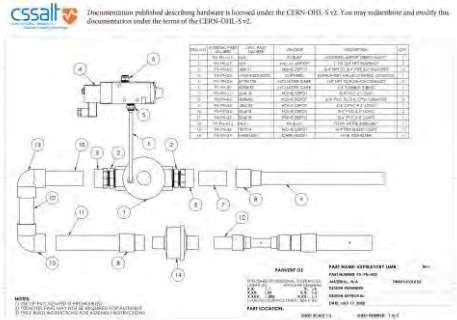
PanVent Sections:

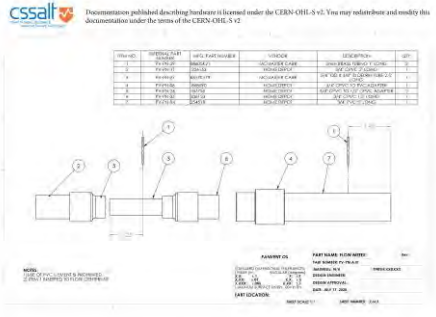
1) PV-PN-A03 - Inspiratory limb
    1A) PV-PN-A04 - Anti Asphyxia valve
    1B) PV-PN-A05 - Overpressure valve
    1C) PV-PN-000 - Orifice
2) PV-PN-A10 - Flow meter assembly
3) PV-PN-A02 - Expiratory limb
    3A) PV-PN-A16 Modified Orbit Valve
    3B) PV-PN-A15 - Solenoid wiring harness
4) PV-PN-A13 - Controller box
    4A) PV-PN-A11 - small plenum
    4B) PV-PN-A12 – large plenum
5) PV-PN-A14 - Plastic enclosure
    5A) PV-PN-A06 – Pressure regulator assembly



Pipes to cut per section:







Inspiratory Limb:

Diagram Label	Type/Diam	Length needed per part (inch)	Qty:
4	PVC – ¾”	2.0"	3
8	CPVC – ¾”	5.0"	1

Expiratory Limb:

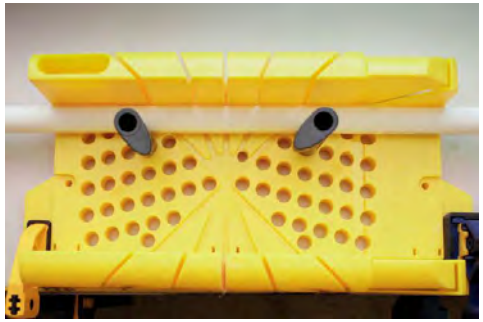
Diagram Label	Type/Diam	Length needed per part (inch)	Qty:
7	PVC – ¾”	2.0"	1
9	CPVC – ¾”	9.5"	1
10	PVC – ¾”	3.5"	2
11	PVC – ¾”	5.5”	1

Flow Meter Assembly:

Diagram Label	Type/Diam	Length needed per part (inch)	Qty:
2	CPVC – ¾”	2"	1
3	Delrin – see BOM	2.5"	1
6	CPVC – ¾"	1.5"	1
7	PVC – ¾”	5"	1

Cutting the PVC sections:

My method:

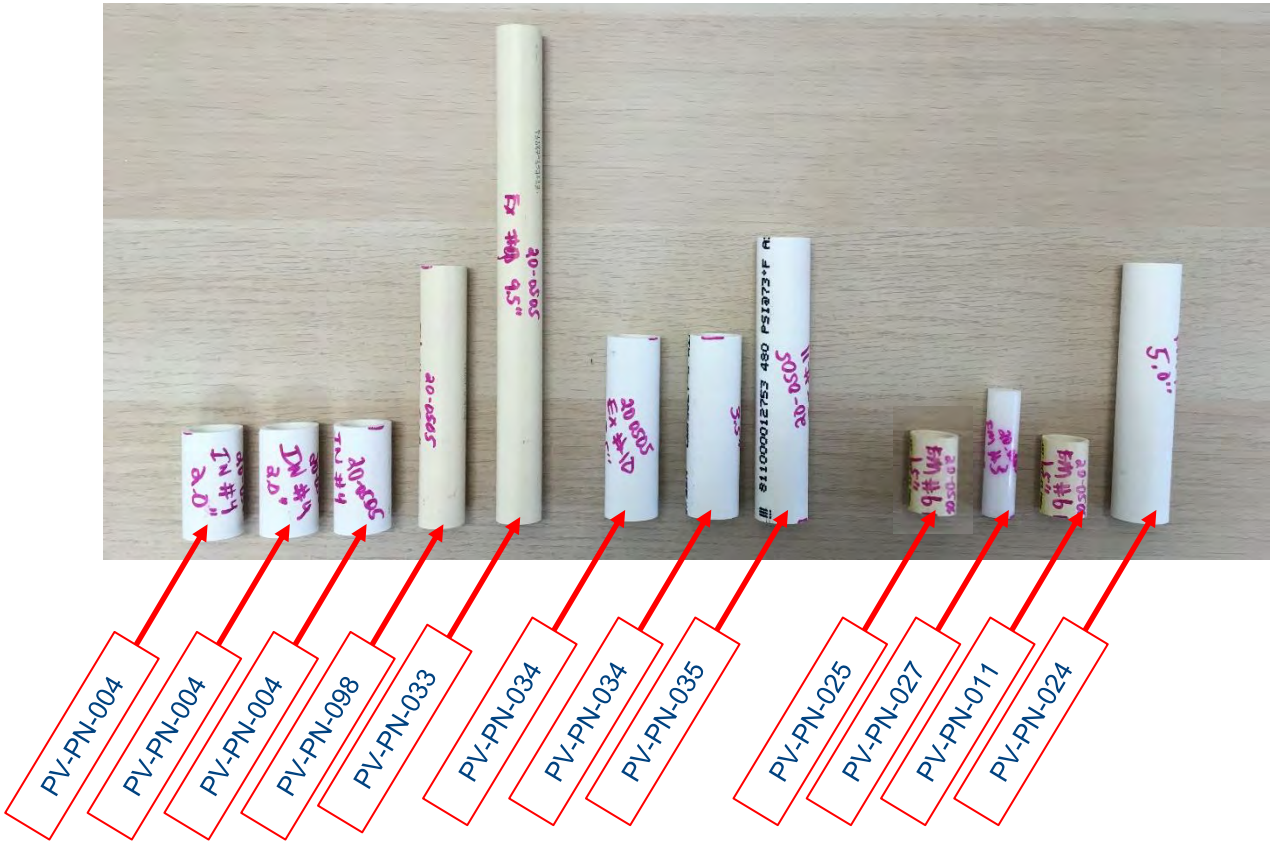


Recommended method:

Alternative methods:

Sand and De-bur ends of newly cut pipes:

All pipes and part numbers:



PV-PN-A04 – Anti Asphyxia valve – All parts

5/32” bit

150 grit sandpaper

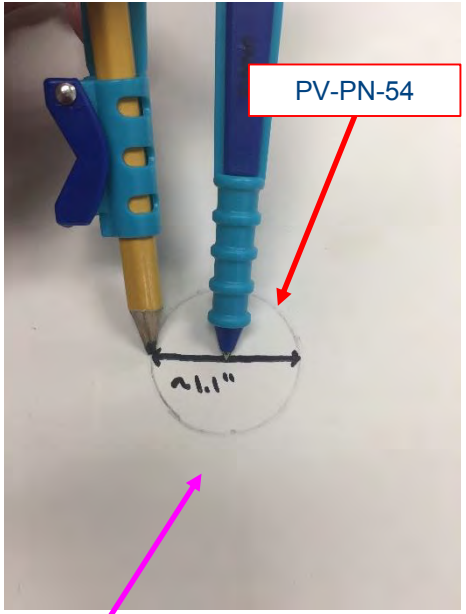
400 grit sandpaper

De-burring tool

Phillips screwdriver

Permanent marker

PV-PN-A04 – Anti Asphyxia valve – STEP 1: cut a circle of diameter ~1.152 inches.



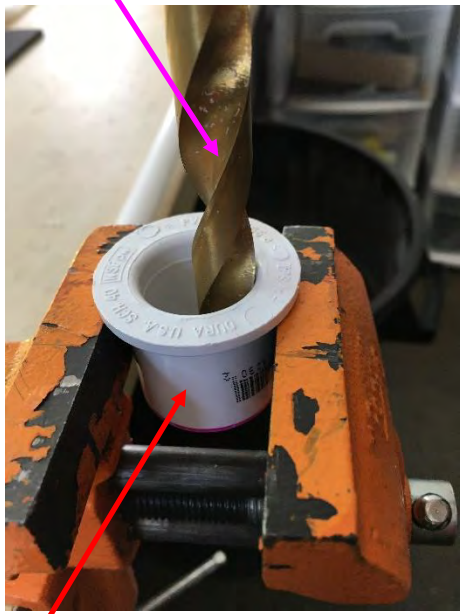
Silicone sheet is 1/16" thick.

PV-PN-201

ENSURE THERE IS A SMALL GAP ALL AROUND THE EDGE.

PV-PN-A04 – Anti Asphyxia valve – STEP 2: drill a ½" hole in the PVC plug.

DRILL HOLE USING A ½"
DRILL BIT AT A SLOW RPM.

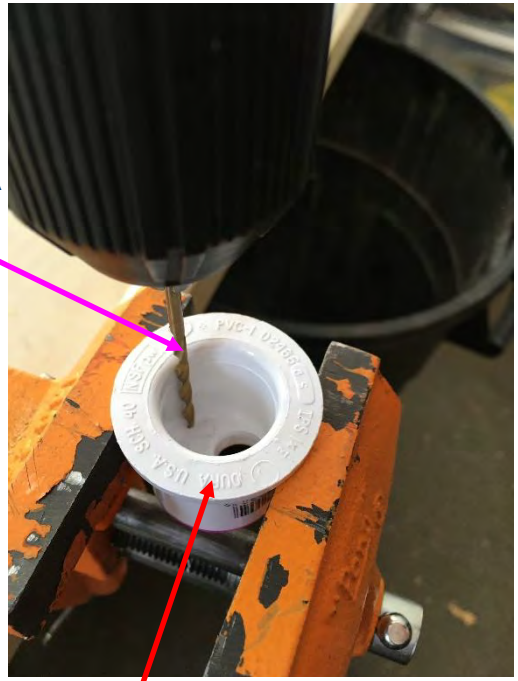


PV-PN-201

EDGE OF HOLE IS AS CLOSE TO INNER WALL AS POSSIBLE

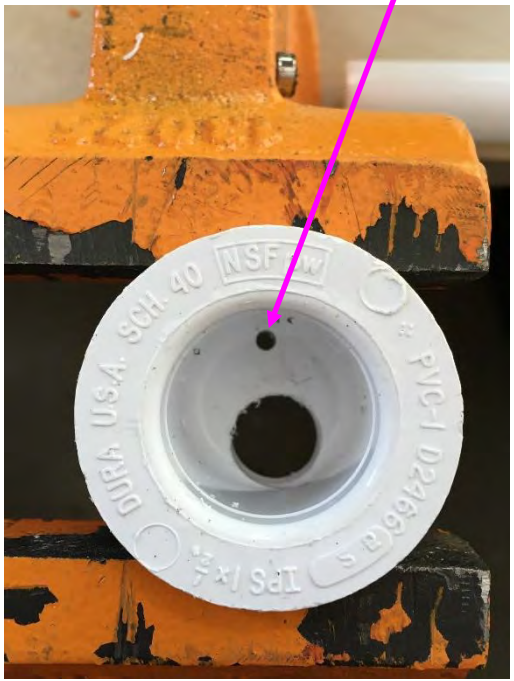
PV-PN-A04 – Anti Asphyxia valve – STEP 3: drill a 7/64” hole in the PVC plug.

DRILL HOLE USING A 7/64” DRILL BIT.



PV-PN-201

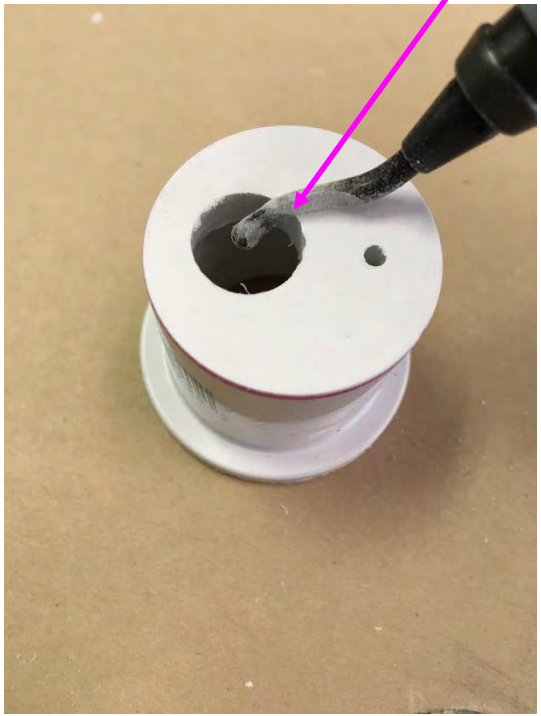
EDGE OF HOLE IS AS CLOSE TO INNER WALL AS POSSIBLE



PV-PN-A04 – Anti Asphyxia valve – STEP 4: sand and de-burr the plug

Start with 150 grit sandpaper. Move to 400 grit sandpaper. Ensure bottom of plug is totally flat.

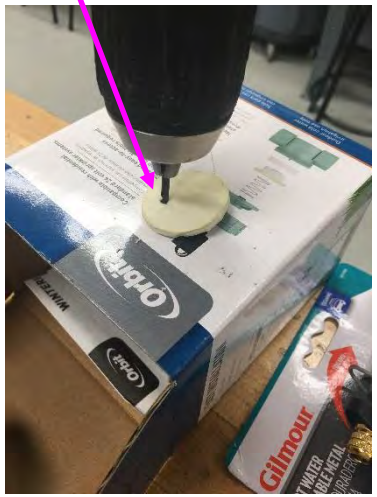
De-bur edges using tool. Perhaps a countersink tool could be used as an alternative.



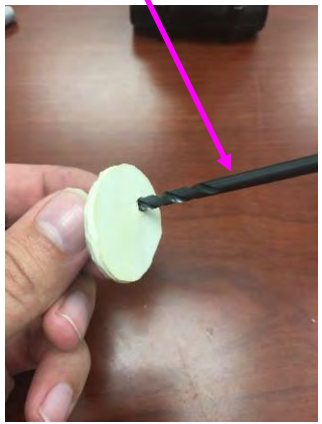
PV-PN-A04 – Anti Asphyxia valve – STEP 5: drill hole in silicone flapper

Place flapper on end of plug. Mark hole location on to the flapper from the opposite side.

Drill hole starting with the 7/64" drill bit.



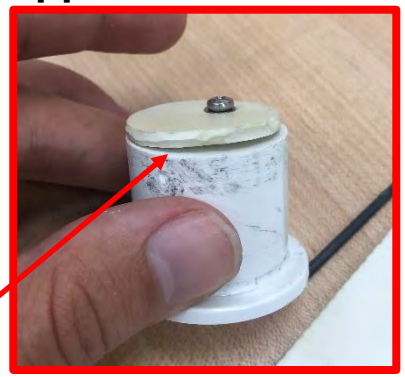
Enlarge the hole with the 5/32 drill bit.



Hole should be roughly the size of the M3 screw.. Maybe a little smaller is OK.

PV-PN-A04 – Anti Asphyxia valve – STEP 6: attach flapper

BAD:
Hole in flapper needs to be enlarged:



Gap exists:

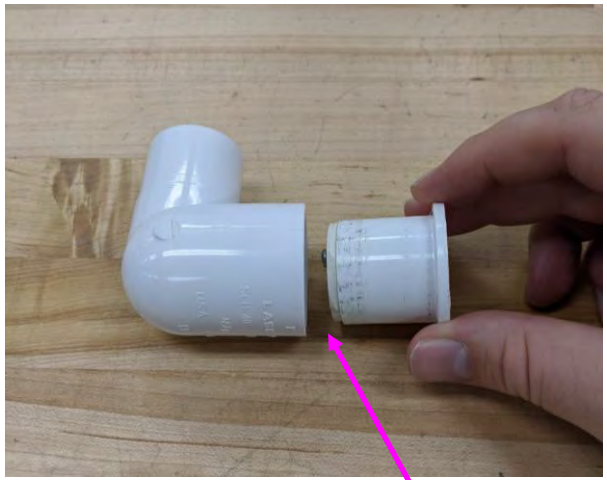
GOOD:
Hole in flapper is acceptable size:

Flapper sits flat:

PV-PN-A04 – Anti Asphyxia valve – STEP 7: test and inspect flapper

Ensure no glue accidently sealed the flapper shut

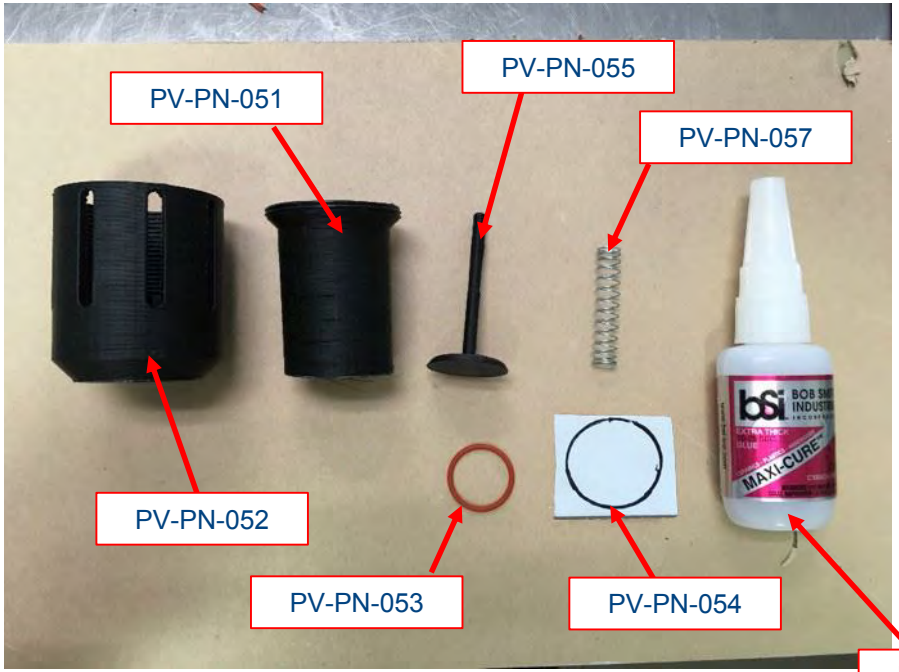
PV-PN-A04 – Anti Asphyxia valve – STEP 8: check flapper function within “elbow”



Push AA valve into PVC elbow.

Flapper should be able to move freely and remain unobscured.

PV-PN-A05 - Inspiratory limb – overpressure valve – all parts:



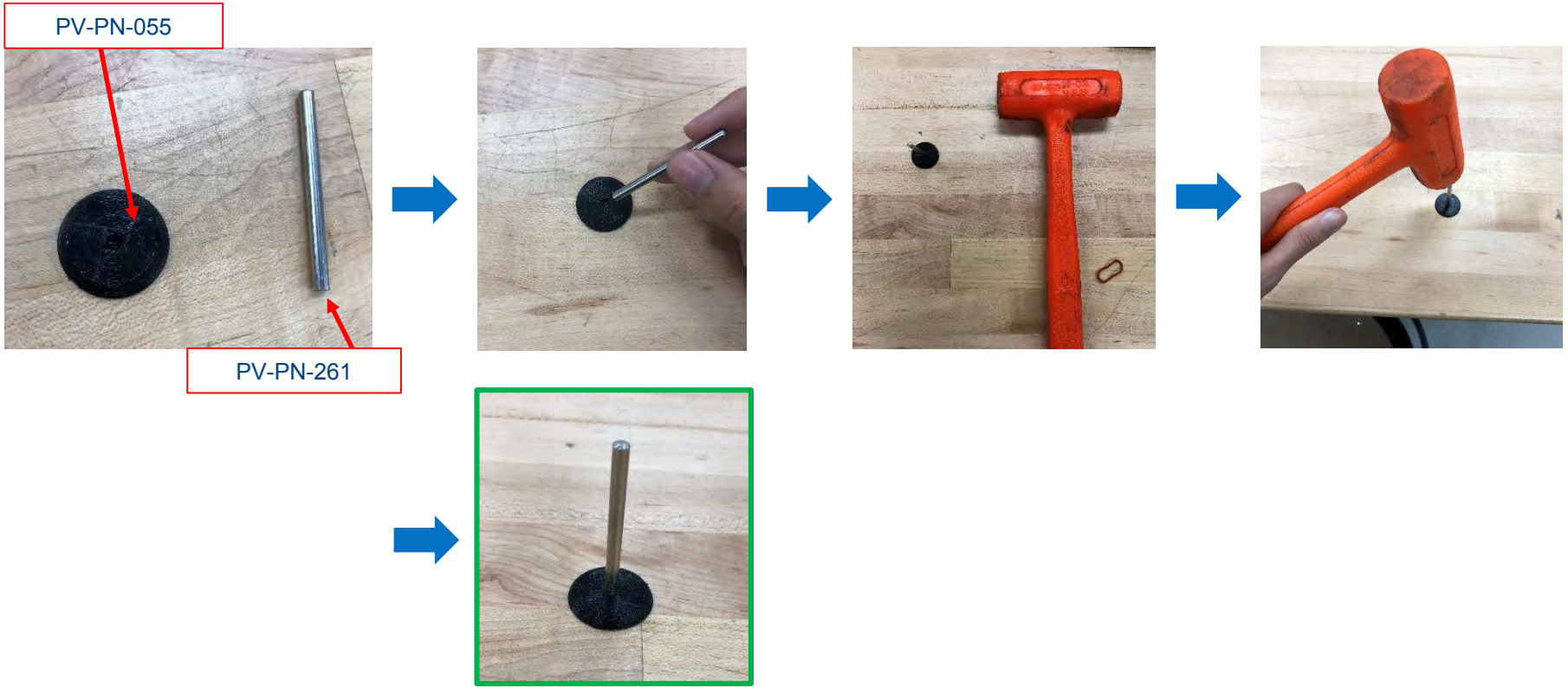
5/32” bit

150 grit sandpaper

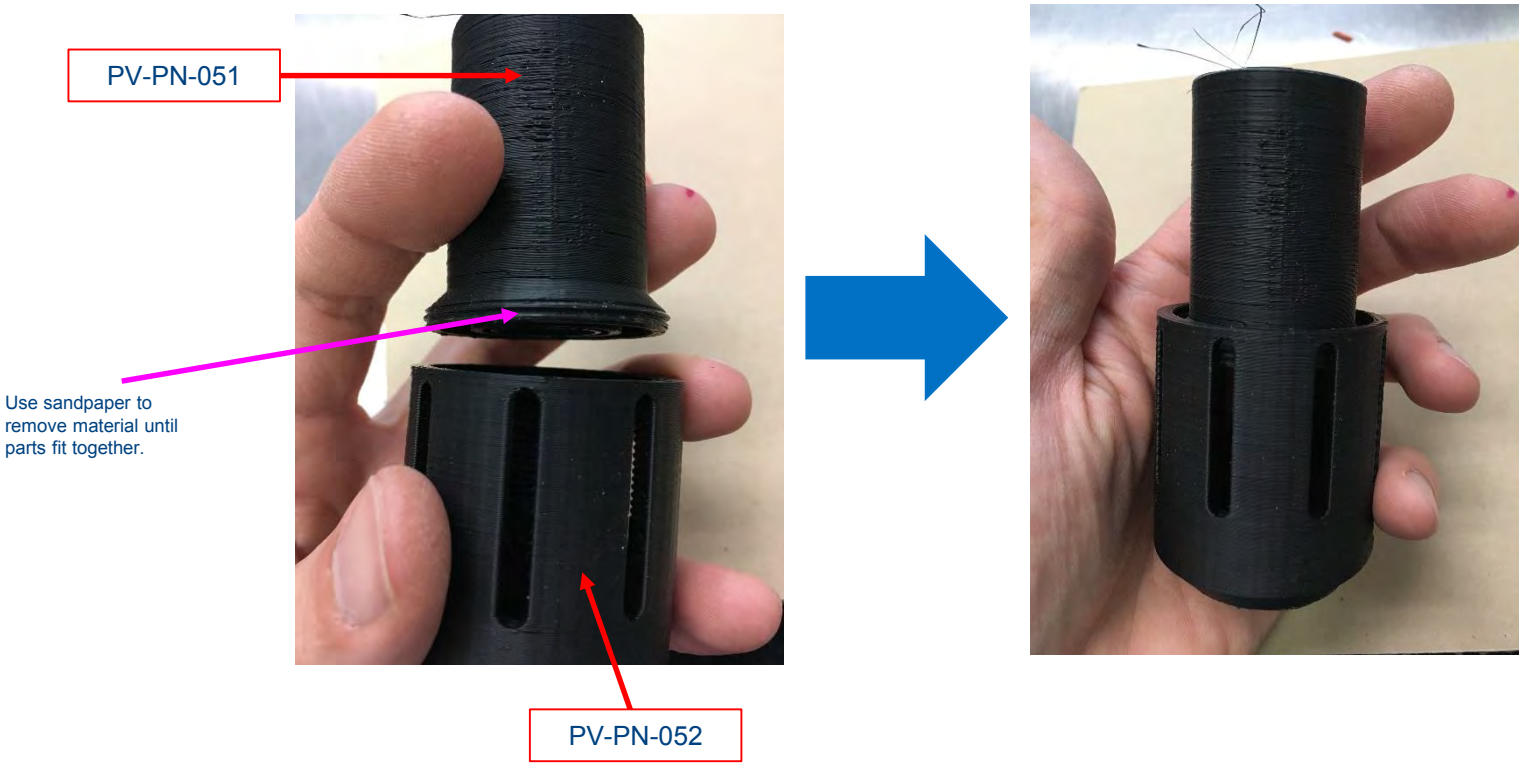
400 grit sandpaper

Permanent marker

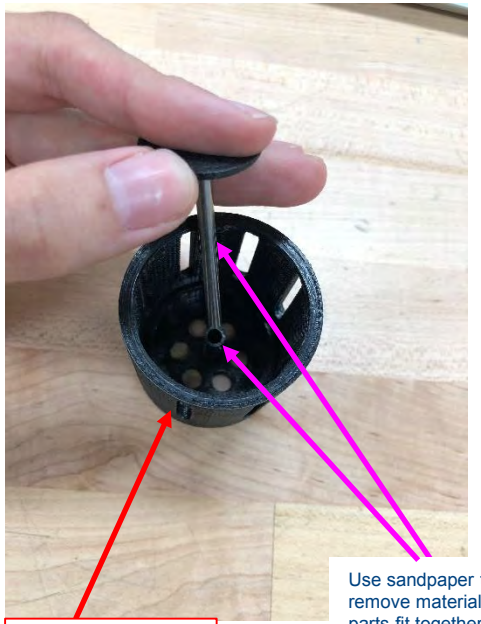
PV-PN-A05 - Inspiratory limb – overpressure valve – STEP 1: assemble 3D printed poppet base and cut stainless steel rod

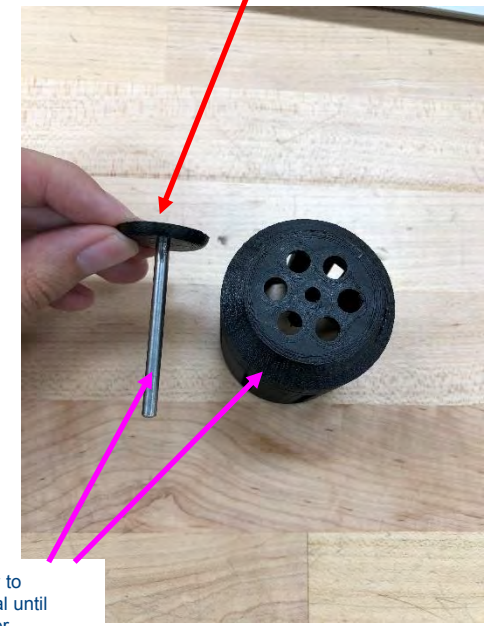


PV-PN-A05 - Inspiratory limb – overpressure valve – STEP 2: ensure 3D printed parts fit together - check threaded interface



PV-PN-A05 - Inspiratory limb – overpressure valve – STEP 3: ensure 3D printed parts fit together - ensure plastic shaft has a loose sliding fit. Remove material until possible.

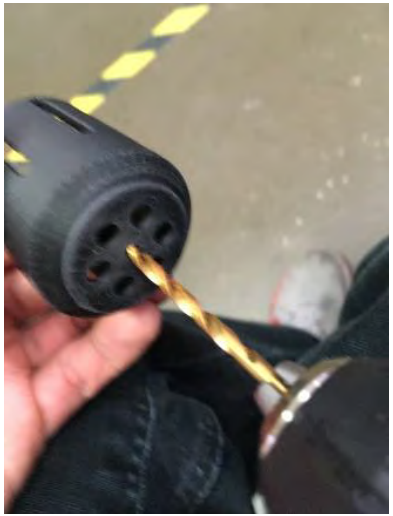




PV-PN-055

PV-PN-052

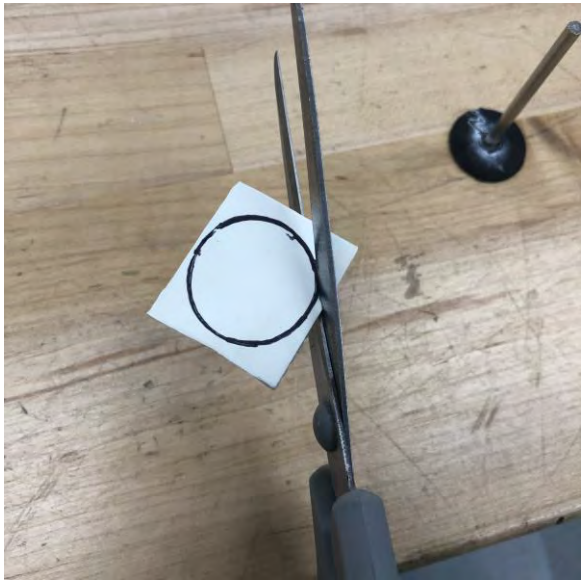
Use sandpaper to remove material until parts fit together.



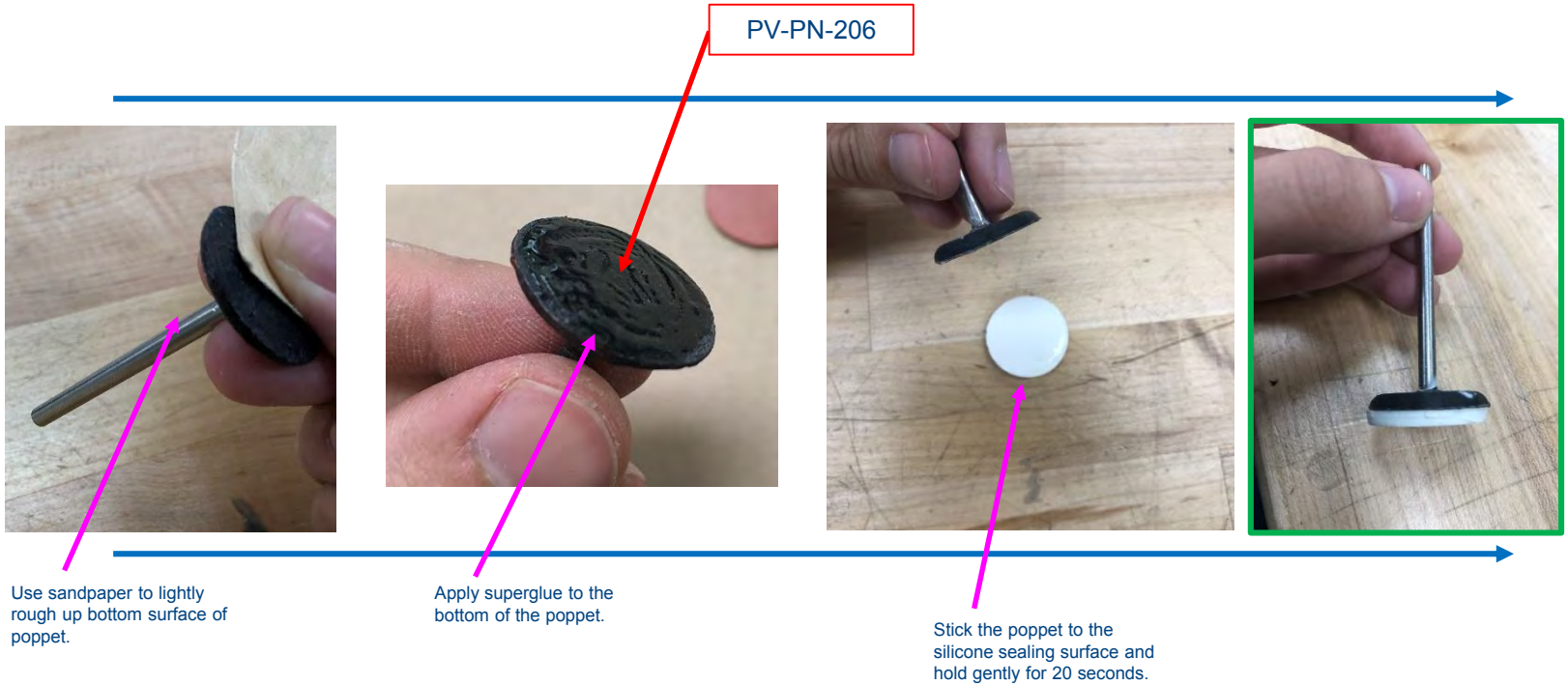
Drilling out ID (be VERY careful… the walls are thin)

PV-PN-A05 - Inspiratory limb – overpressure valve – STEP 4: cut out silicone face seal material

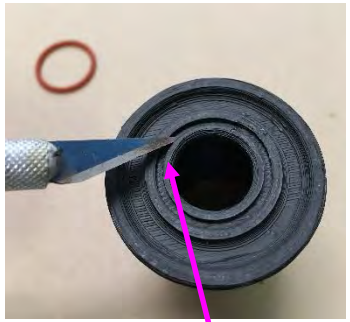
PV-PN-054



PV-PN-A05 - Inspiratory limb – overpressure valve – STEP 5: use superglue to attach the sealing surface to the bottom of the poppet base.



PV-PN-A05 - Inspiratory limb – overpressure valve – STEP 6: push O-ring into groove



Remove enough material to allow O ring to sit flush.

PV-PN-053

Push O-ring into groove.

BAD:
Remove more material.

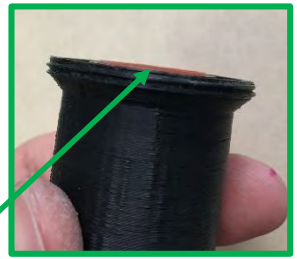
large bumps on O-ring

BAD:
Remove more material.

Small bumps on O-ring

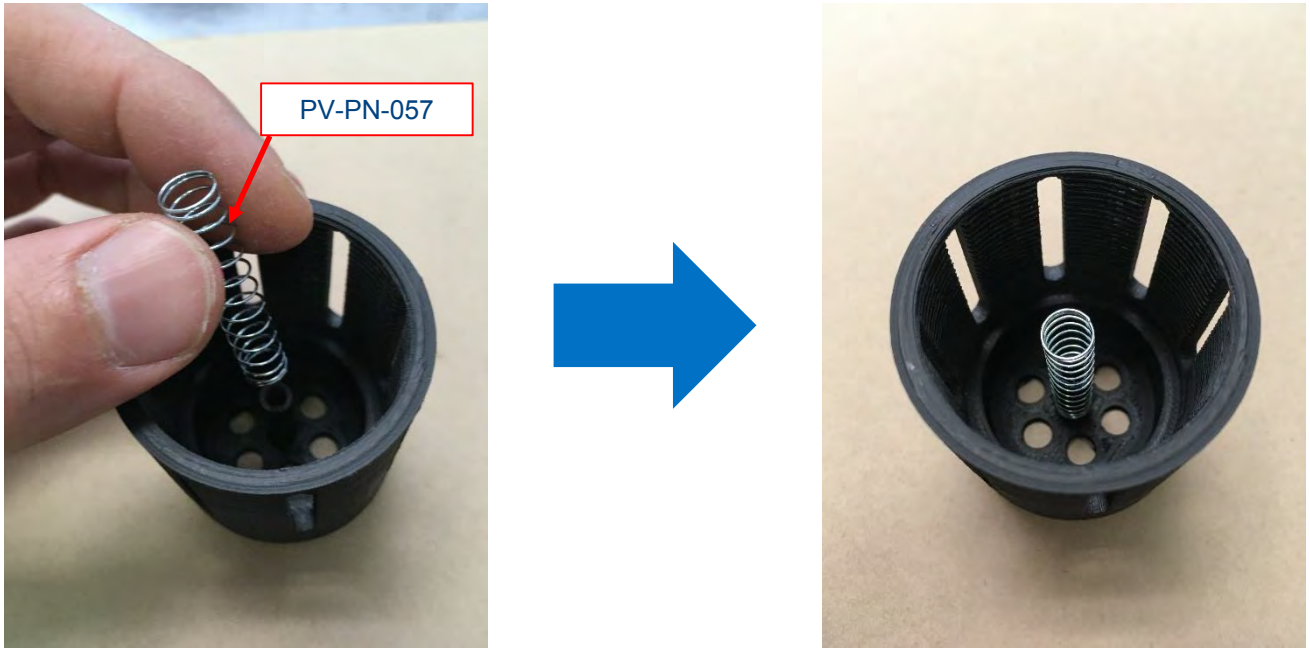
GOOD:
O-ring groove is an acceptable size.

No bumps on O-ring

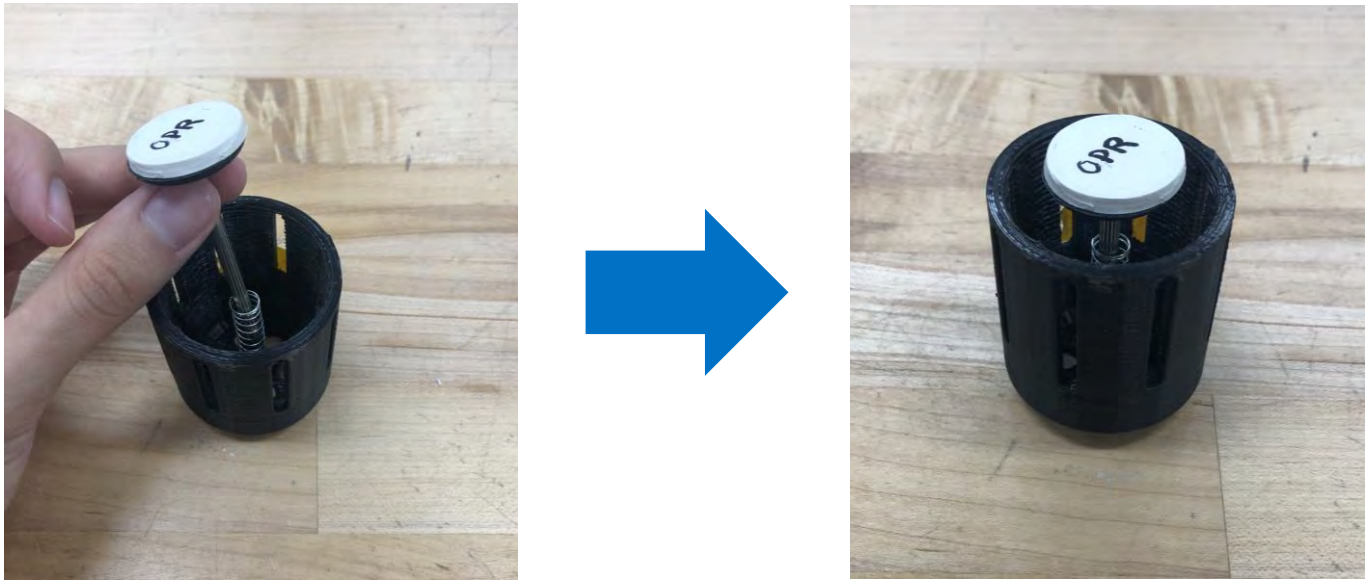


O ring with good fit.

PV-PN-A05 - Inspiratory limb – overpressure valve – STEP 7: place spring in assembly.



PV-PN-A05 - Inspiratory limb – overpressure valve – STEP 8: place poppet on top of spring

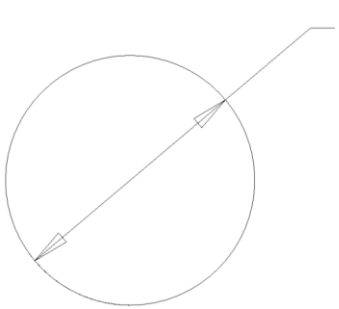


PV-PN-A05 - Inspiratory limb – overpressure valve – STEP 9: place OPR base on top of poppet base

Screw parts together carefully.

PV-PN-000 – orifice plate – STEP 1: use laser cutter to cut out a circle

1/8” or 3mm acrylic can be used. This one is a tiny bit thinner at 2.91mm



AS CUT = 25.92mm

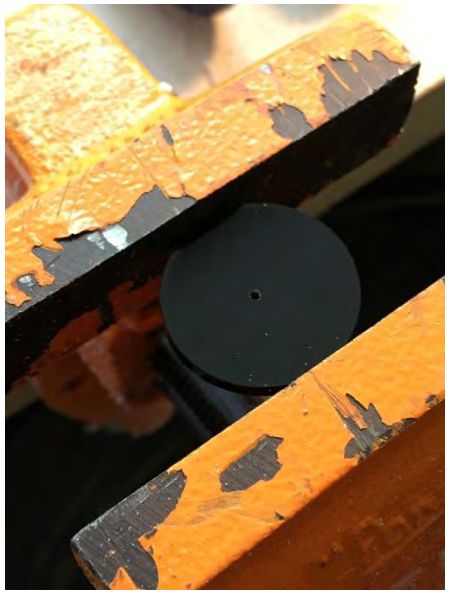
20-0508_019_orifice_plate_blank_v1.dxf

PV-PN-000 – orifice plate – STEP 2: test fit orifice plate in ¾” PVC tee

Orifice should rest on this ledge. If PVC fitting does not have this ledge, create one with a 1/8” section of ¾” PVC pipe pressed in first. Note that there is the possibility some PVC fittings won’t have these nice ledges. If so, use an 1/8” thin piece of pipe to create that ledge.

PV-PN-000 – orifice plate – STEP 3: using a #55 drill bit, create a hole in the center

#55 drill bit
(0.052 in)
(1.3208 mm)



PV-PN-A06 – Pressure regulator – STEP 1: install NPT plug

NOTE: the flow direction arrow should point to the port you are plugging.

PV-PN-007

PV-PN-015

PV-PN-227

PV-PN-A06 – Pressure regulator – STEP 2: install NPT gauge

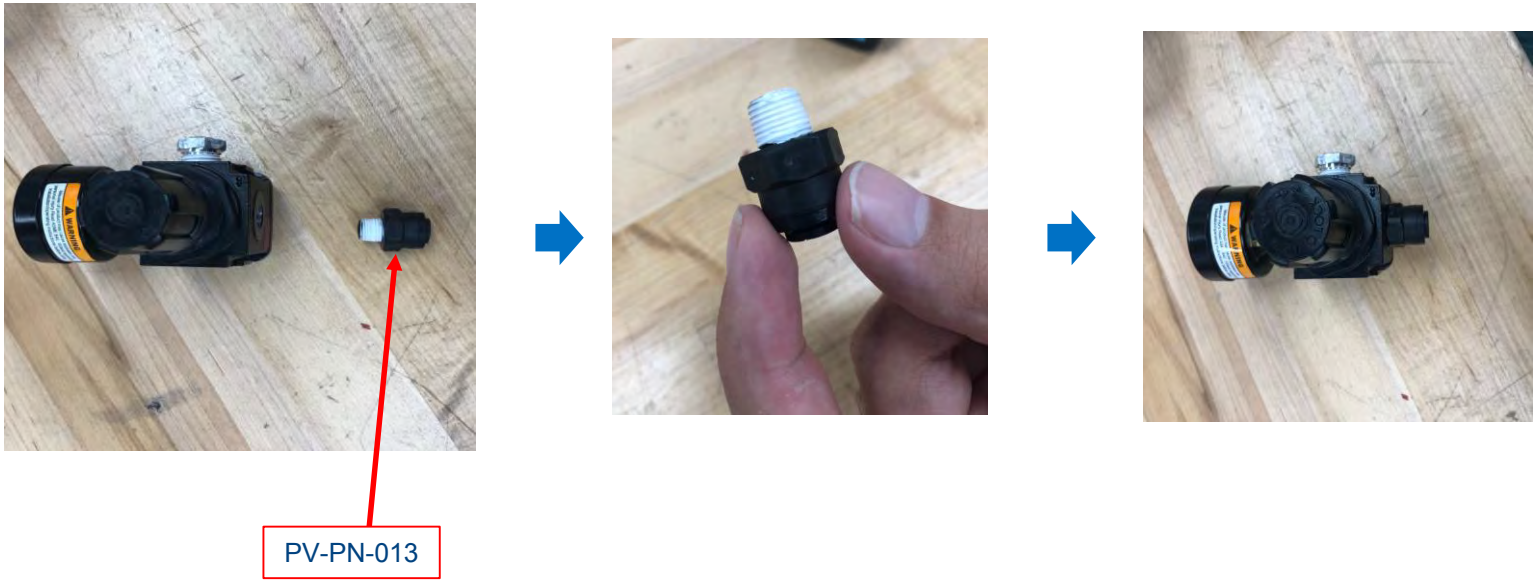
PV-PN-014

Wrap each of the threaded portions with Teflon tape. Two to three times around.

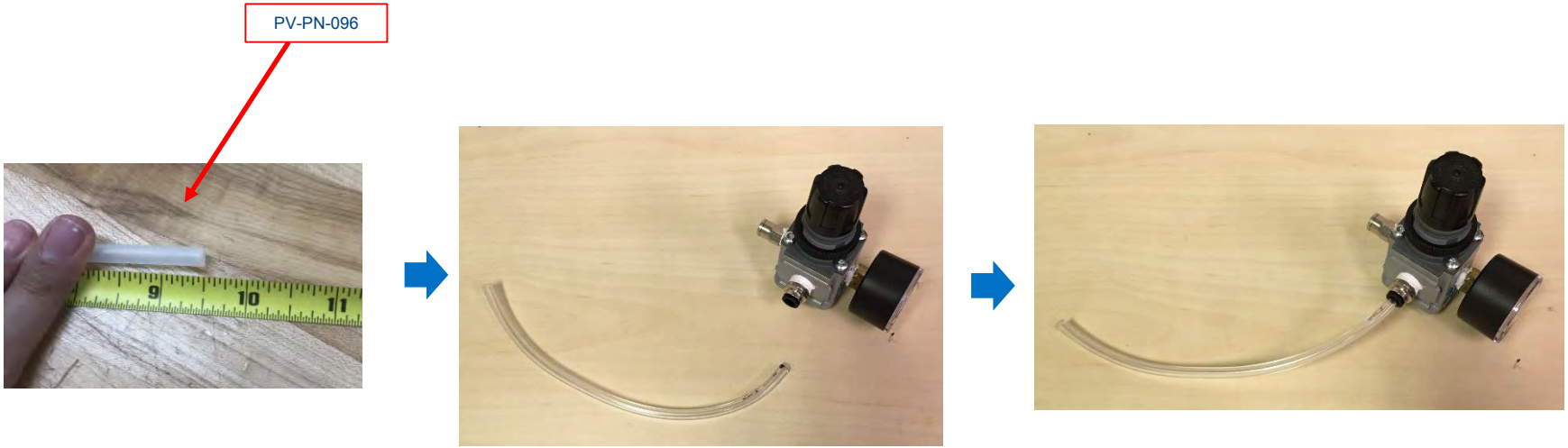
Wrap clockwise.

PV-PN-A06 – Pressure regulator – STEP 3: install NPT fitting

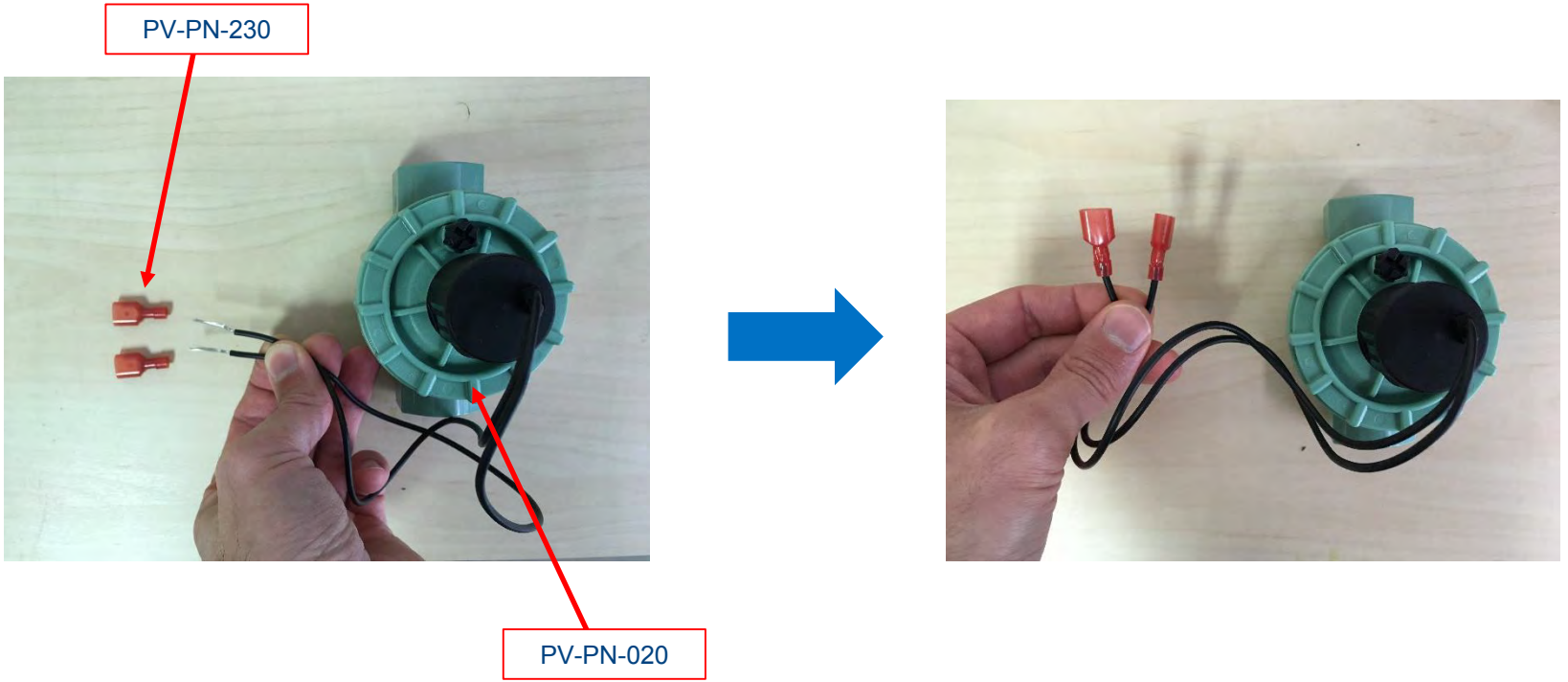
PV-PN-A06 – Pressure regulator – STEP 4: install second NPT fitting



PV-PN-A03 – Pressure regulator– STEP 5: cut supply line out of ¼” tubing.



PV-PN-A03 – Inspiratory limb – STEP 1: attach connectors to the end of the valve wires

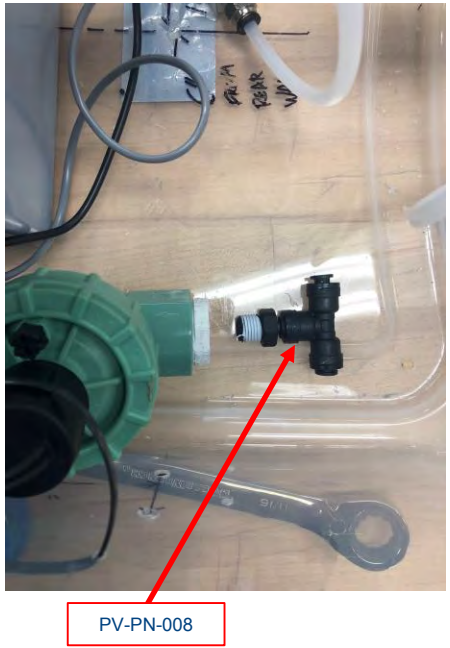


PV-PN-A03 – Inspiratory limb – STEP 2: screw in NPT adapter fitting

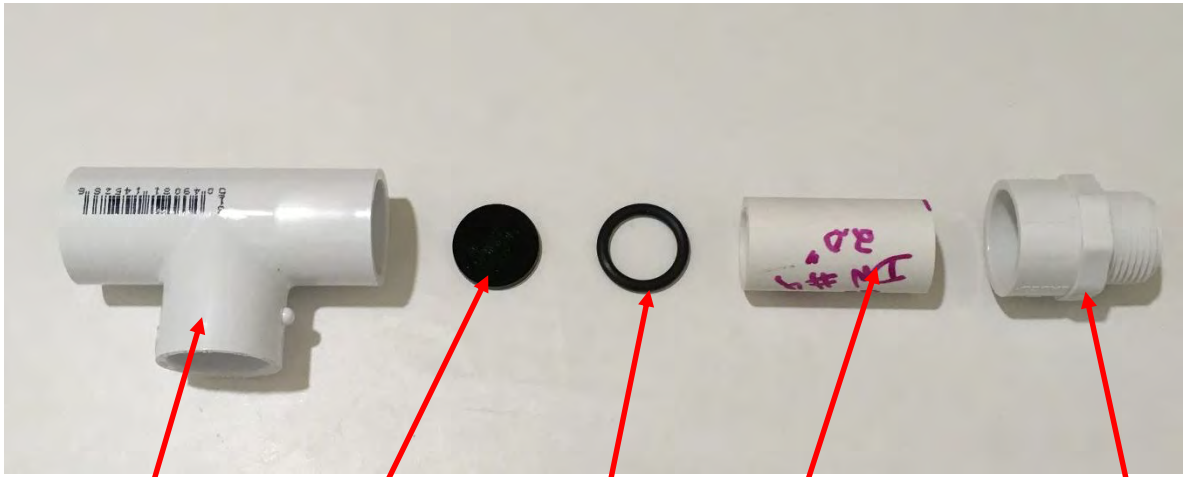
PV-PN-010

Wrap
clockwise.

PV-PN-A03 – Inspiratory limb – STEP 3: screw in NPT push-to-connect “Y” fitting



PV-PN-A03 – Inspiratory limb – STEP 4: orifice related parts shown here



PV-PN-001

PV-PN-000

PV-PN-018

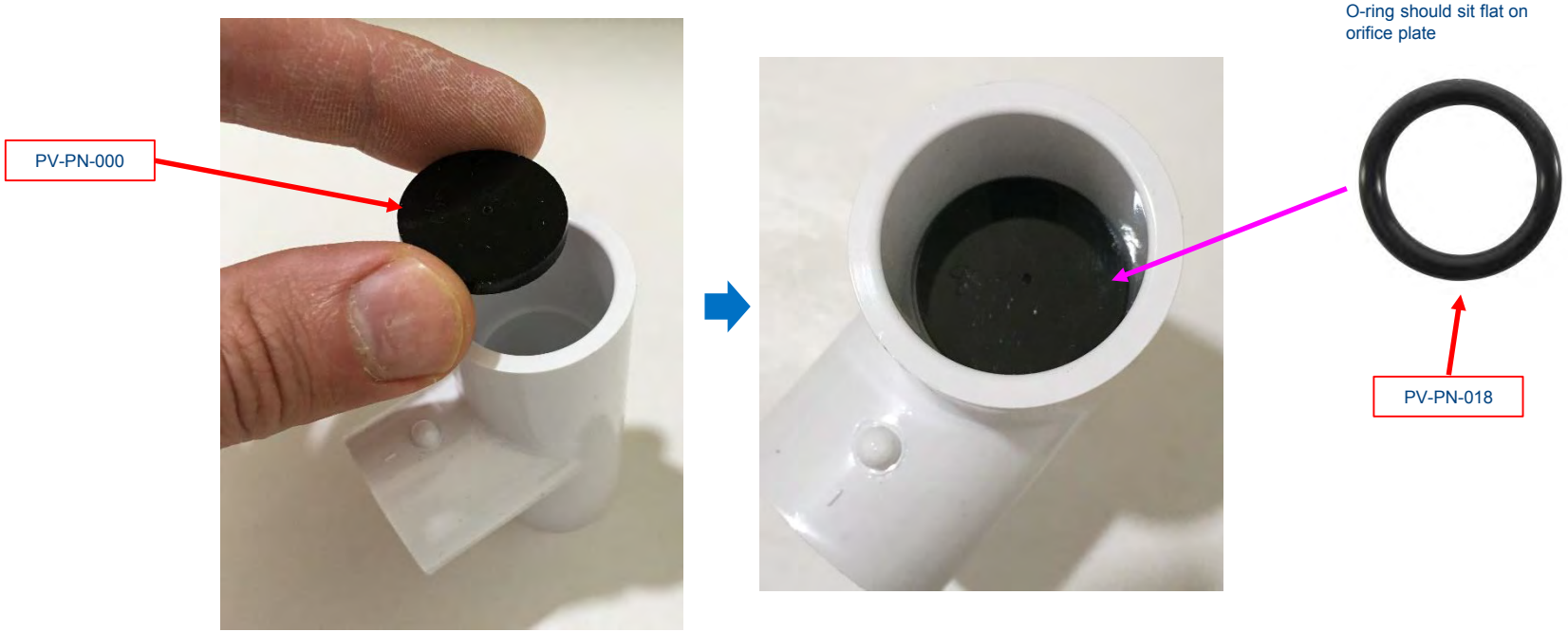
PV-PN-004

PV-PN-002

#60-ish drill bit

9/64 drill bit

PV-PN-A03 – Inspiratory limb – STEP 5: place orifice in fitting and O-ring on top.



PV-PN-A03 – Inspiratory limb – STEP 6: install PVC tube

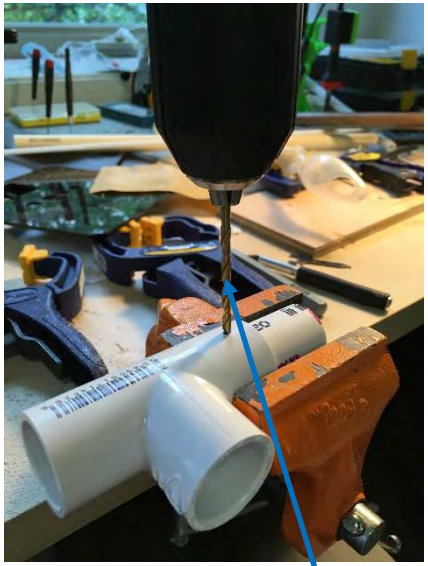
PV-PN-004

PV-PN-229

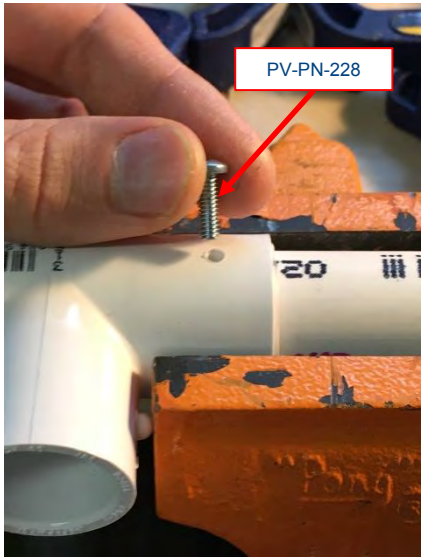
PV-PN-A03 – Inspiratory limb – STEP 7: mark and cut guide hole in PVC connection.

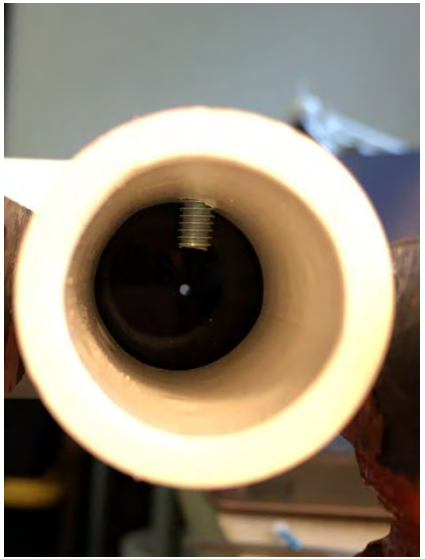
#60-ish drill bit

PV-PN-A03 – Inspiratory limb – STEP 8: using guide hole, drill out actual hole.



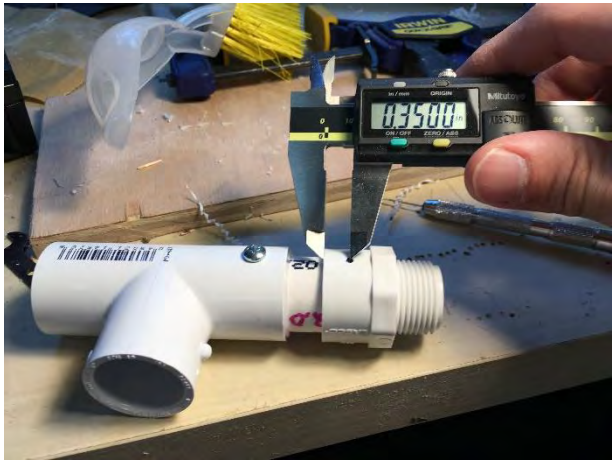
PV-PN-A03 – Inspiratory limb – STEP 9: screw in bolt to lock two parts together





PV-PN-A03 – Inspiratory limb – STEP 10: glue and install PVC fitting

PV-PN-A03 – Inspiratory limb – STEP 11: mark and drill second guide hole

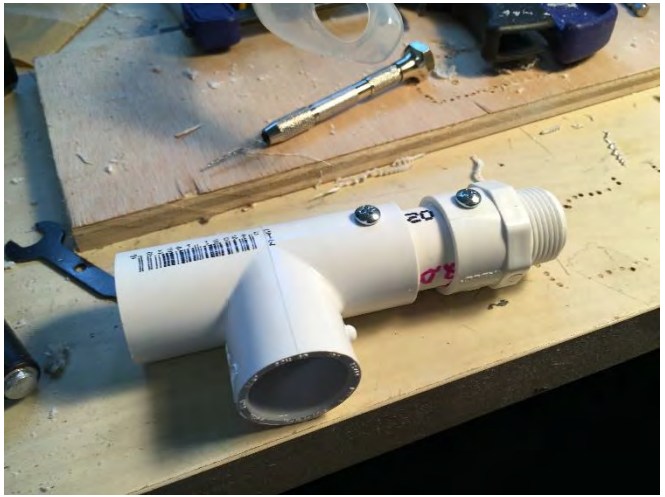


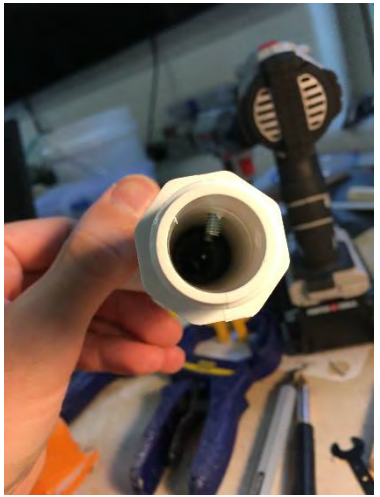
#60-ish drill bit

PV-PN-A03 – Inspiratory limb – STEP 12: using guide hole drill the actual hole.

9/64 drill bit

PV-PN-A03 – Inspiratory limb – STEP 13: install second screw to pin two parts together



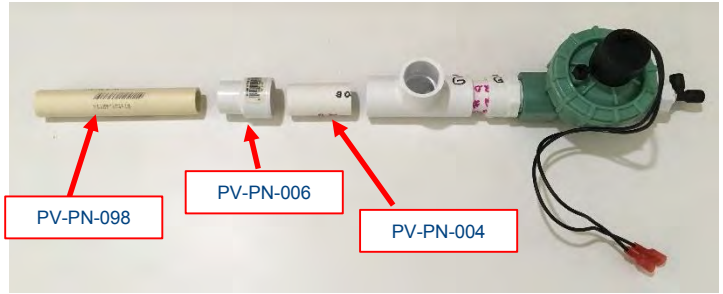


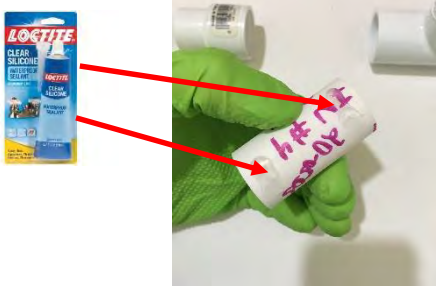
PV-PN-A03 – Inspiratory limb – STEP 14: attach Orbit valve.

Wrap clockwise.

Wrap the threaded portion with enough Teflon tape.

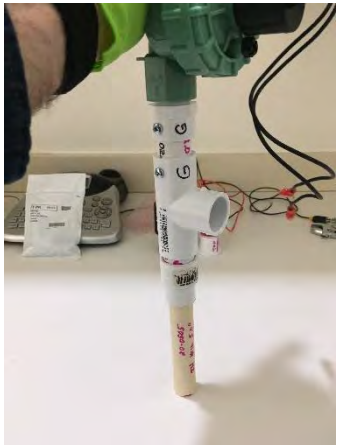
PV-PN-A03 – Inspiratory limb – STEP 15: add pipe to assembly



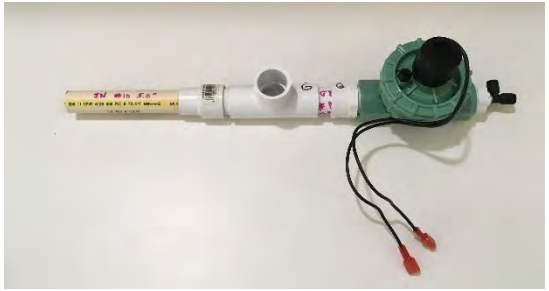


Apply a blob of silicone adhesive to each end of the PVC tube. Smear the adhesive blobs to around the circumference to create a thin but uniform layer.

Apply a blob of silicone adhesive to the end of the CPVC tube. Smear the adhesive blobs to around the circumference to create a thin but uniform layer.



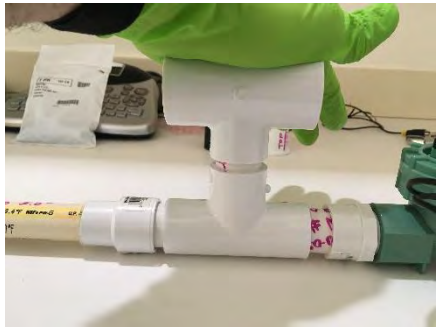
Push and hold all parts together for a few minutes to make sure they don't try and slide apart. (the silicone adhesive acts as a lubricant and the PVC parts are tapered.)



PV-PN-A03 – Inspiratory limb – STEP 16: add more pipe and fitting to assembly

PV-PN-229

Apply a blob of silicone adhesive to the end of the CPVC tube. Smear the adhesive blobs to around the circumference to create a thin but uniform layer.



Push and hold all parts together for a few minutes to make sure they don't try and slide apart. (the silicone adhesive acts as a lubricant and the PVC parts are tapered.)

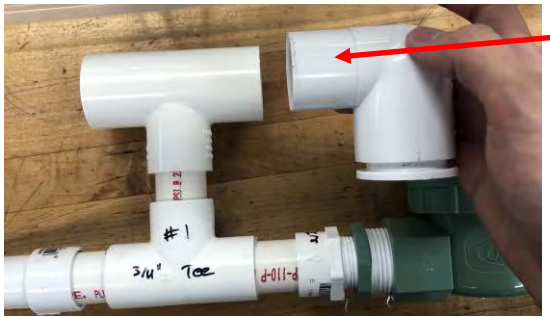
PV-PN-A03 – Inspiratory limb – STEP 17: install anti asphyxia valve

PV-PN-A04

Apply a blob of silicone adhesive to the end of the PVC plug. Smear the adhesive blobs to around the circumference to create a thin but uniform layer.

PV-PN-229

Push and hold all parts together for a few minutes to make sure they don't try and slide apart. (the silicone adhesive acts as a lubricant and the PVC parts are tapered.)



Apply a blob of silicone adhesive to the end of the PVC plug. Smear the adhesive blobs to around the circumference to create a thin but uniform layer.

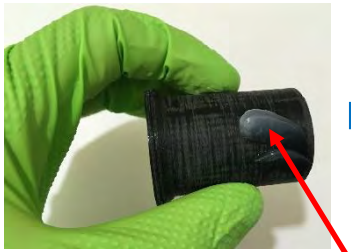
PV-PN-229

Ensure the AAV is pointing downwards, gravity ensures it remains closed when it is not activated.

Push and hold all parts together for a few minutes to make sure they don't try and slide apart. (the silicone adhesive acts as a lubricant and the PVC parts are tapered.)

PV-PN-A03 – Inspiratory limb – STEP 18: install OPR valve

PV-PN-A05



Apply a blob of silicone adhesive to the end of the CPVC tube. Smear the adhesive blobs to around the circumference to create a thin but uniform layer.

Push and hold all parts together for a few minutes to make sure they don't try and slide apart. (the silicone adhesive acts as a lubricant and the PVC parts are tapered.)

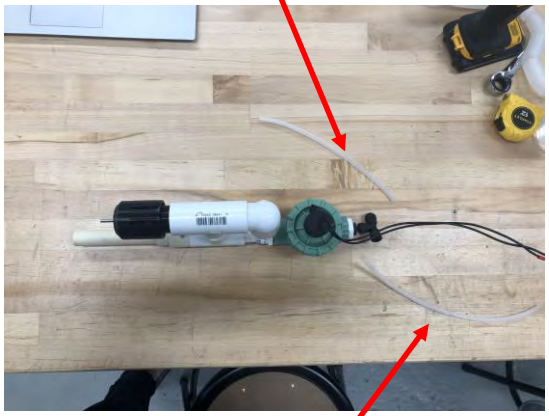
PV-PN-A03 – Inspiratory limb – STEP 19: replace cap on OPR valve

Re-thread on the cap for the overpressure valve.

Overpressure valve installed

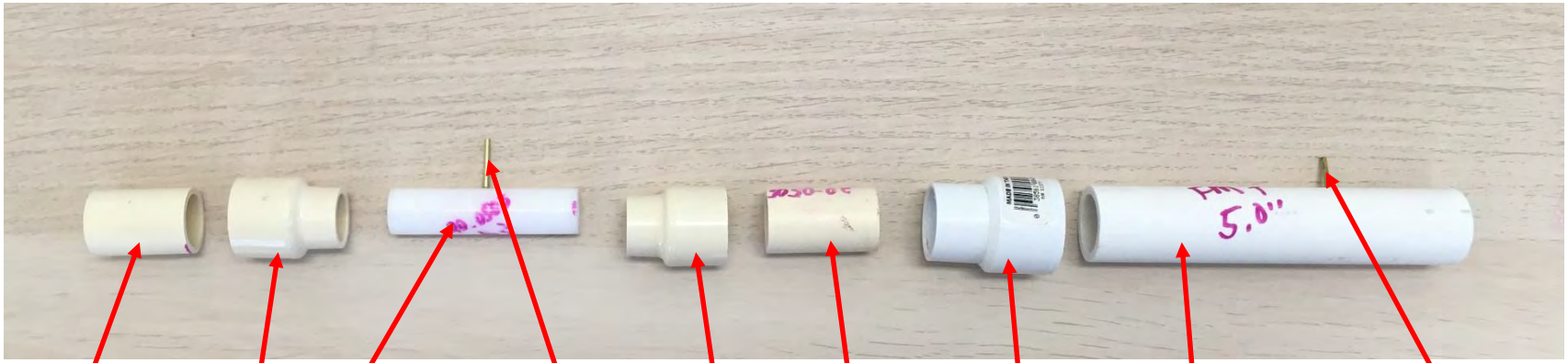
PV-PN-A03 – Inspiratory limb – STEP 20: measure and cut tubes and push into fittings

PV-PN-231



PV-PN-016

PV-PN-A10 – flow meter assembly– all parts:



PV-PN-011

PV-PN-026

PV-PN-027

PV-PN-029

PV-PN-026

PV-PN-025

PV-PN-006

PV-PN-024

PV-PN-029

Small hammer

Permanent marker.

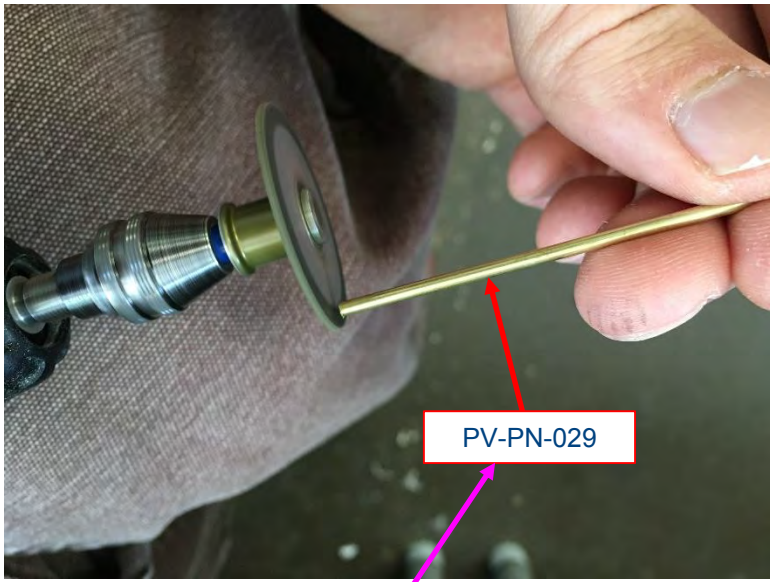
#60-ish drill bit

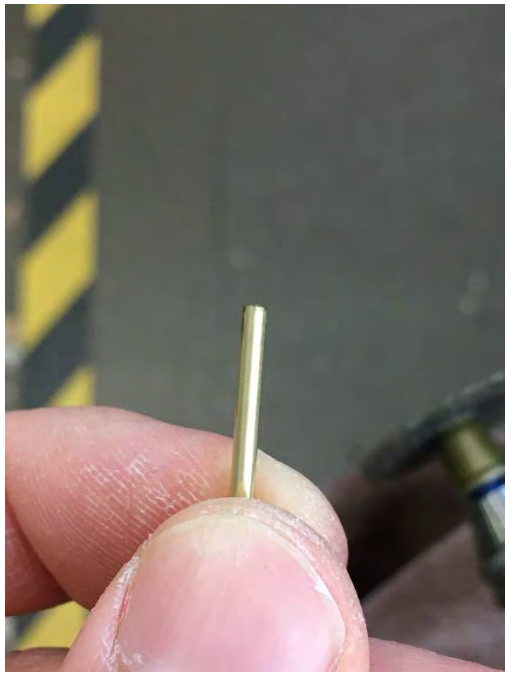
#47 drill bit

PV-PN-206

PV-PN-229

PV-PN-A10 – flow meter assembly– STEP 1: square off end of brass tube stock

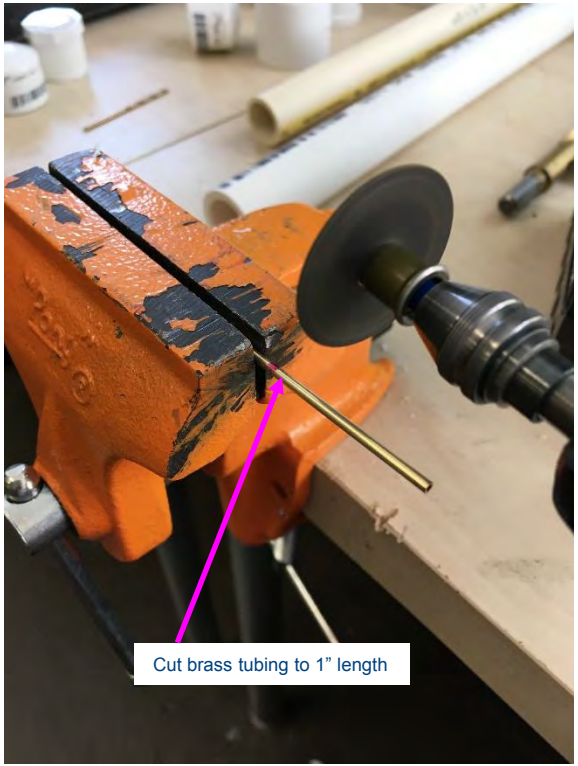




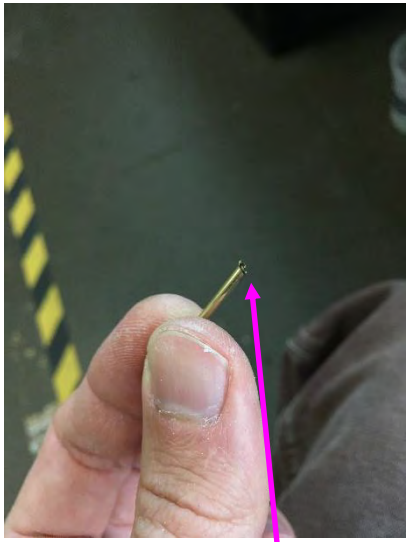
Tip: You will use qty: 8 of these in each ventilator assembly. Feel free to make all of them at once.
Qty: 6 will be used with plenums
Qty: 2 will be used in the flow meter assembly

PV-PN-A10 – flow meter assembly– STEP 2: measure and cut brass tube section

Measure and mark a length of 1 inch.

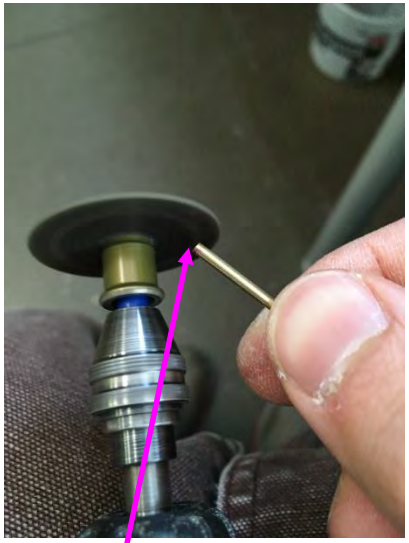


PV-PN-A10 – flow meter assembly– STEP 3: clean up, square off, and remove burrs on cut.

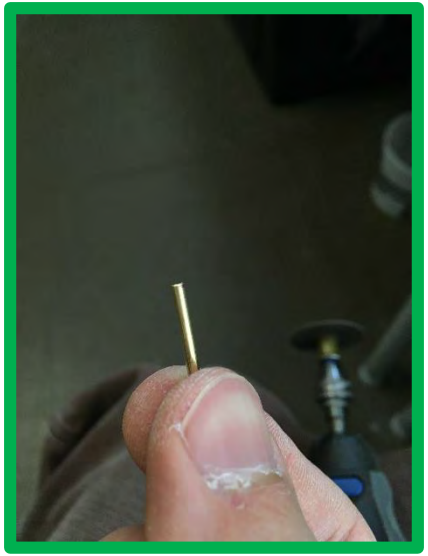


Tip may have a big bur on the end.

Use cutoff wheel carefully or use sandpaper to flatten and square the end of the tube.

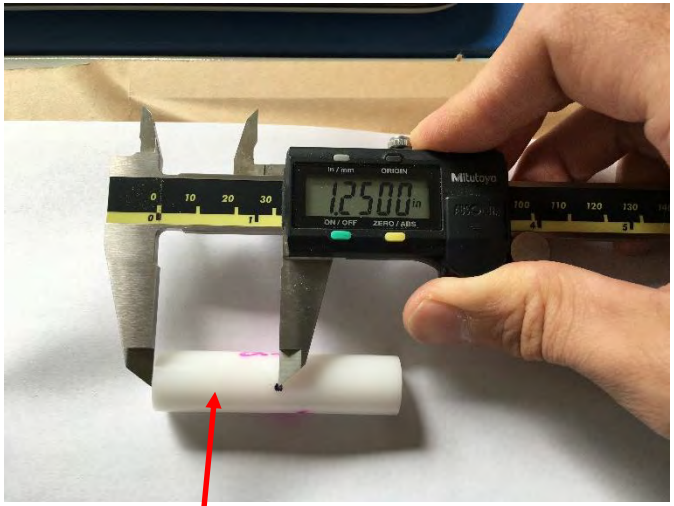


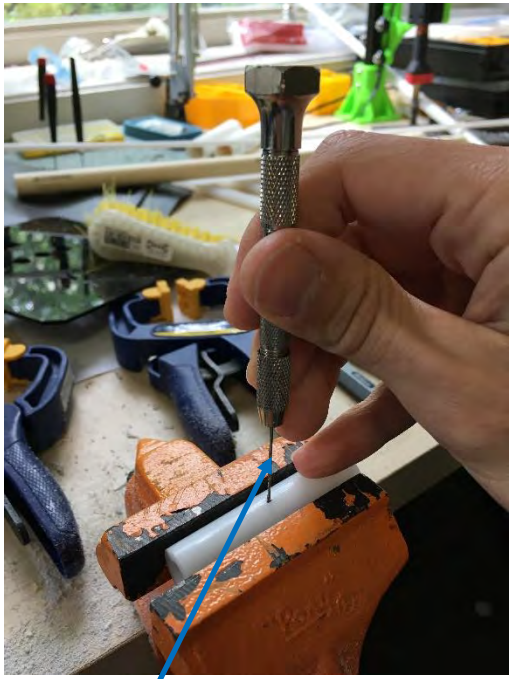
Very lightly bevel the corners of the brass tube.



PV-PN-A10 – flow meter assembly– STEP 4: remove burrs on ID of tube.

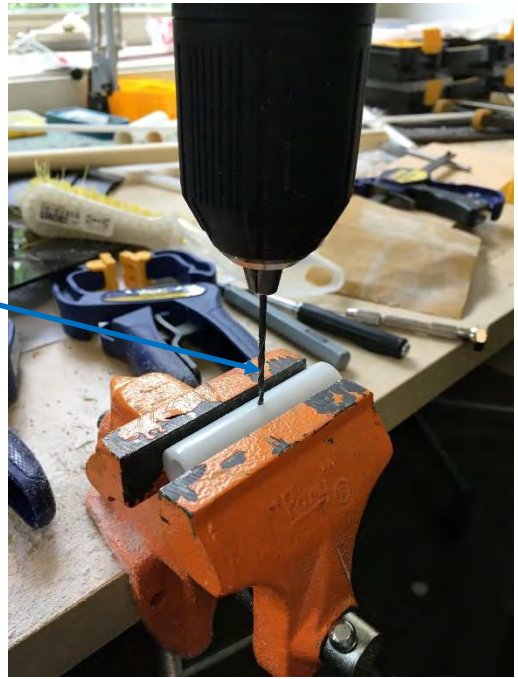
PV-PN-A10 – flow meter assembly– STEP 5: measure and drill pilot hole



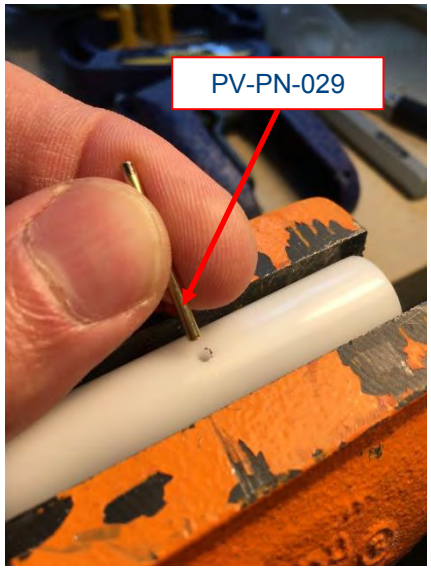


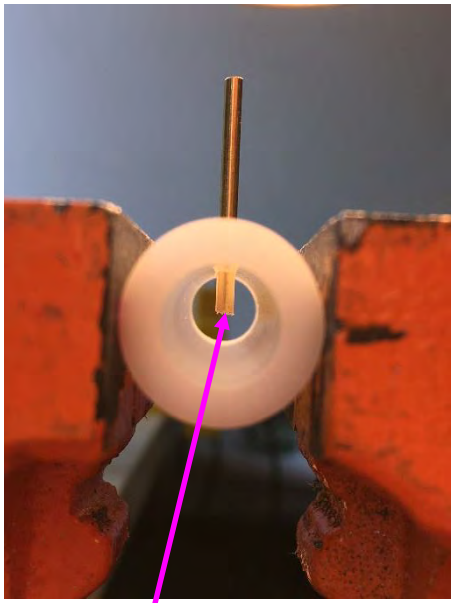
PV-PN-A10 – flow meter assembly– STEP 6: using pilot hole, drill actual hole.

#47 drill bit



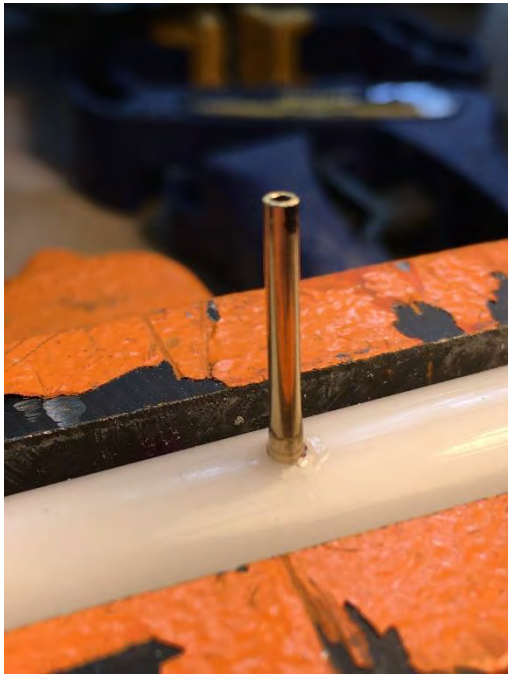
PV-PN-A10 – flow meter assembly– STEP 7: carefully tap brass tube into pipe



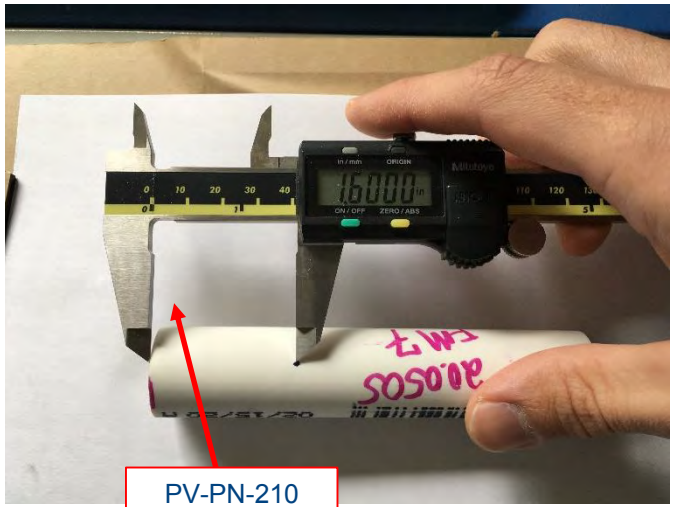


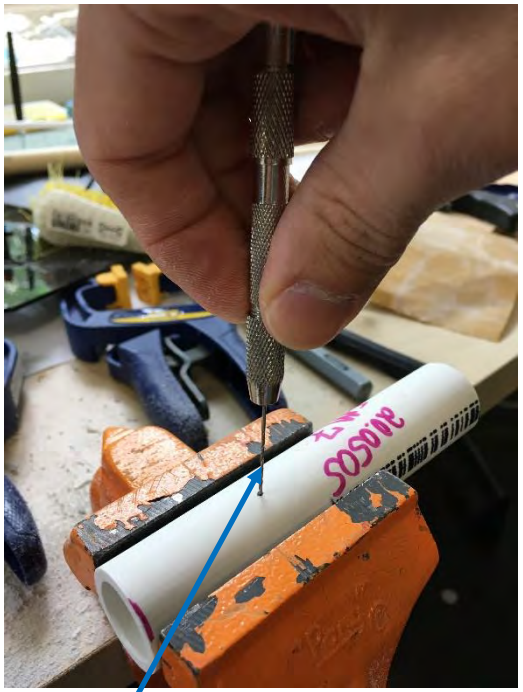
Tip of brass tube should be in the center of the Delrin tube.

PV-PN-A10 – flow meter assembly– STEP 8: add glue to base of the tube



PV-PN-A10 – flow meter assembly– STEP 9: measure and drill pilot hole

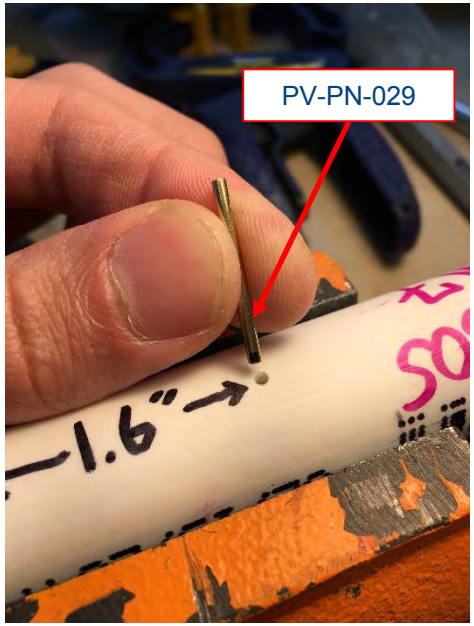


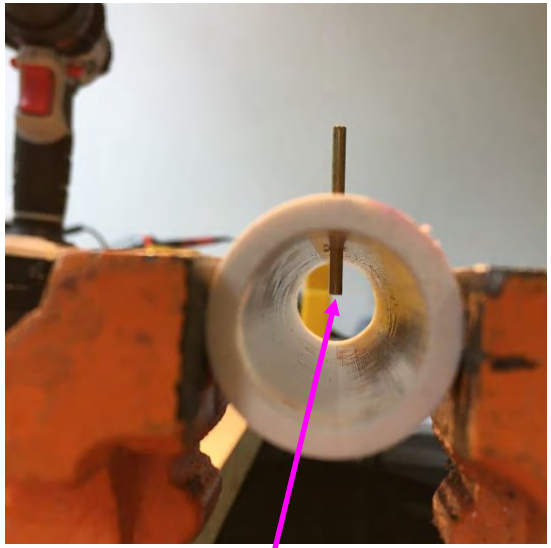


PV-PN-A10 – flow meter assembly– STEP 10: using pilot hole, drill actual hole

#47 drill bit

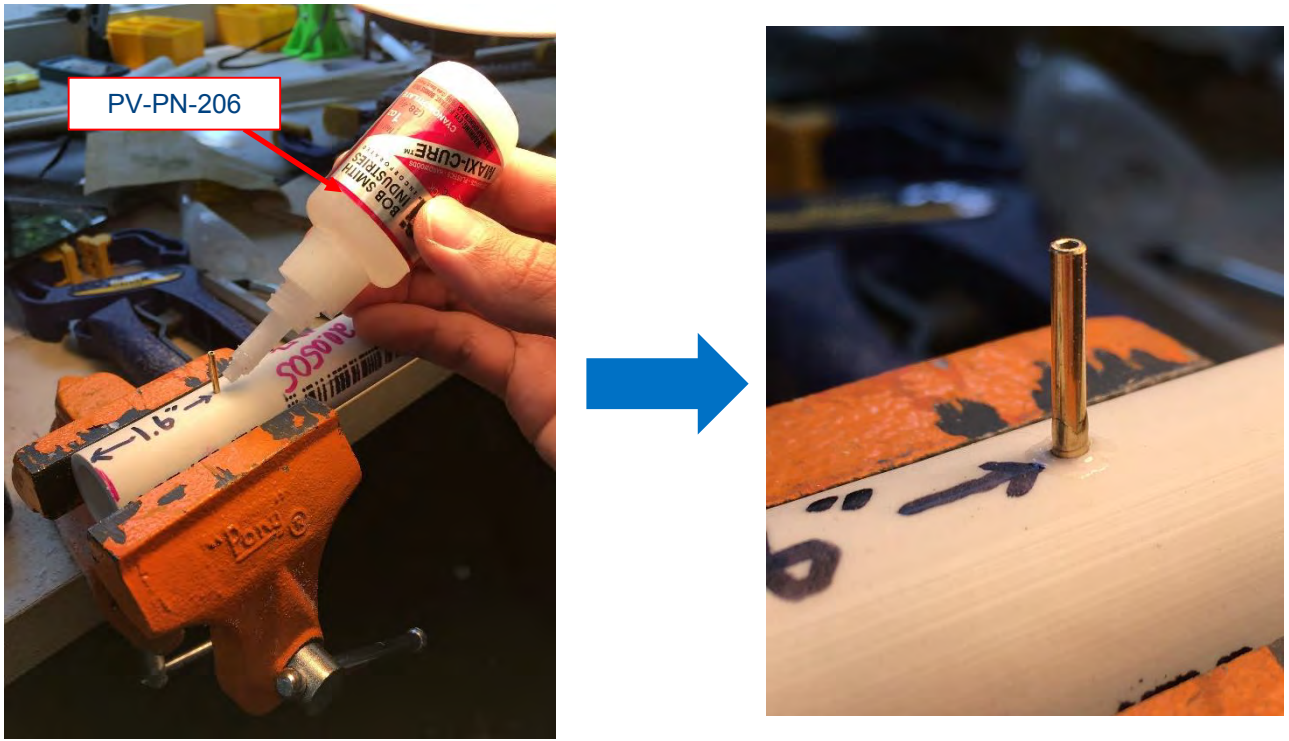
PV-PN-A10 – flow meter assembly– STEP 11: gently tap brass tube into PVC pipe.





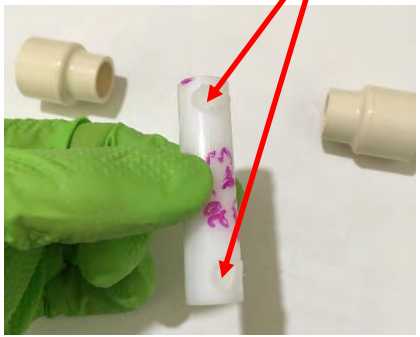
Tip of brass tube should be in the center of the PVC tube.

PV-PN-A10 – flow meter assembly– STEP 12: add glue to base of brass tube.

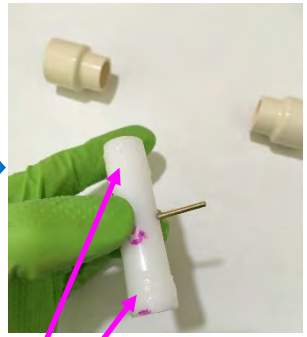


PV-PN-A10 – flow meter assembly– STEP 13: glue and push fittings over tube.

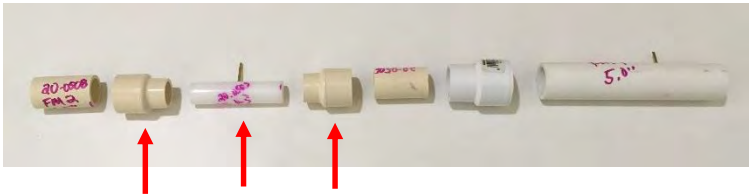
PV-PN-229



Apply a blob of silicone adhesive to each side of the Delrin tube.



Smear the adhesive blobs to around the circumference to create a thin but uniform layer.

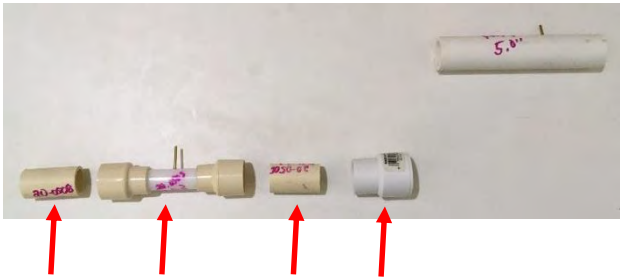


Push CPVC fittings on each end of the Delrin tube.

Use a clamp to ensure the CPVC parts don't "walk" off due to the taper. I have seen this happen. Perhaps clamp it for 5 or 10 minutes.

PV-PN-A10 – flow meter assembly– STEP 14: add more fittings to assembly

PV-PN-229



Apply a blob of silicone adhesive to the end of the CPVC tube. Smear the adhesive to create a thin but uniform layer around the tube.

Push CPVC tube into CPVC fitting

Apply a blob of silicone adhesive to the ends of the CPVC tube. Smear the adhesive to create a thin but uniform layer around the tube.

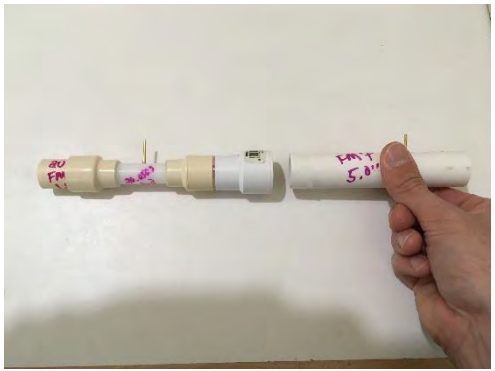
Push fittings on to newly siliconed tube.

Use a clamp to ensure the parts don't "walk" off due to the taper. I have seen this happen. Perhaps clamp it for 5 or 10 minutes.

PV-PN-A10 – flow meter assembly– STEP 15: add tube to assembly

PV-PN-229

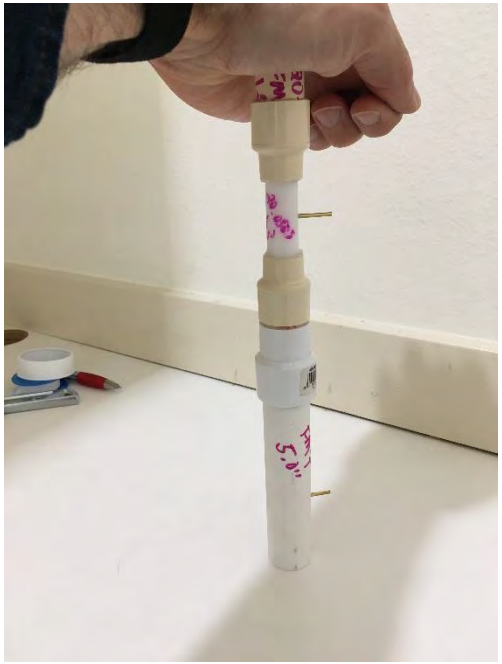
Apply a blob of silicone adhesive to the end of the CPVC tube. Smear the adhesive to create a thin but uniform layer around the tube.



Push CPVC tube into CPVC fitting

Ensure the two brass tubes are parallel to each other.

PV-PN-A10 – flow meter assembly– STEP 16: push on parts to ensure they stay put.



Hold parts together to ensure the parts don't "walk" off due to the tapers. I have seen this happen. Perhaps hold it for a few minutes. A clamp would be easier.

Each connection that had silicone adhesive added to it was marked with a "G". This is just as a reminder.

Expiratory Orbit Jartop valve modification – all parts

Permanent Marker

PV-PN-216

PV-PN-020

PV-PN-215

X-Acto knife

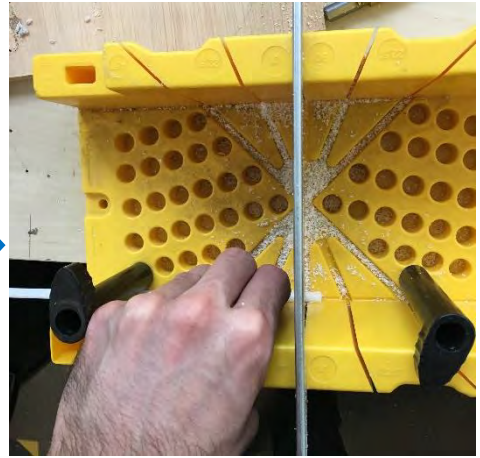
11/64 or slightly larger drill bit

400 grit sandpaper

PV-PN-217

NOTE: this part comes as long uncut stock.

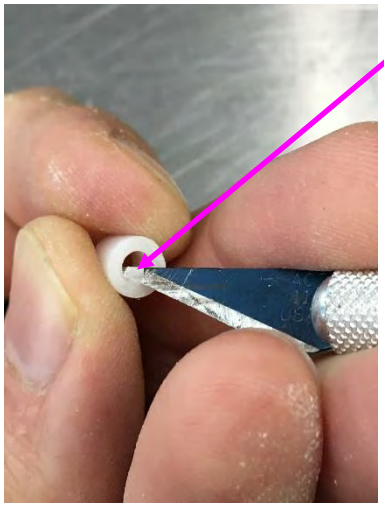
Expiratory Orbit Jartop valve modification – STEP 1: measure and cut spacer stock

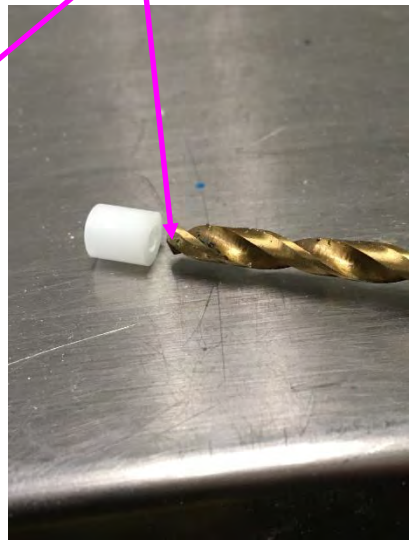


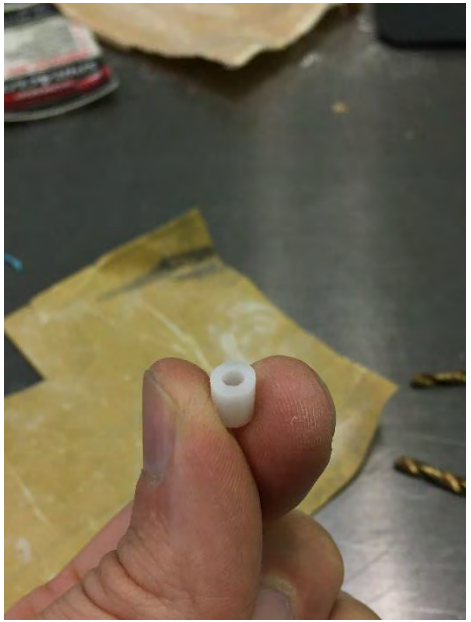
Expiratory Orbit Jartop valve modification – STEP 2: sand to size (0.280 in long)

Expiratory Orbit Jartop valve modification – STEP 3: if sanding didn't, de-burr ID of spacer

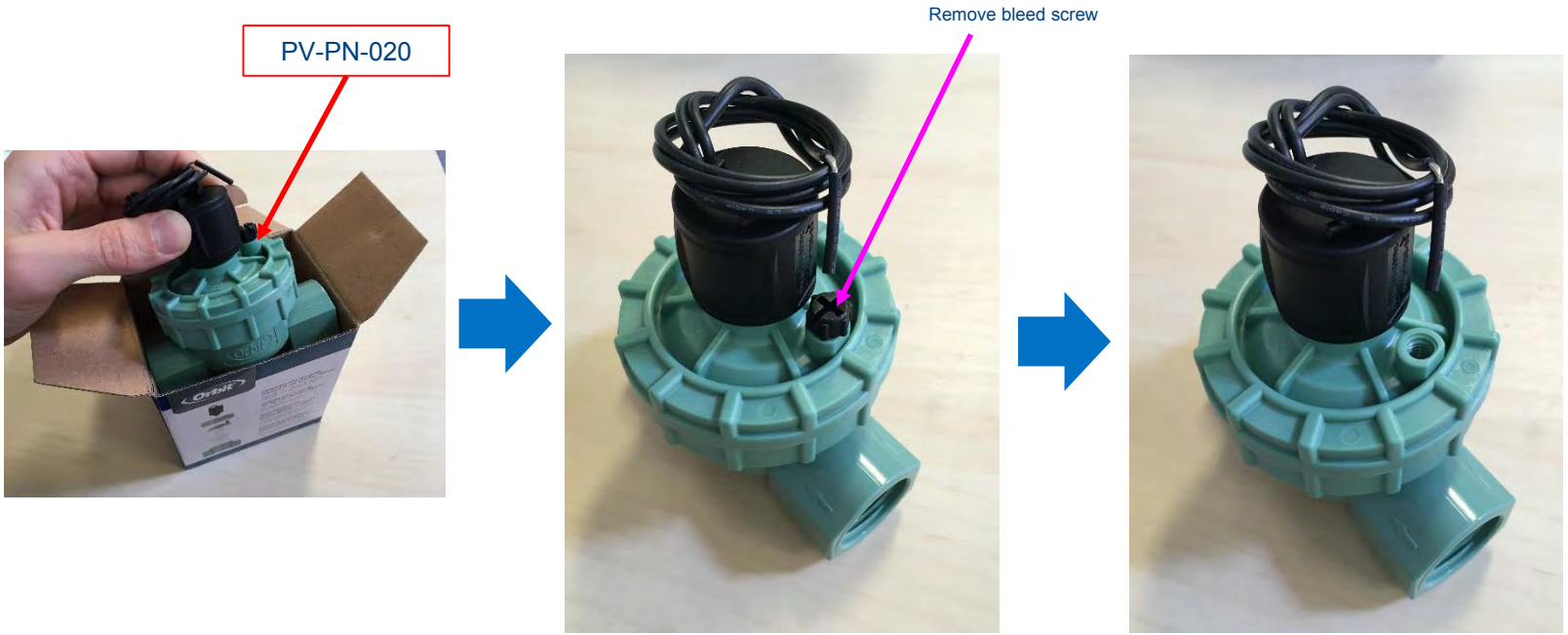
Use these tools to lightly **deburr** outer edge of ID of spacer.
NOTE: do NOT drill center of hole to be larger.







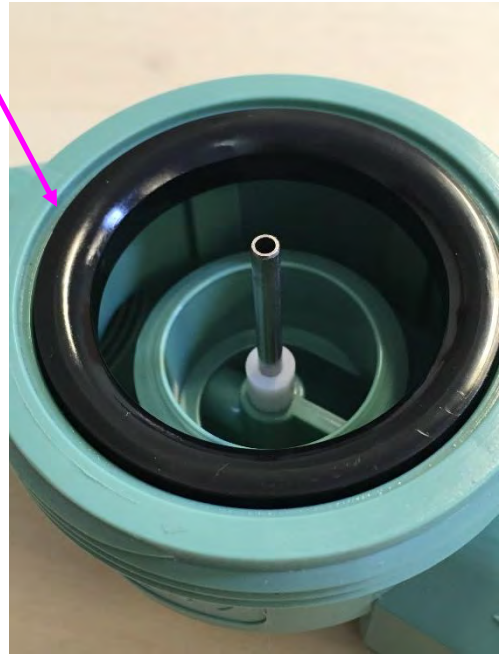
Expiratory Orbit Jartop valve modification – STEP 4: unbox and remove bleed screw



Expiratory Orbit Jartop valve modification – STEP 5: unscrew “jar top” and remove lid.

Expiratory Orbit Jartop valve modification – STEP 6: install spacer on the stainless post.

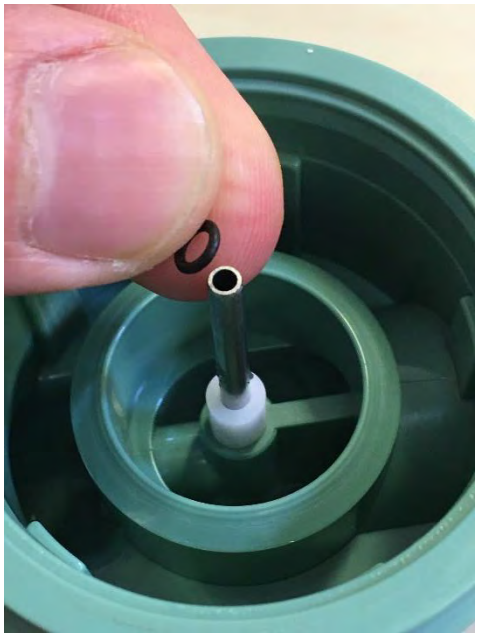
Spacer should slide freely all the way to the bottom of the post.

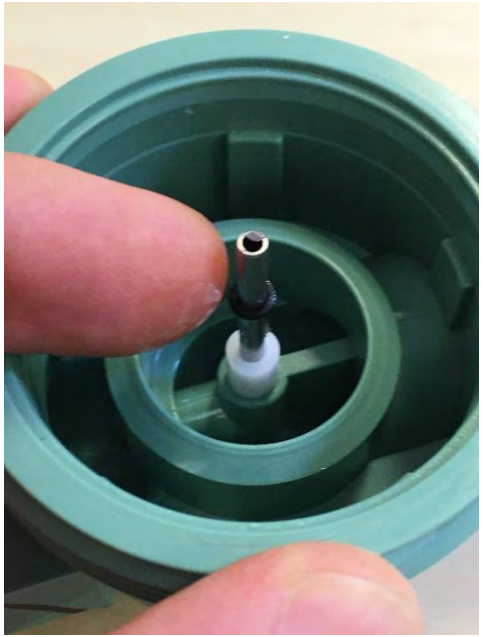


NOTE: if the black ring accidently comes out, above is can the correct orientation for reinstallation.

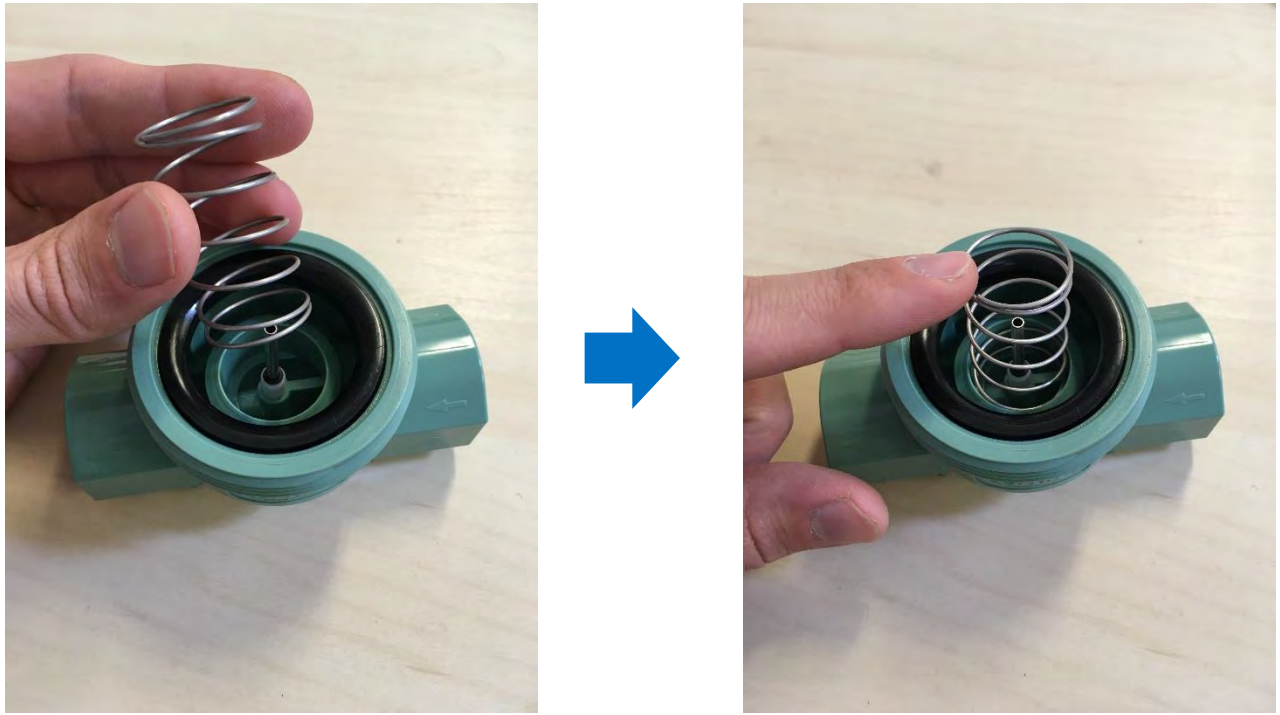
Expiratory Orbit Jartop valve modification – STEP 7: apply a small amount of synthetic grease to the post above the spacer.

Expiratory Orbit Jartop valve modification – STEP 8: slide an O-ring down the post and apply a small amount of additional grease on top of it. Repeat with a second O-ring.



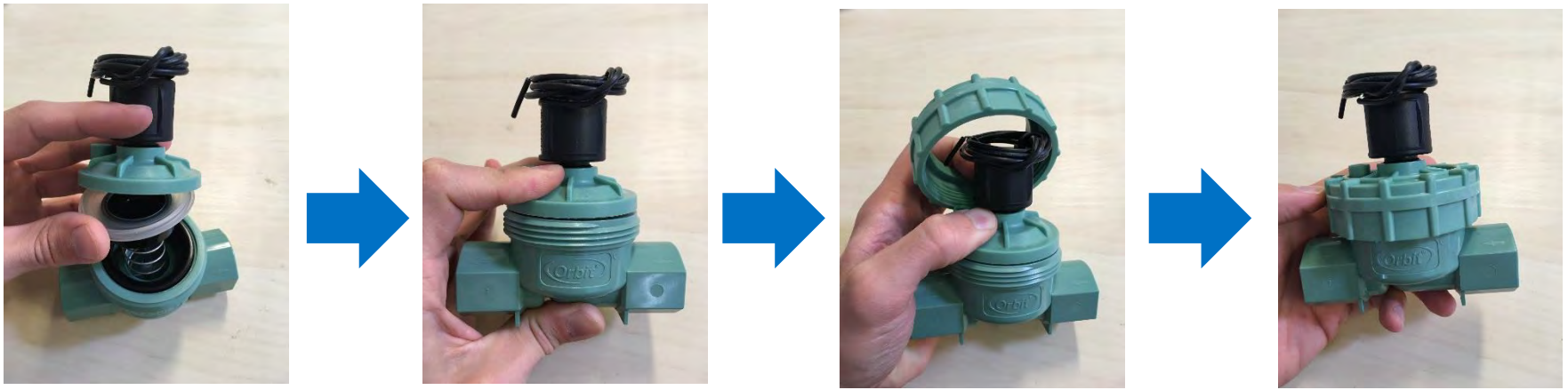


Expiratory Orbit Jartop valve modification – STEP 9: re-install the spring in its new location <u>BENEATH</u> the rubber diaphragm.

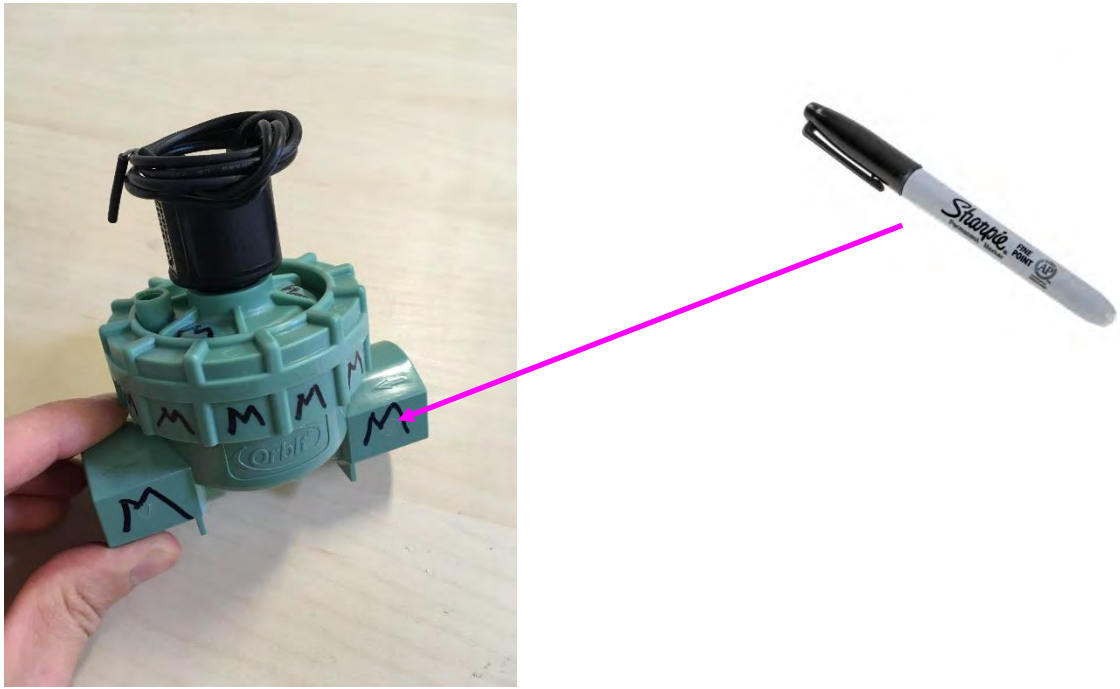


Expiratory Orbit Jartop valve modification – STEP 10: next, place the diaphragm ON TOP of the spring.

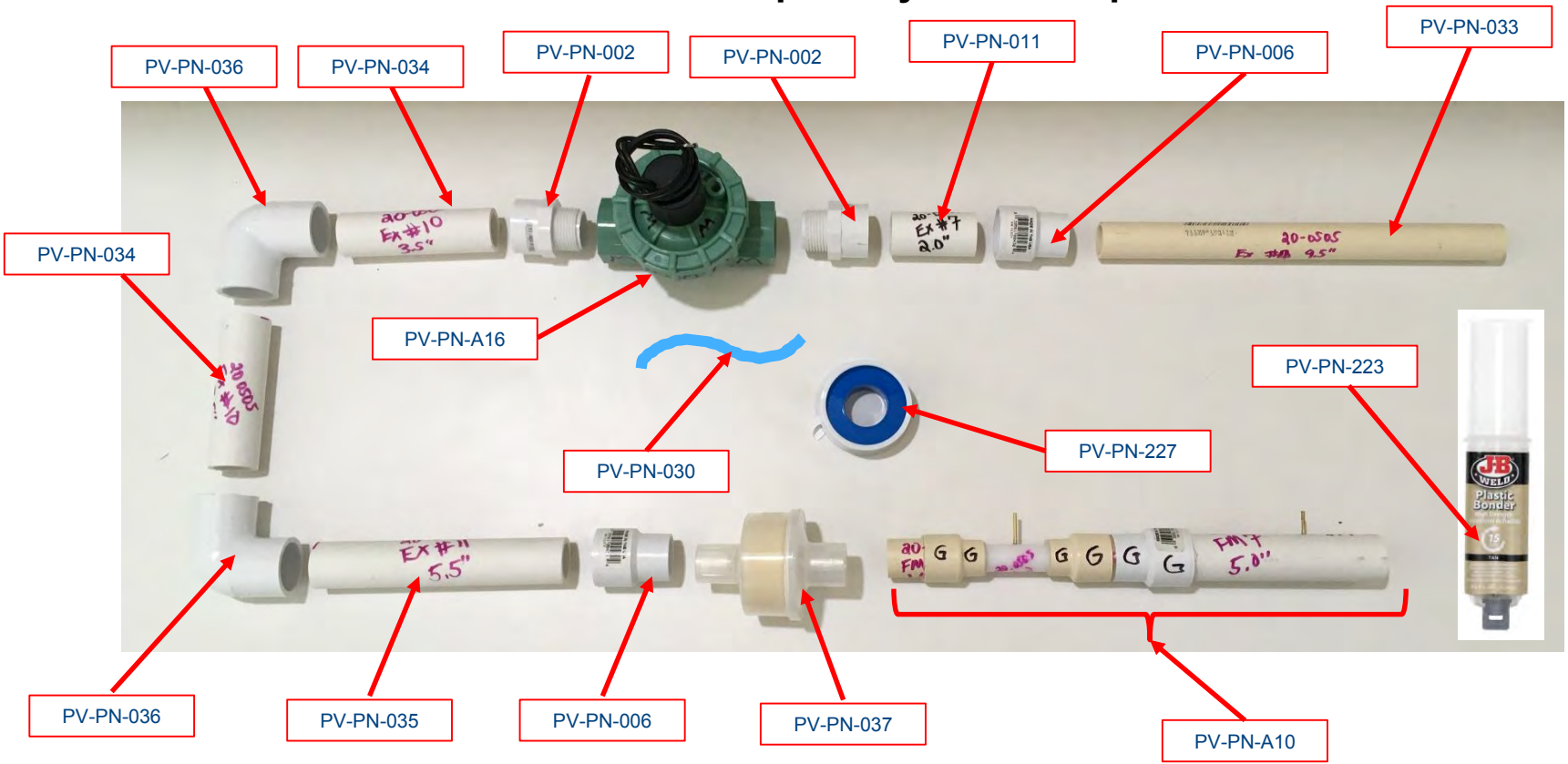
Expiratory Orbit Jartop valve modification – STEP 11: carefully compress the sandwich of the components and re-install the jar top ring to hold it all together.



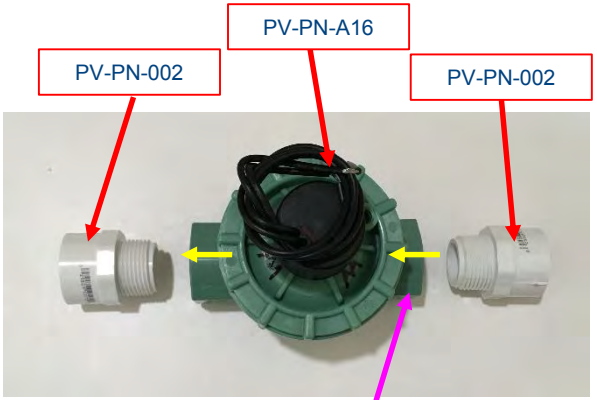
Expiratory Orbit Jartop valve modification – STEP 12: mark this valve to clearly distinguish it from the other Orbit valve in the inspiratory limb.

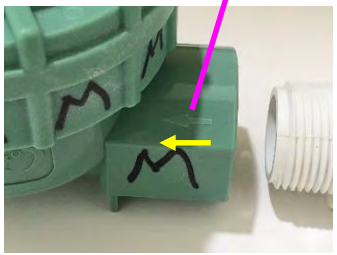


PV-PN-A10 – expiratory limb – all parts:



PV-PN-A10 – expiratory limb – STEP 1: tape and screw fittings into valve body





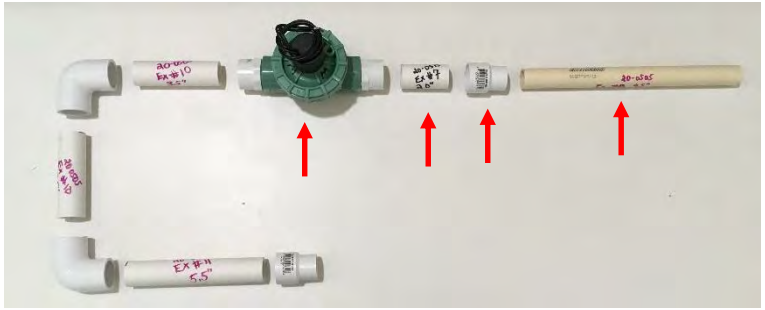
Ensure the flow direction is oriented as show.

PV-PN-227

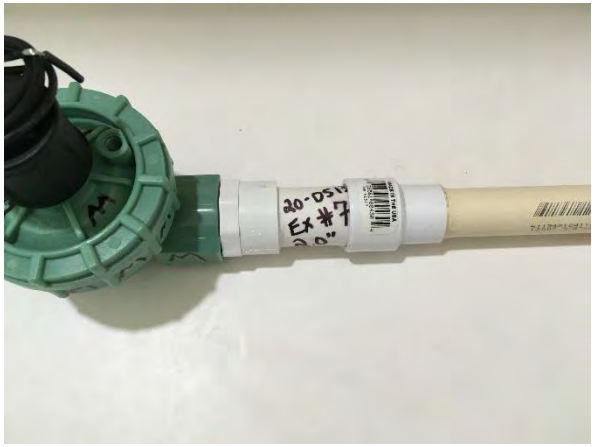
Wrap each of the threaded portions with Teflon tape. Two to three times around.

Wrap clockwise.

PV-PN-A10 – expiratory limb – STEP 2: glue and push fittings together



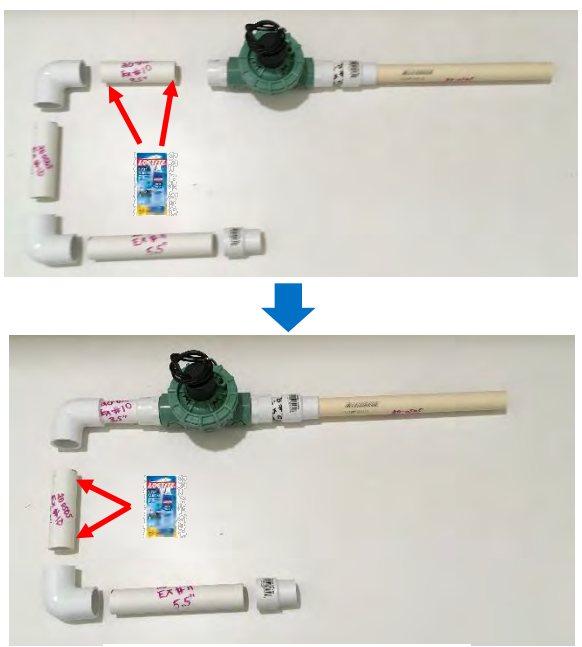
Apply a blob of silicone adhesive each end of the related tubes. Smear the adhesive blobs around the circumference to create a thin but uniform layer.



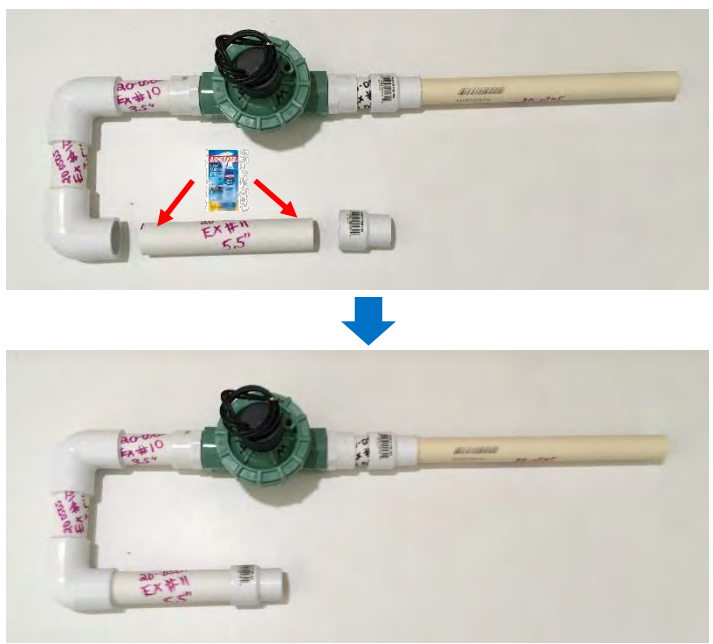
Push tubes and fittings together

Hold parts together for a minute or two to keep them from separating due to the PVC tapers.

PV-PN-A10 – expiratory limb – STEP 3: one step at a time, glue and attach fittings and pipes



Apply a blob of silicone adhesive each end of the related tubes. Smear the adhesive blobs around the circumference to create a thin but uniform layer.



Hold parts together for a minute or two to keep them from separating due to the PVC tapers.

PV-PN-A10 – expiratory limb – STEP 4: glue and install filter

Apply a blob of silicone adhesive each end of the related tubes. Smear the adhesive blobs around the circumference to create a thin but uniform layer.

Push filter into fitting. Hold parts together for 5 to 10 minutes using a rubber band.

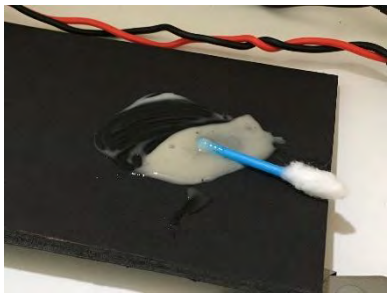
PV-PN-A10 – expiratory limb – STEP 5: install tube into valve

PV-PN-030

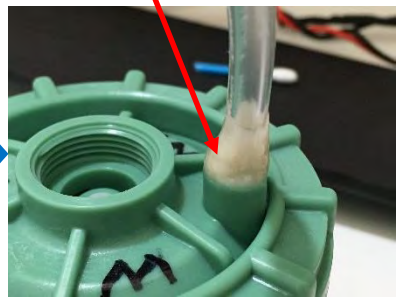
Using a set of pliers I “threaded” this tube into the solenoid port.

Remove the solenoid temporarily.

PV-PN-A10 – expiratory limb – STEP 6: secure tube in valve body using epoxy



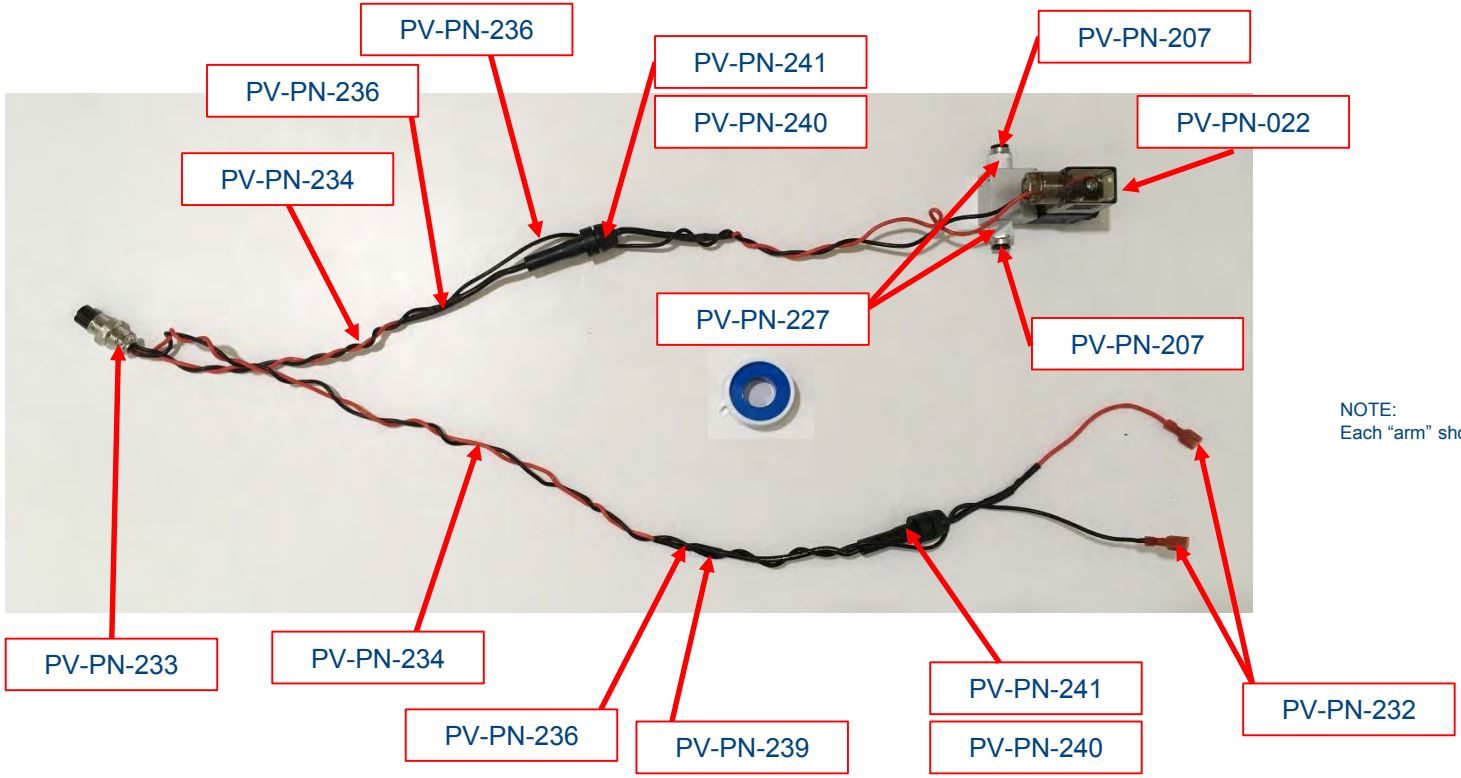
PV-PN-223



Using a set of pliers I “threaded” this tube into the solenoid port.

Remove the solenoid temporarily.

PV-PN-A15 – solenoid wiring harness – all parts: build wiring harness.



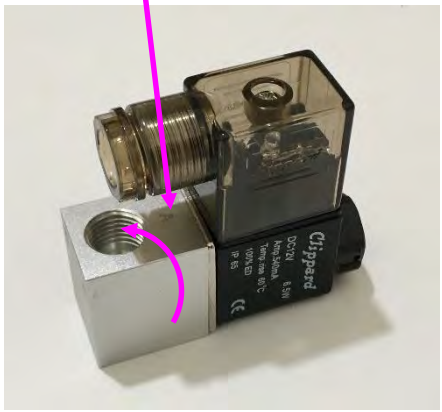
NOTE:
Each “arm” should be roughly 2 feet long.

PV-PN-A15 – solenoid wiring harness – STEP 1: twist valve to gain access to ports

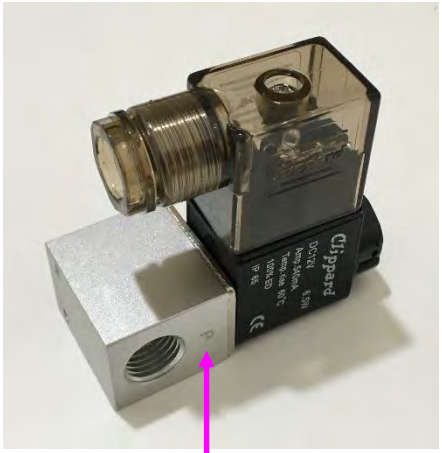
Not used.

PV-PN-022

Note the “A” here:

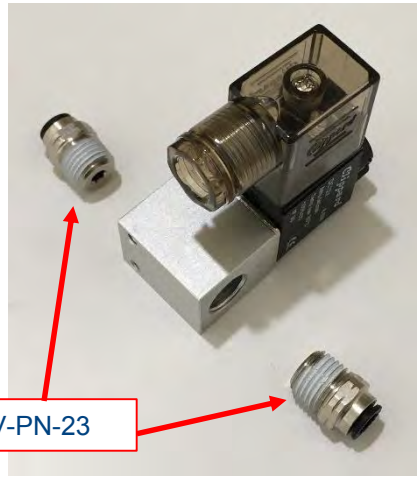


Rotate the metal portion of the solenoid valve as shown. (It should only be able to do a full 90 degree rotation in one direction.)



Note the “P” here:

PV-PN-A15 – solenoid wiring harness – STEP 2: tape and attach fittings



PV-PN-23

Push-to-connect fittings installed:

PV-PN-227

Wrap each of the NPT threads with Teflon tape. I only needed a little over 1 turn here… there was already sealant on the threads.

Wrap clockwise.

PV-PN-A15 – solenoid wiring harness – STEP 3: remove terminal block from valve block

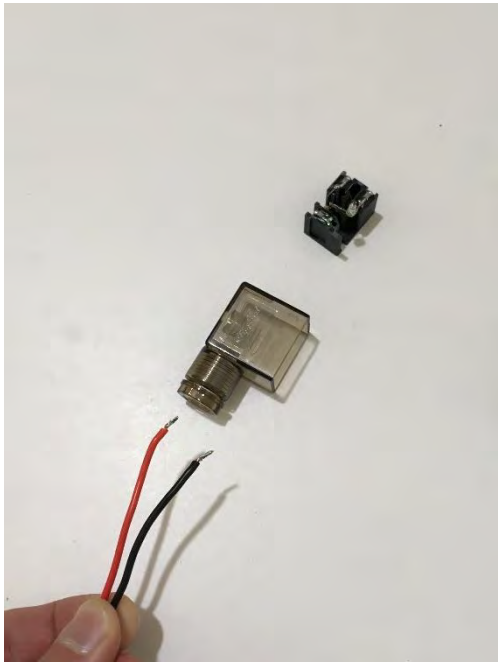
Unscrew the screw in the plastic housing.

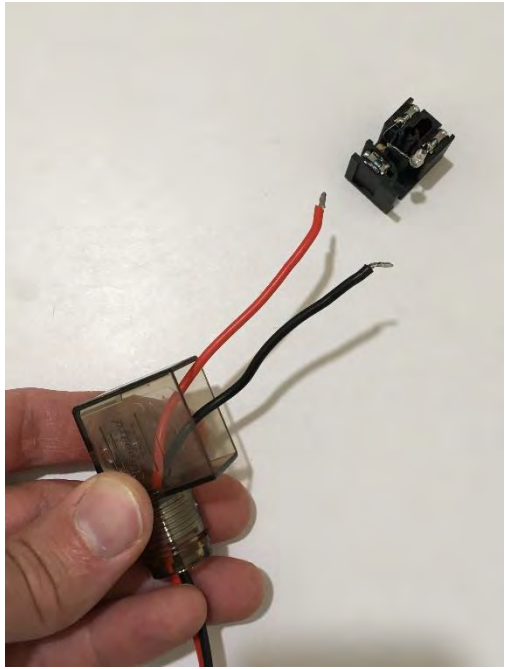
Remove screw

Plastic housing should pull off.. It is possible the black terminal lug section could come off with it.

Pull off the black terminal lug section.

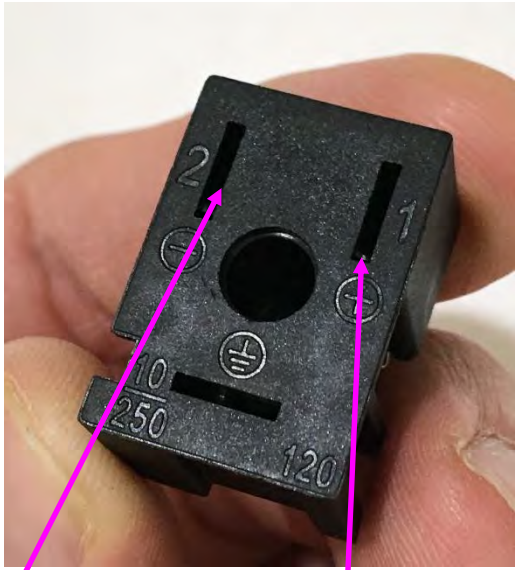
PV-PN-A15 – solenoid wiring harness – STEP 4: push wires through plastic cap.





PV-PN-A15 – solenoid wiring harness – STEP 5: secure wires in terminals

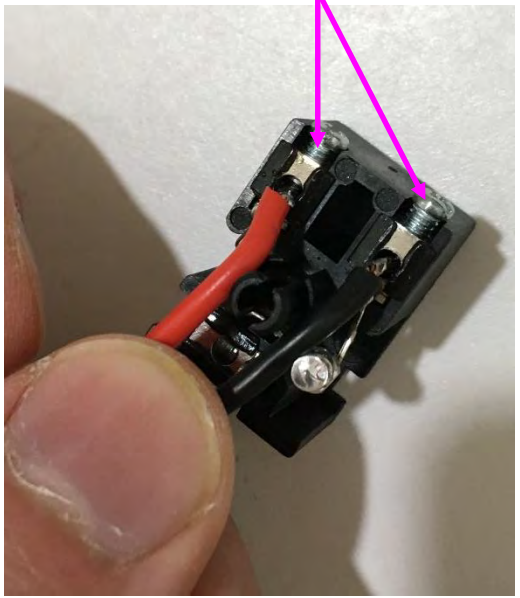
NOTE: when wired and reassembled correctly, this LED should flash RED whenever the valve is actuated.



BLACK wire connects to “2”

RED wire connects to “1”

Remove insulation on wires and clamp down with the screw terminals.



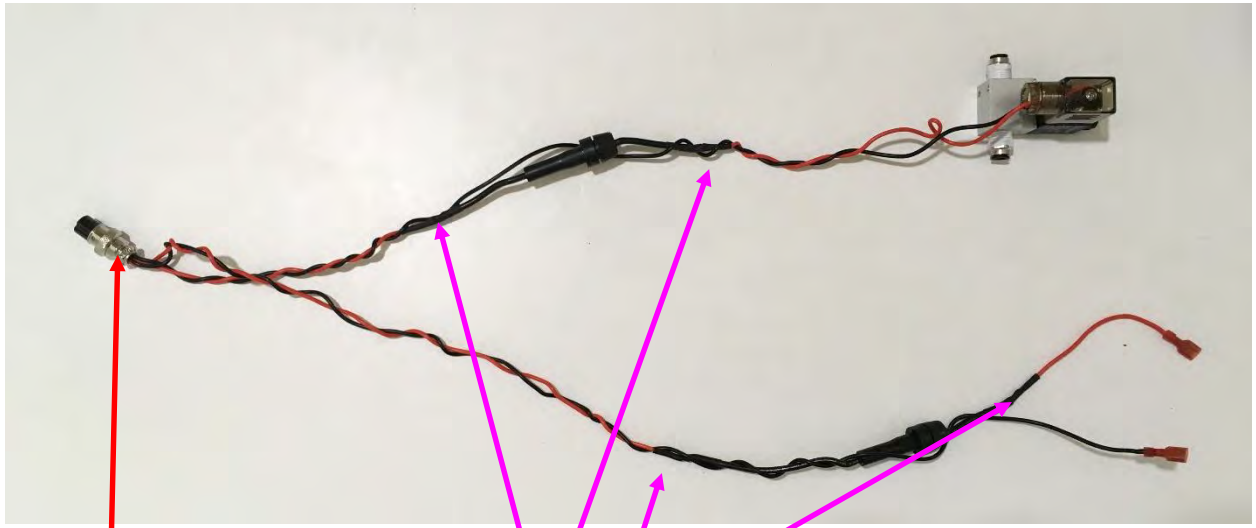
PV-PN-A15 – solenoid wiring harness – STEP 6: re-install terminal block

Push the plastic covered terminal block back onto the valve body.

Re-tighten screw.

PV-PN-A15 – solenoid wiring harness – all parts: connect appropriate wires to connector

pin 1 – **RED** – green inspiratory Orbit valve
pin 2 – **RED** - pneumatic solenoid valve (expiratory)
pin 3 – **BLACK** – ground from inspiratory Orbit valve
pin 4 – **BLACK** – ground from pneumatic solenoid valve (expiratory)



PV-PN-233

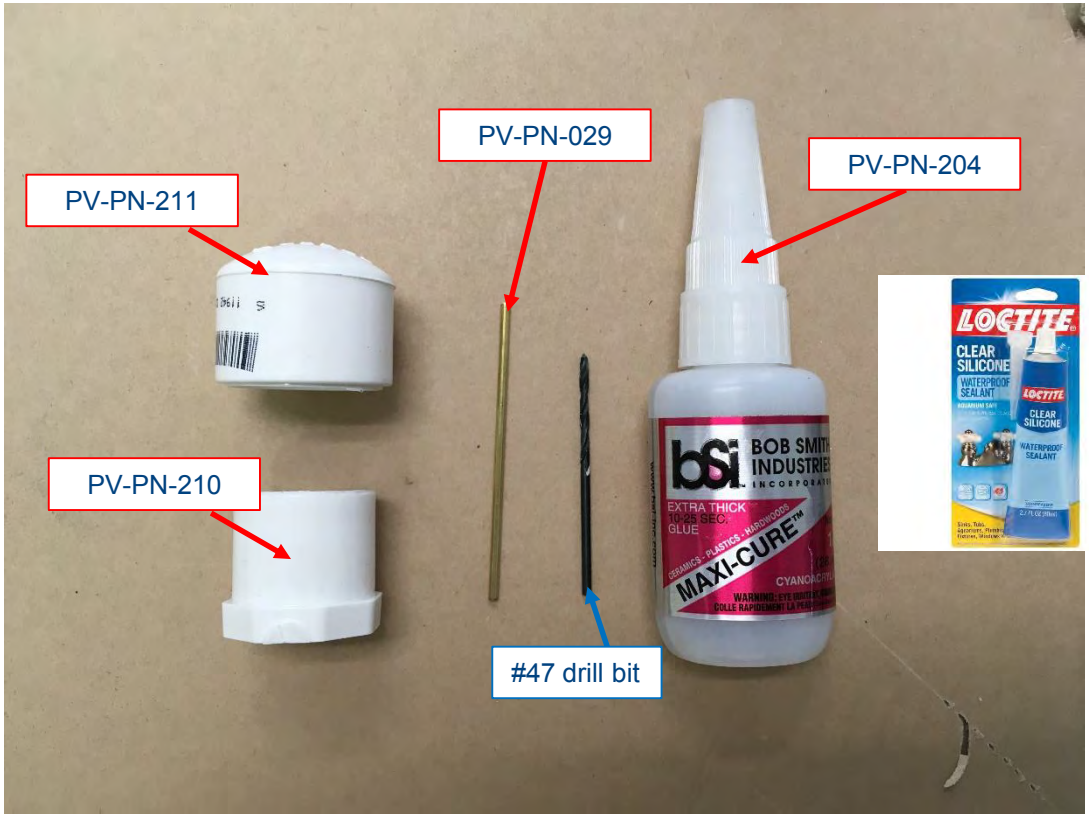
Disassemble radio plug to attach wires. Use the guide on this page.

Add heat shrink where the fuse holders attached to the red wires.

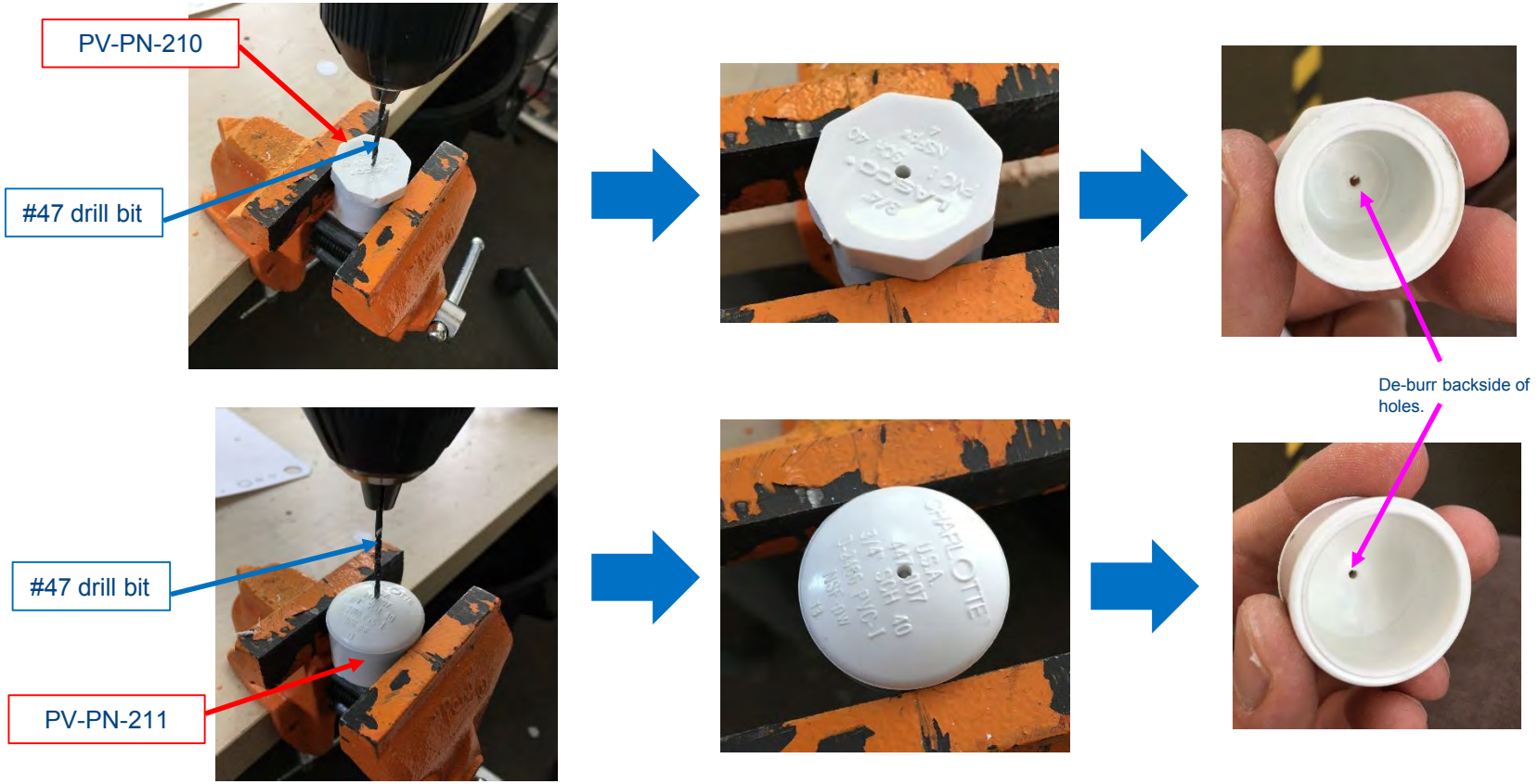
These fuse holders come with 30A fuses. You must replace those with the 2A fuses.

PV-PN-A11 – small plenum – all parts:

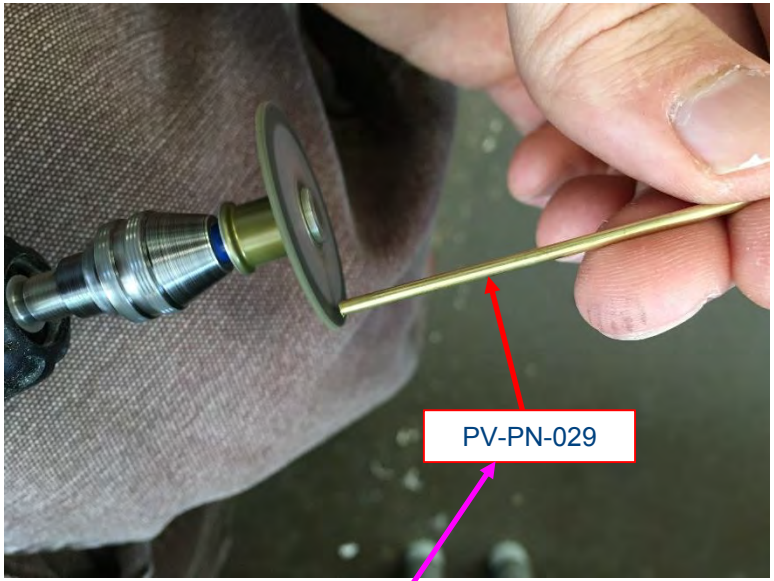
NOTE: you will be making **qty: 2** of these per device.

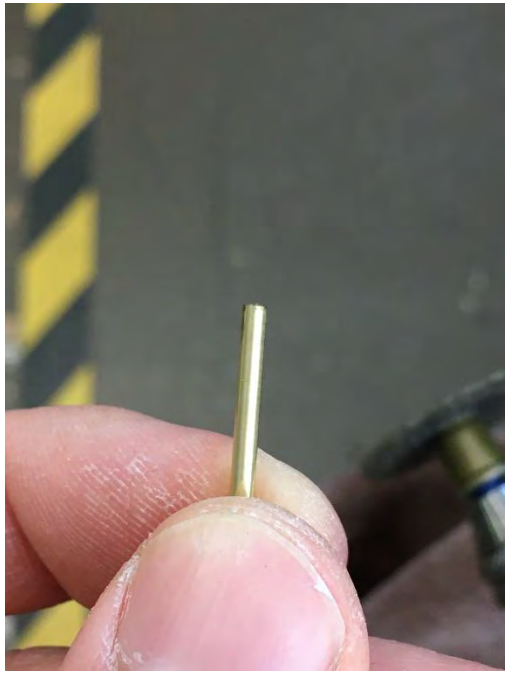


PV-PN-A11 – small plenum – STEP 1: drill holes in the center of the PVC plug and cap.



PV-PN-A11 – small plenum – STEP 2: flatten/deburr the end of the brass tube stock.



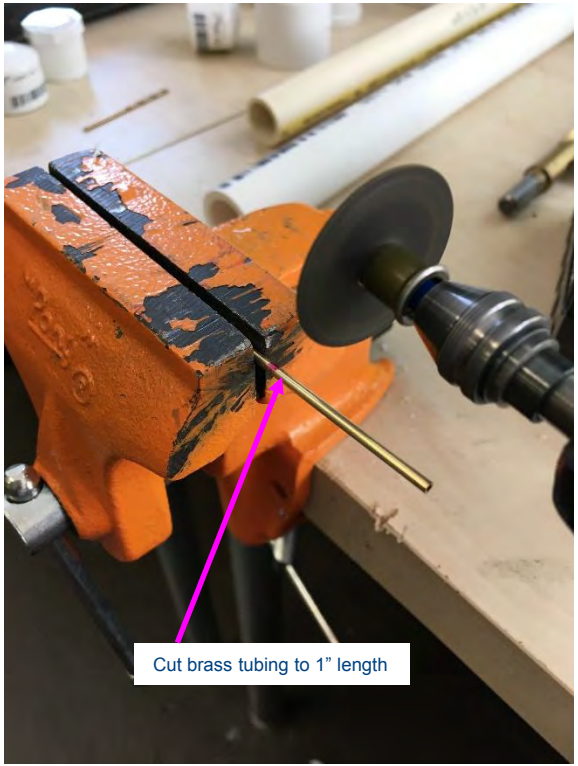


Tip: You will use qty: 8 of these in each ventilator assembly. Feel free to make all of them at once.
Qty: 6 will be used with plenums
Qty: 2 will be used in the flow meter assembly

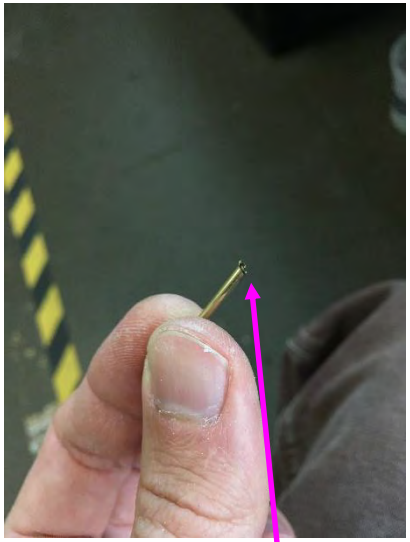
PV-PN-A11 – small plenum – STEP 3: cut brass tubing to length

Measure and mark a length of 1

Reminder: You will use qty: 8 of these in each ventilator assembly. Feel free to make all of them at once.

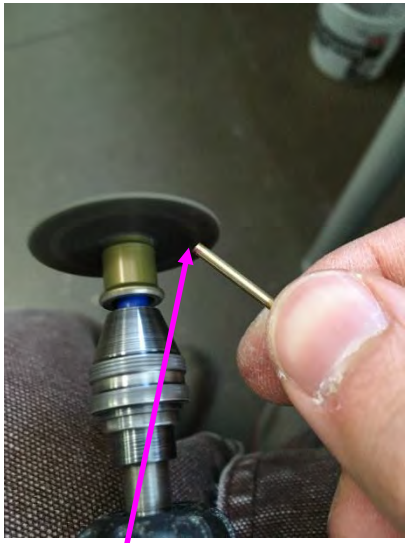


PV-PN-A11 – small plenum – STEP 4: remove burrs and square end of newly cut tube

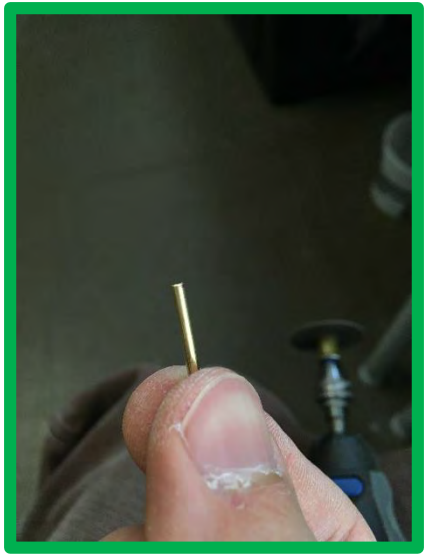


Tip may have a big bur on the end.

Use cutoff wheel carefully or use sandpaper to flatten and square the end of the tube.

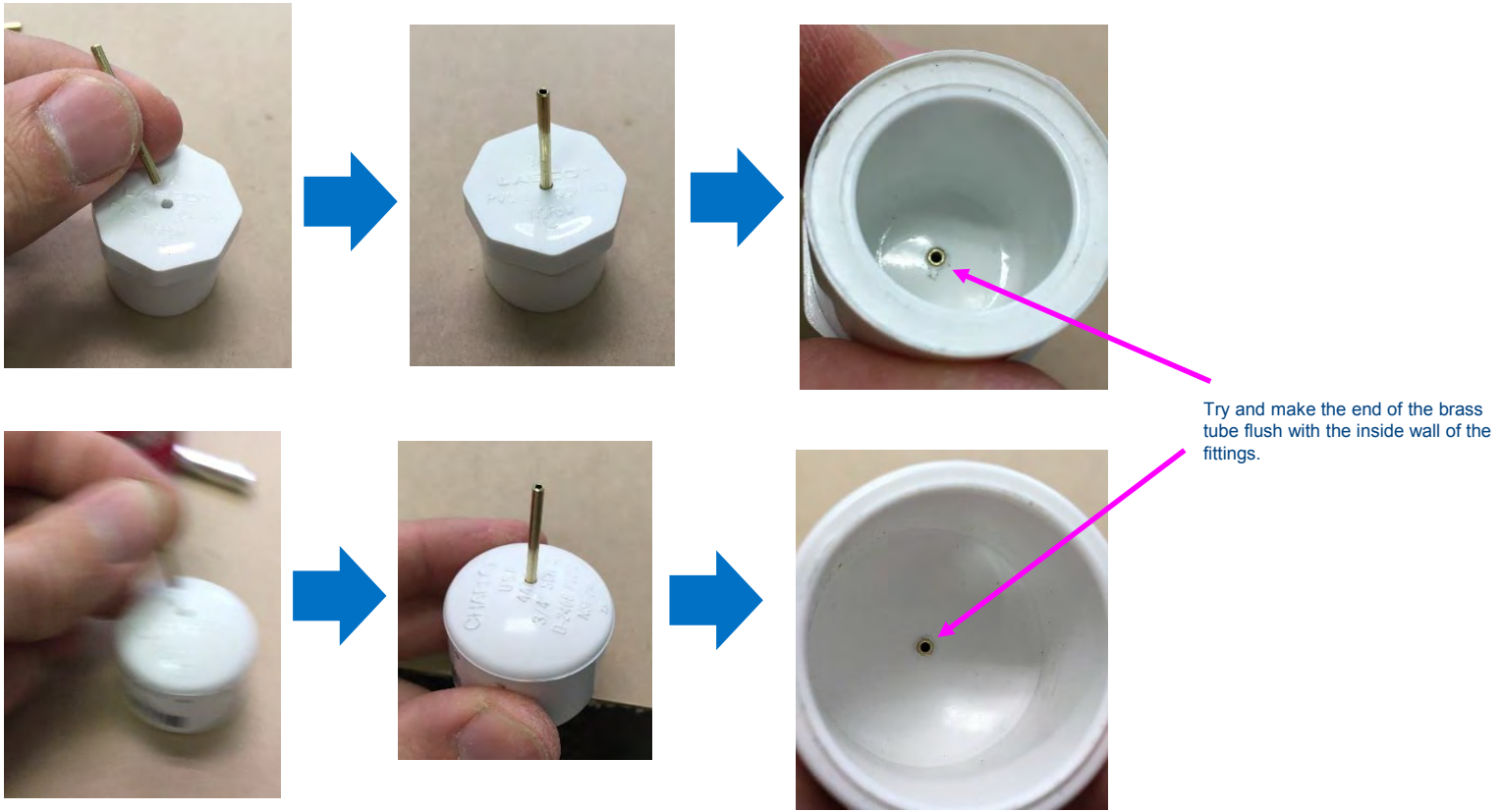


Very lightly bevel the corners of the brass tube.



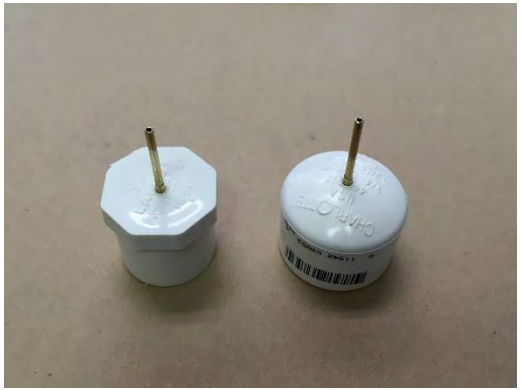
PV-PN-A11 – small plenum – STEP 5: deburr the inside diameter of the ends of the brass tube

PV-PN-A11 – small plenum – STEP 6: push brass tubes into PVC fittings

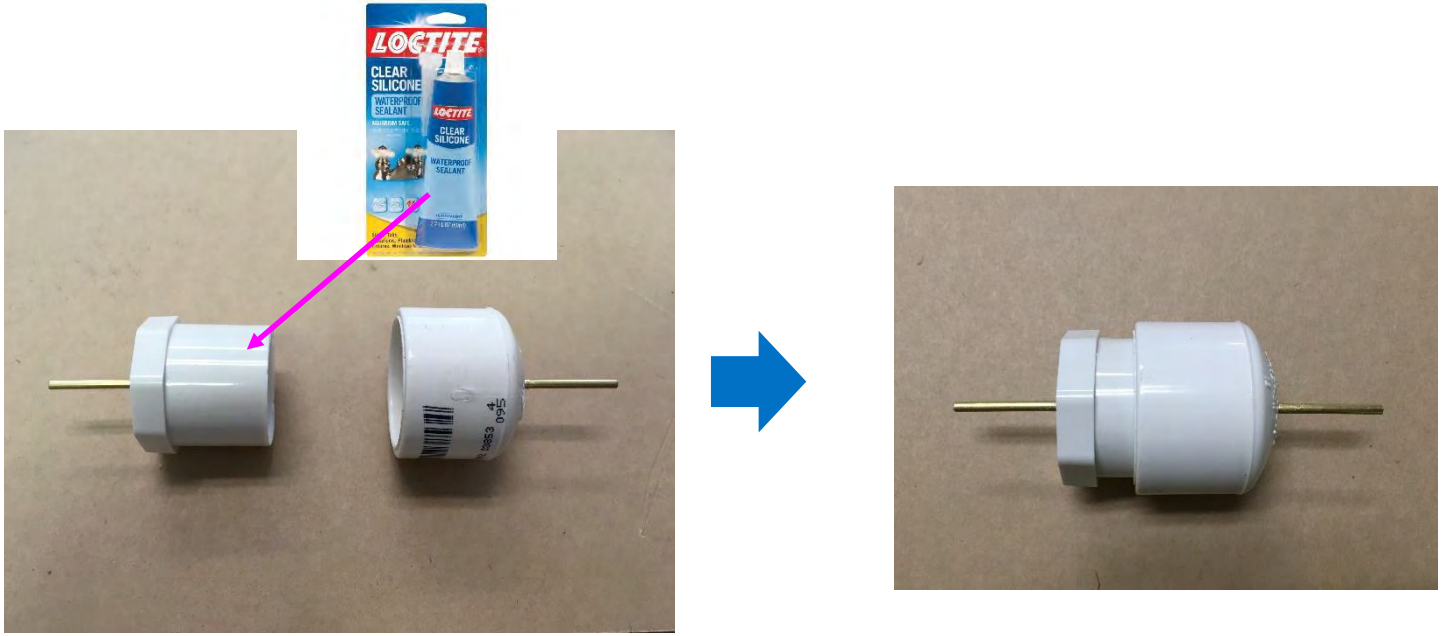


PV-PN-A11 – small plenum – STEP 7: add glue to base of brass tubes

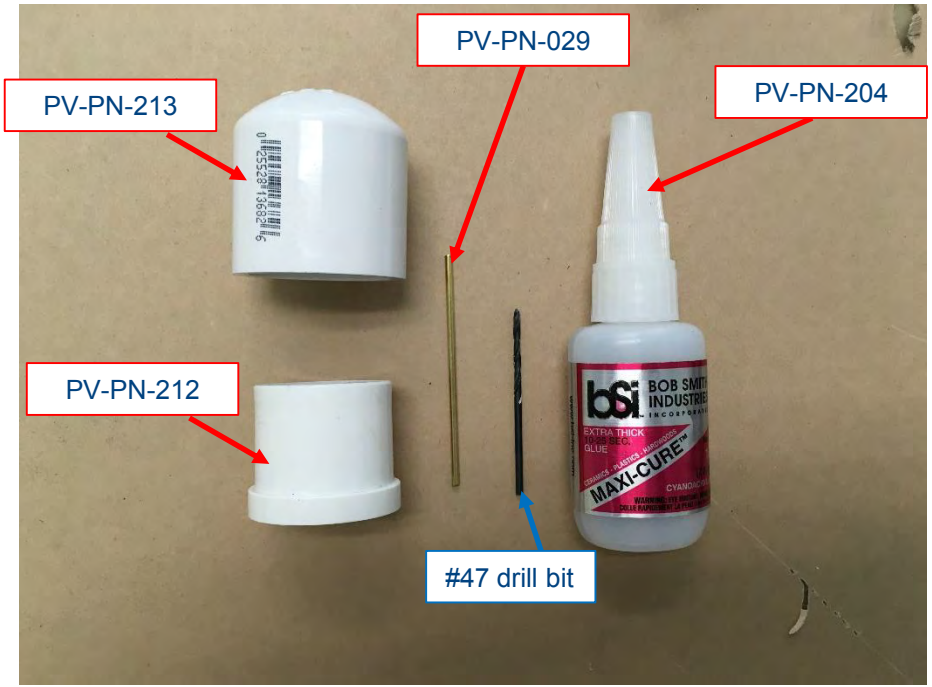
Apply super glue to the base of the brass tubes



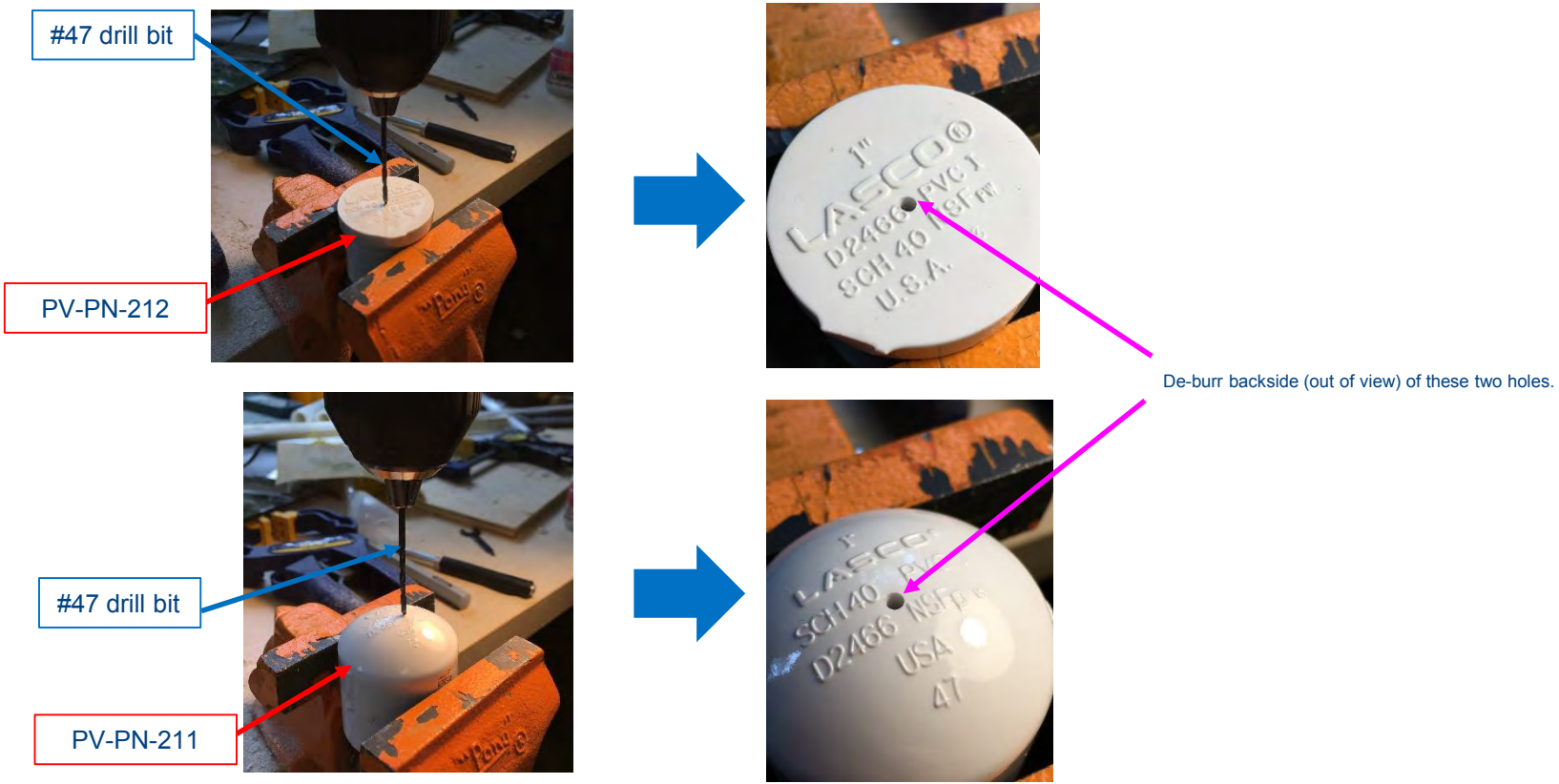
PV-PN-A11 – small plenum – STEP 8: add silicone adhesive and push fittings together



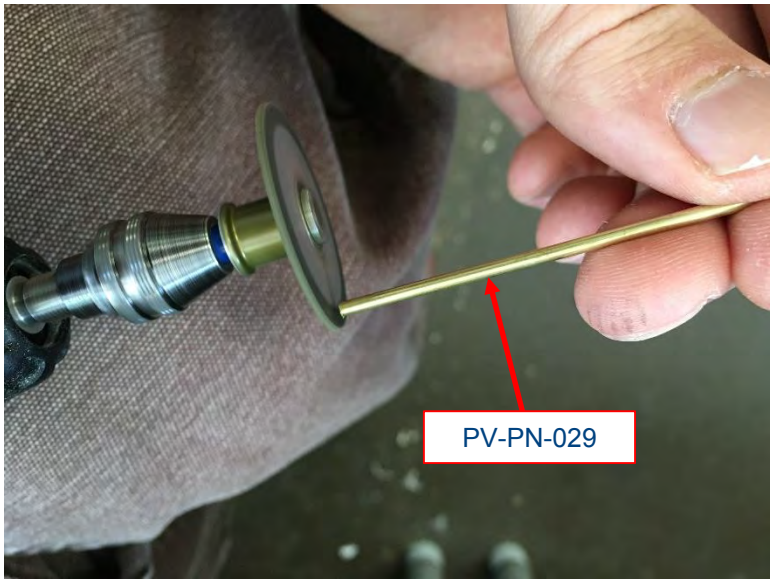
PV-PN-A12 – large Plenum – all parts:

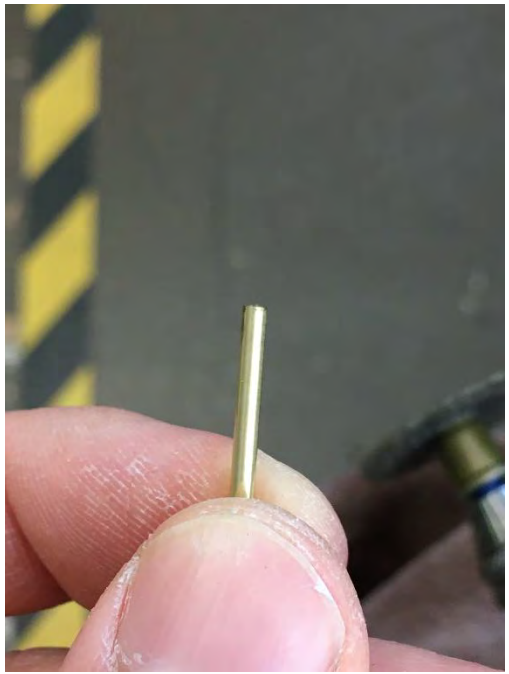


PV-PN-A12 – large Plenum – STEP 1: drill holes in the center of the PVC plug and cap.



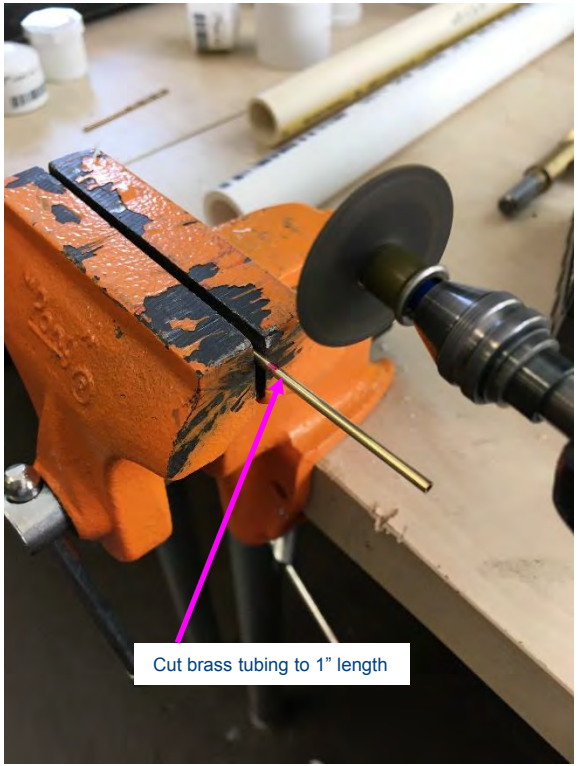
PV-PN-A12 – large Plenum – STEP 2: flatten/deburr the end of the brass tube stock.





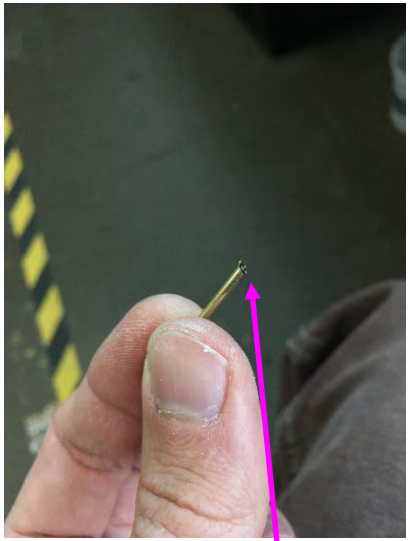
PV-PN-A12 – large Plenum – STEP 3: cut brass tubing to length

Measure and mark a length of 1 inch.



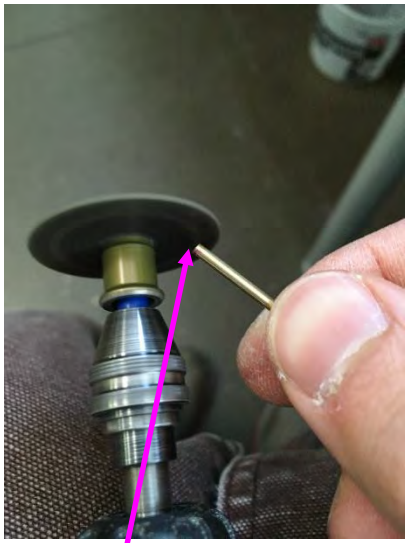
Cut brass tubing to 1” length

PV-PN-A12 – large Plenum – STEP 4: remove burrs and square end of newly cut tube

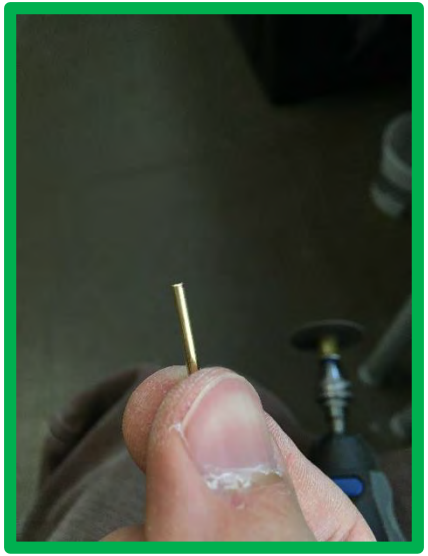


Tip may have a big bur on the end.

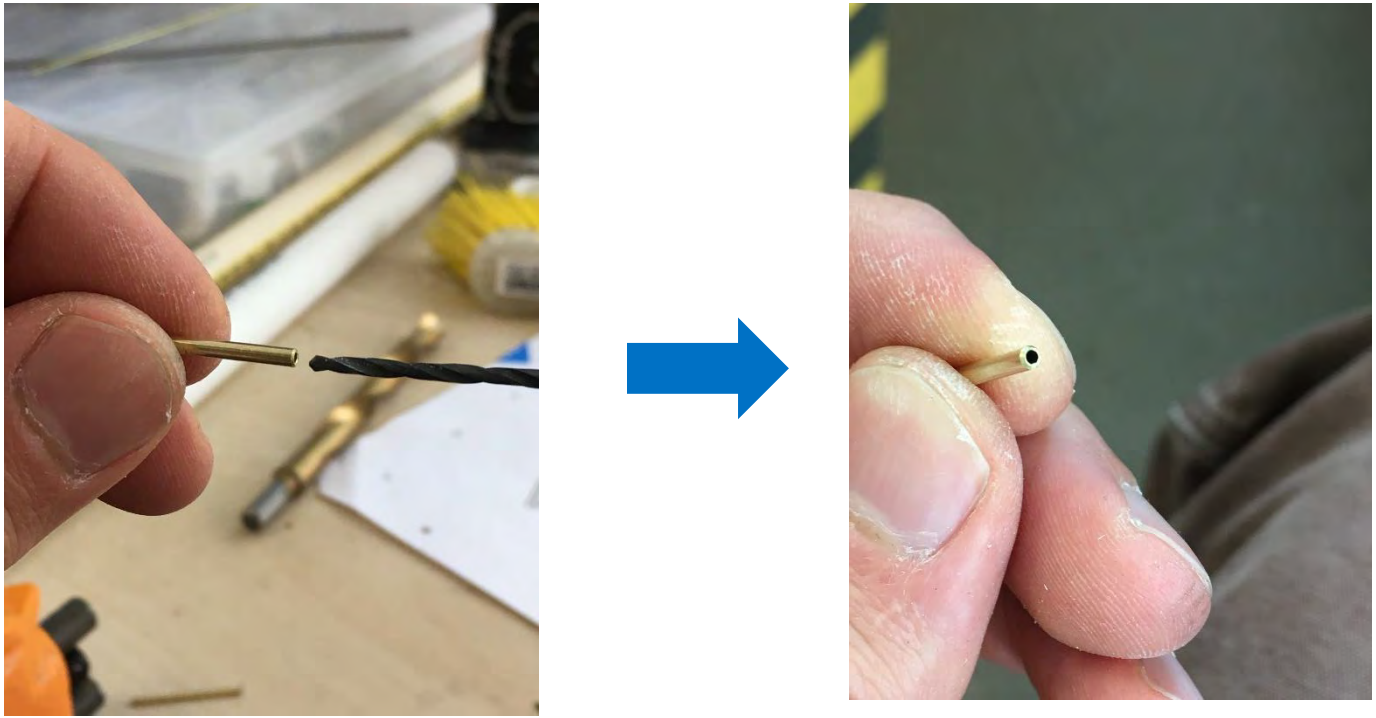
Use cutoff wheel carefully or use sandpaper to flatten and square the end of the tube.



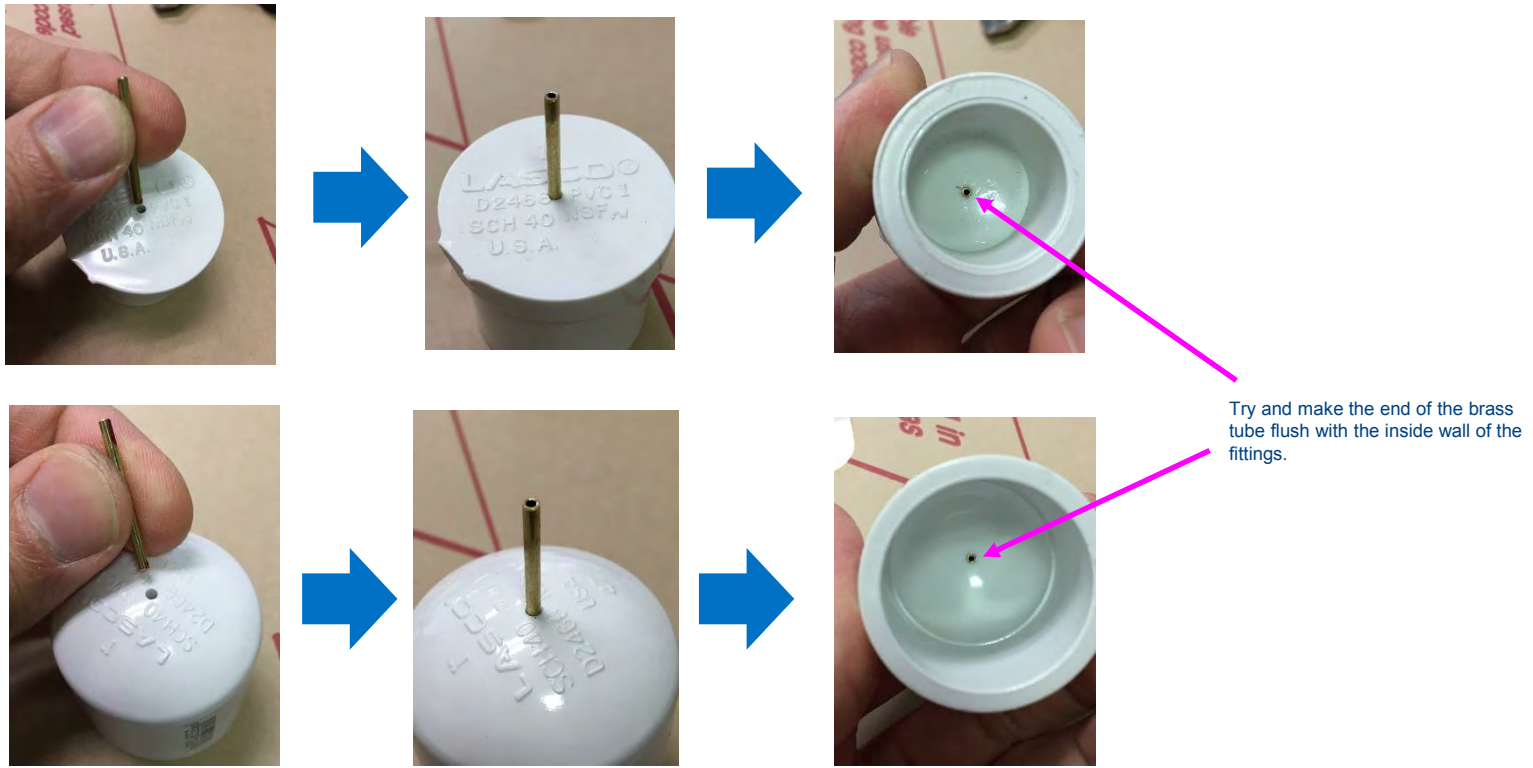
Very lightly bevel the corners of the brass tube.



PV-PN-A12 – large Plenum – STEP 5: deburr the inside diameter of the ends of the brass tube



PV-PN-A12 – large Plenum – STEP 6: push brass tubes into fittings



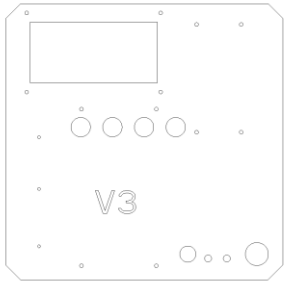
PV-PN-A12 – large Plenum – STEP 7: put super glue on base of brass tubes.

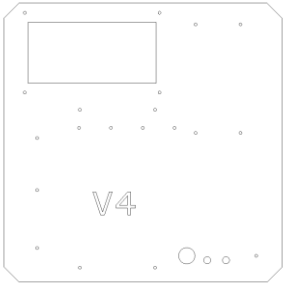
Apply super glue to the base of the brass tubes

PV-PN-A12 – large Plenum – STEP 8: add silicone adhesive and push fittings together

Push the two fittings together as far as possible. See example to the right. You should see a little bead of silicone adhesive appear at the joint when you push them together.

PV-PN-209 – controller box lid modification – STEP 1: find jig and clamp jig to box lid.





20-0508_18_drill_jig_v3_t4.dxf

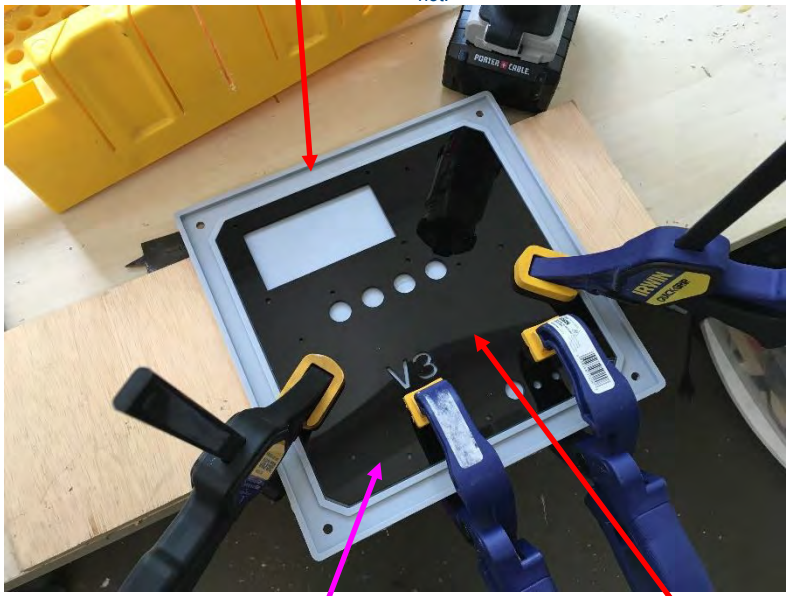
20-0511_19_drill_jig_v4_t1.dxf

NOTE: V3 was used when I made it

NOTE: V4 is recommended to make the countersinks easier.

PV-PN-209

NOTE: CANTEX box was used here. Carlon box is what Home Depot has sometimes. It unknown if this will work or not.

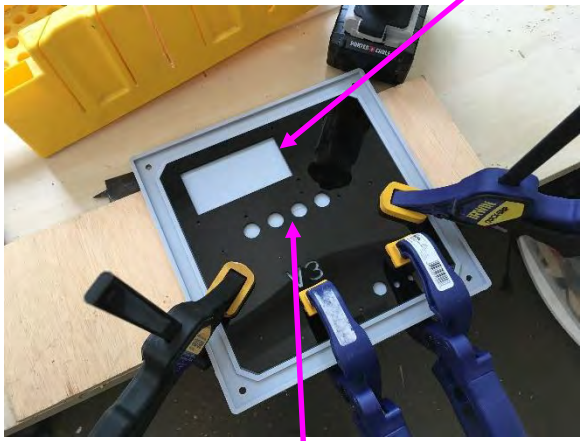


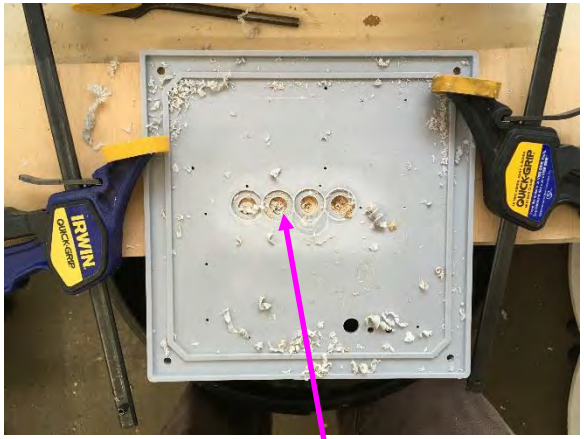
NOTE: jig is made of 3mm acrylic and was cut on a laser cutter.

PV-PN-T201

PV-PN-209 – controller box lid modification – STEP 2: countersink and drill out all the holes. Mark where the display "window" needs to be

I used an X-acto knife to scribe the proper location of the window into the back of the lid.



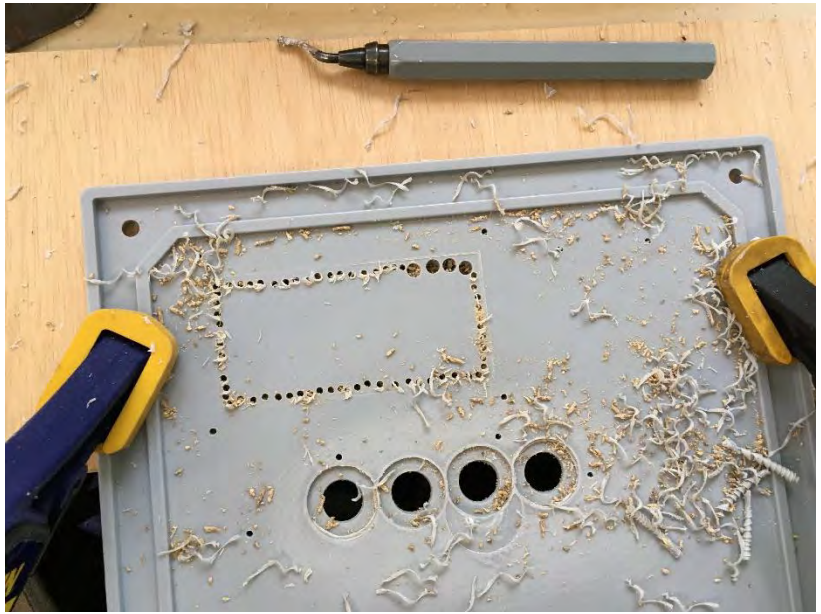


Using the **V3** jig, I marked the center of each of the four button holes. A 2.0mm drill was used to make a starter hole for the counterbore tool. I used a counterbore/wood drill to create counterbores between 2.0 and 2.5mm deep.

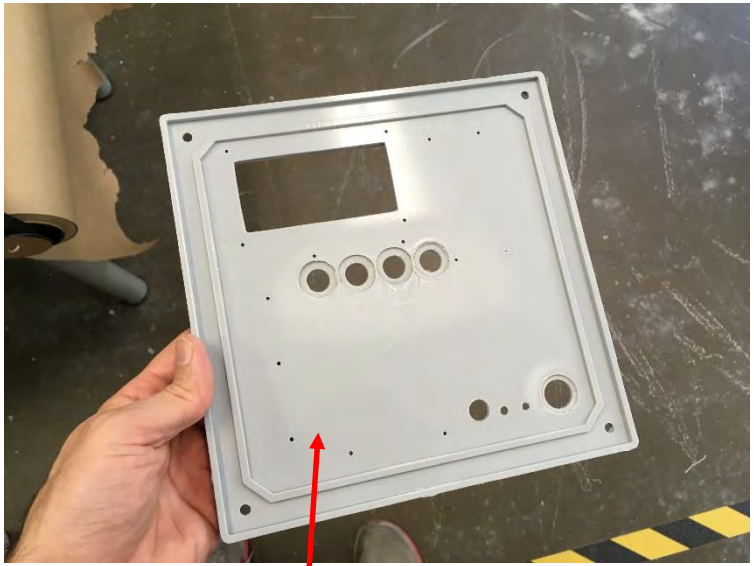
Using the **V4** jig, there is now simply a 2.0mm hole that can be used as a starter hole for the counterbore drill.

After counterbores are drilled, use a 0.5" drill bit to carefully drill through to create the button holes.

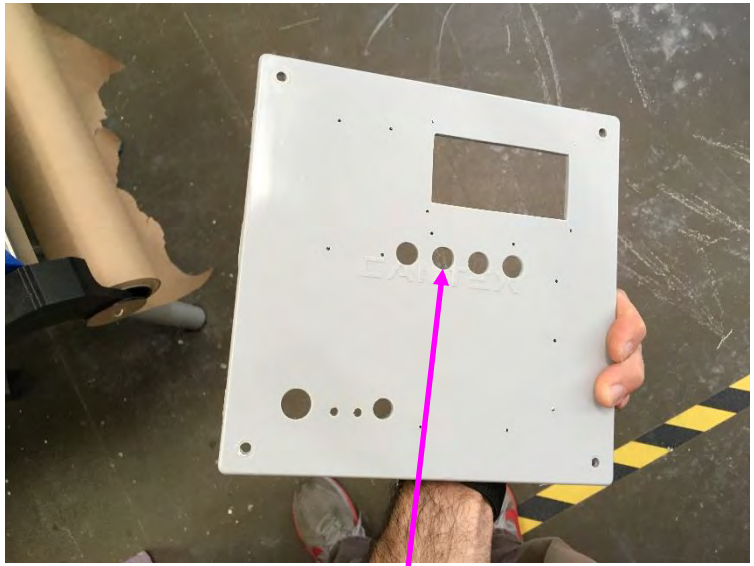
PV-PN-209 – controller box lid modification – STEP 3: cut display window.



PV-PN-209 – controller box lid modification – STEP 4: prepare lid for buttons

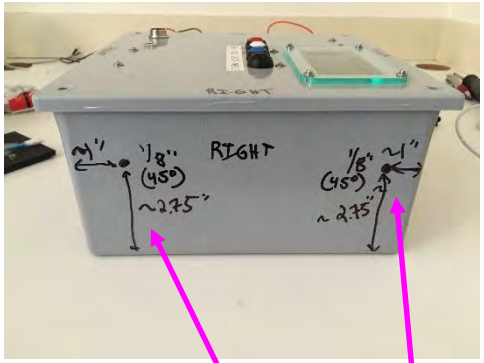


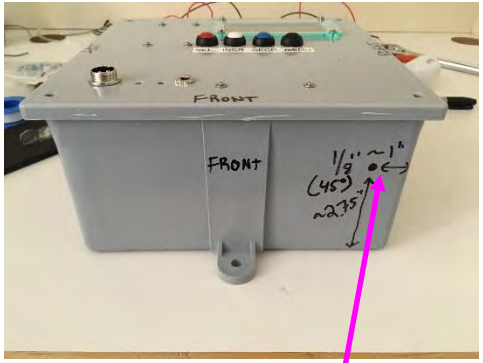
PV-PN-209

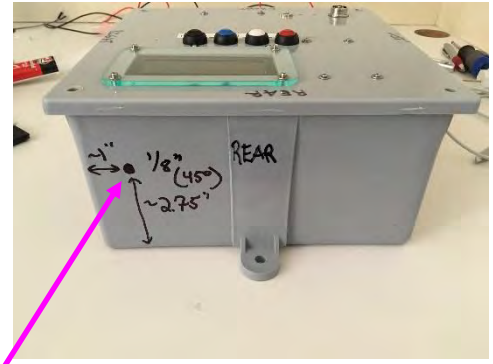


Use a de-burring tool to remove material and create a chamfer on the button holes. This will allow the buttons to sit flush with the front of the panel.

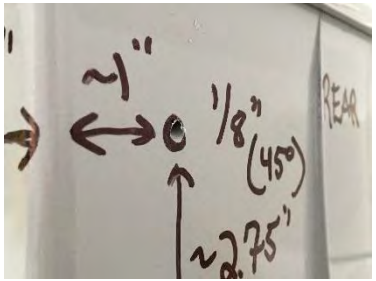
PV-PN-209 – controller box base modification – STEP 1: drill vent holes



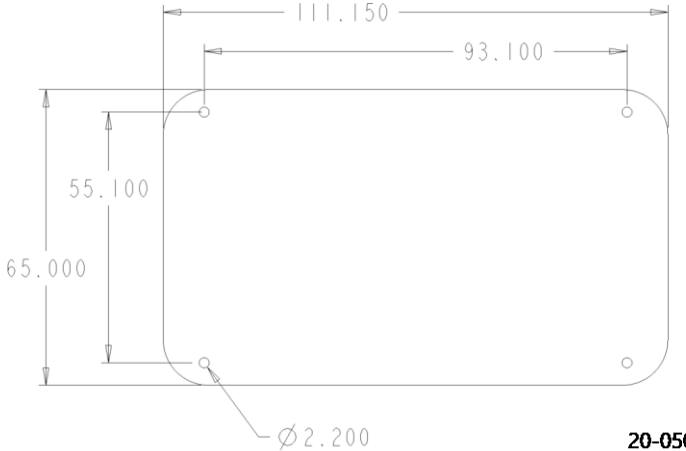




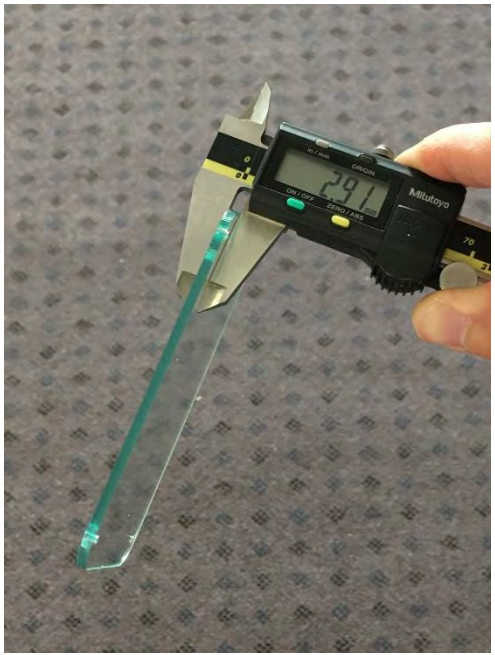
Holes are to be of 1/8” diameter and angled upward at a 45 degree angle.
Water should not collect in box if dripped from above.

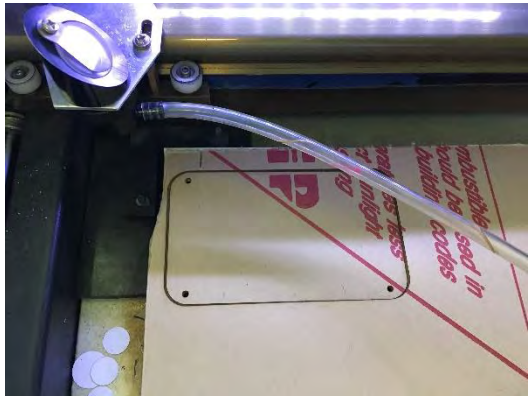


PV-PN-214 – acrylic display window – build this for controller box build

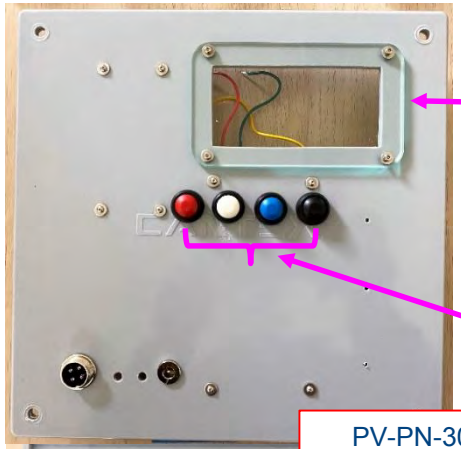


20-0508_019_orifice_plate_blank_v1.dxf





Controller box assembly – STEP 1: add standoffs, display window, buttons, audio jack & power jack, and solder wires to buttons



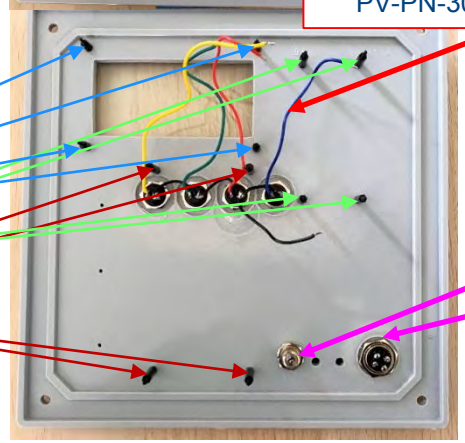
PV-PN-214

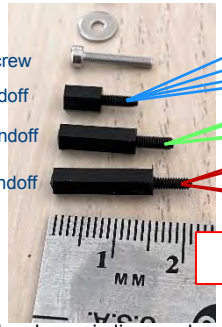
2. Install display window to the top of the box. Use 4x 12mm screws with washer, pass them through from top and secure them with 4x 6mm standoffs (blue) at the bottom. Do not overtighten the standoff.

PV-PN-301

PV-PN-307

3. Install four buttons from the top side and secure them with washer and hex nut on the bottom side. Solder a 6-7 inch long wire to the left terminal and daisy-chain ground (black) wire to the right. You should have 5 wires (4 + 1 black) with one end open.





1. Install 4x 12 mm standoffs (green) and 4x 15 mm standoffs (red) to the lid. Insert 4x 12mm screws with washer from the top side to secure these standoffs at the bottom of the lid. Do not overtighten

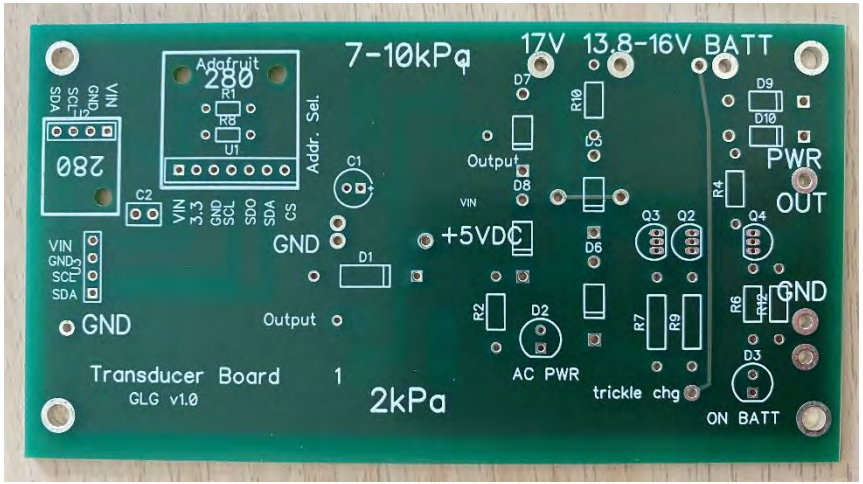
PV-PN-302

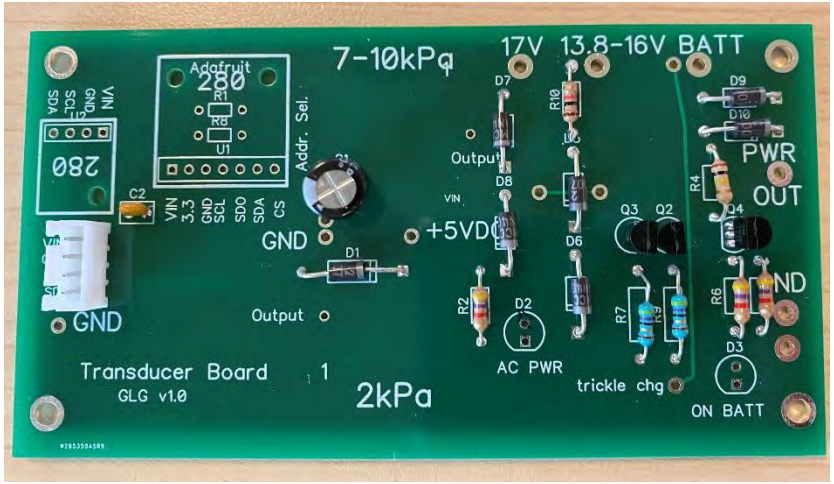
4. Install the audio jack and power jack from the top side and secure them with the washer and the hex nut at the bottom.

PV-PN-304

PV-PN-303

Controller box assembly – STEP 2: prepare transducer board, basic assembly





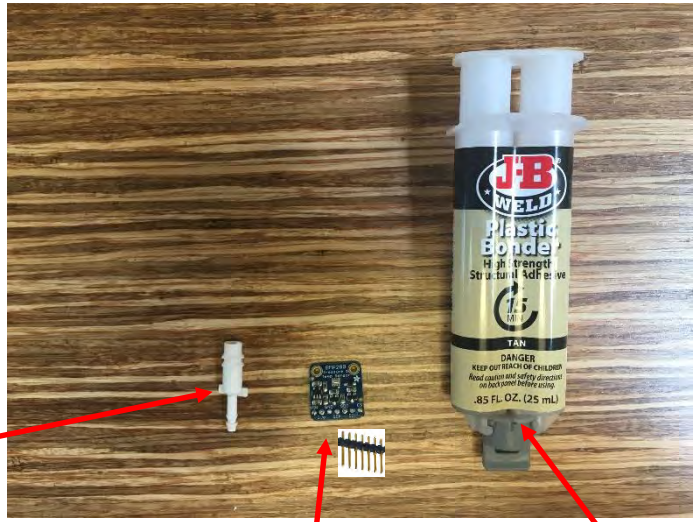
1. Obtain bare Transducer PCB board from the University of Florida team, or fab your own board

PV-PN-305

2. Assemble the components shown as per the transducer board parts listed in the BOM spreadsheet, except for the Green & Red LEDs. We will cover those in a later slide

Controller box assembly – STEP 3: prepare BMP280 sensor (airway pressure) for installation on the transducer board – all parts:

Vacuum Connector Assortment



¼” x 1/8” connector

Adafruit BMP280 sensor and 7-pin header

Epoxy glue

PV-PN-222

400 grit sandpaper

PV-PN-309

PV-PN-308

PV-PN-223

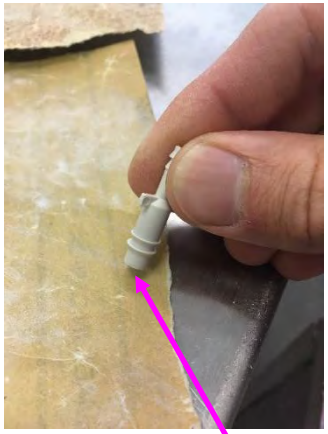
Controller box assembly – STEP 4: solder header, sand fitting, add a small amount of adhesive and place fitting over pressure sensor

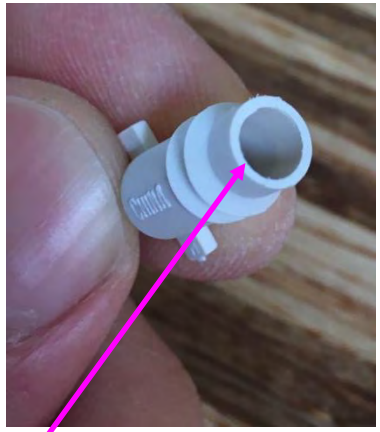
PV-PN-308

Sensor side

Opposite side

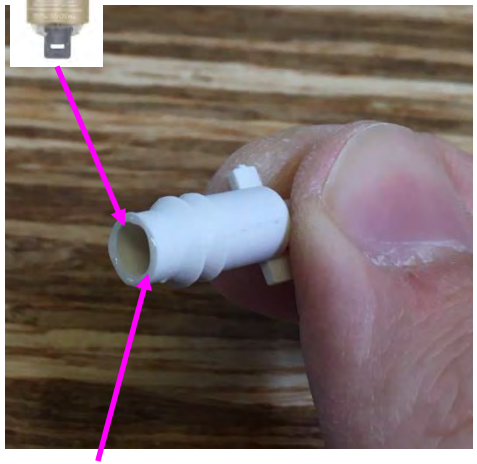
1. Solder a 7-pin header to the Adafruit BMP280 sensor board. The header pins stick out on the board from the opposite side of the BMP280 sensor.





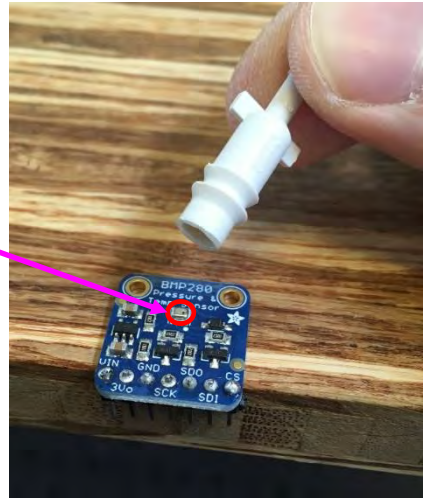
2. Sand base of fitting to create a nice flat surface on the larger end.

PV-PN-223



3. Mix a small amount of the two part epoxy and apply a very small amount around the bottom of the fitting. Be careful not to get any on the ID of fitting.

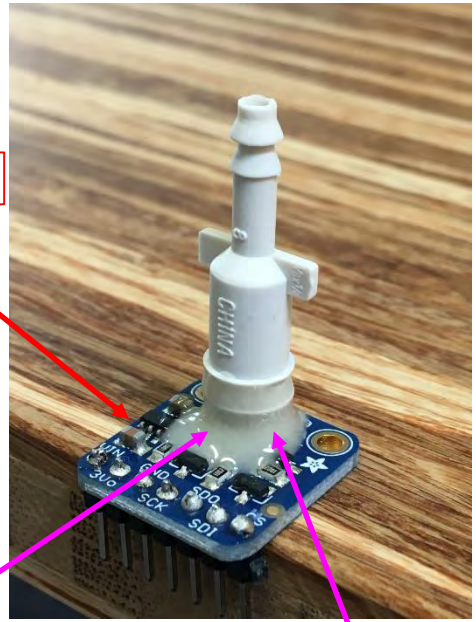
4. This is the pressure sensor. Be VERY careful while placing the fitting over the sensor, not to get any epoxy on this component.



5. Cover pressure sensor entirely and WAIT for Epoxy to fully cure

Controller box assembly – STEP 5: build up a strengthening adhesive structure around base of fitting.

PV-PN-308



Wait for epoxy to fully cure

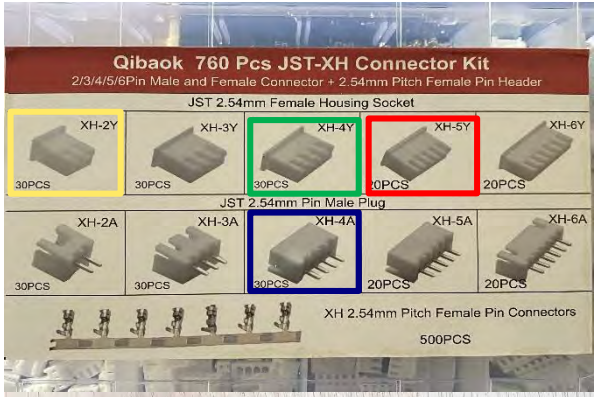
1. Ensure the epoxy is fully cured.

PV-PN-223

2. Mix another larger amount of the two part adhesive.

3. Add adhesive until entire connection from fitting to board is covered and sealed. No air should be able to get to the sensor unless it comes from inside the fitting.

Controller box assembly – STEP 6: prepare BMP280 (ambient pressure) sensor & Allsensors (diff pressure) DLHR-F50D-E1BD – all parts:

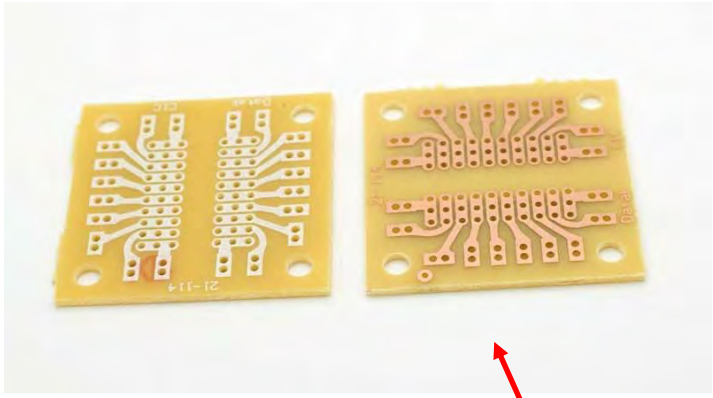


JST-XH Connector Kit with Crimping tool

PV-PN-310

Ribbon cable bundle

PV-PN-311



Prototype Circuit board

PV-PN-312

PV-PN-313

3M industrial strength double-sided tape

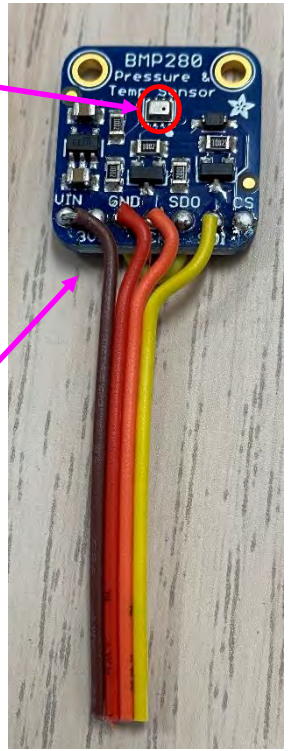
Controller box assembly – STEP 7: prepare BMP280 sensor (ambient pressure) for installation on the transducer board

PV-PN-308

BMP280 sensor

PV-PN-311

1. Solder a 4-wire bundle to VIN, GND, SCK and SDI terminals on the same side as the BMP280 sensor



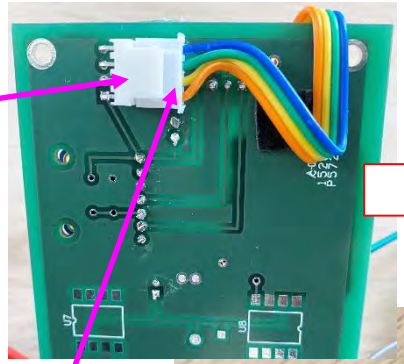
2. Solder a jumper wire between SDO and GND terminals on the other side of BMP280 sensor. This sets the address of this BMP280 sensor to value 0x76 (hex) on the I2C bus

Controller box assembly – STEP 8: prepare Allsensors DLHR-F50D-E1BD (diff pressure) sensor for installation on the transducer board

PV-PN-312

1. Cut the 20-pin protoboard to an approx. 1”x 1.5” size such that 8 pins are available to solder the Allsensors DLHR-F50D sensor to the protoboard.

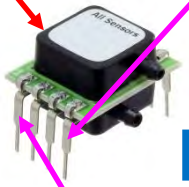
4-pin Right-angled male plug



PV-PN-305

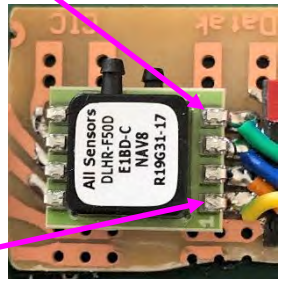
4. Select a 4-pin XH-4A JST male plug from the JST connector kit or an equivalent right-angled male plug. Solder the 4 pins of the plug to the bottom side of the 4-pin BMP280 (ambient sensor) board location marked “280” on the transducer board.

PV-PN-314



Pin 4

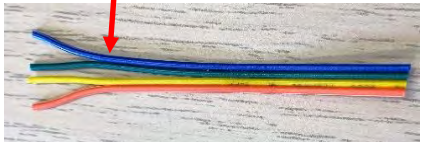
Pin 1

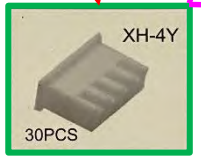


2. Carefully solder a DLHR-F50D sensor to the cut protoboard and solder one end of a 5-inch 4-wire bundle.

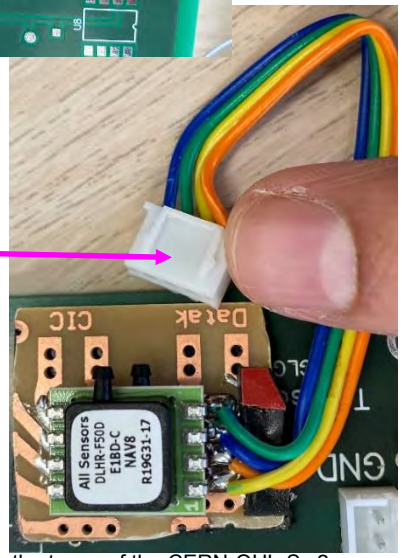
PV-PN-310

PV-PN-311



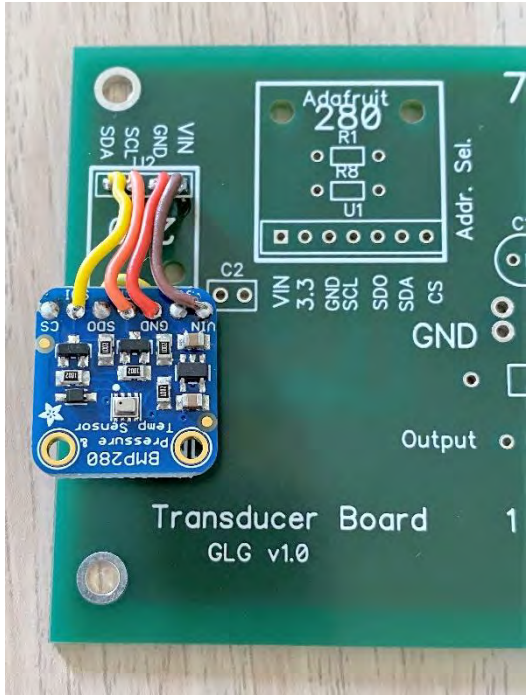


3. Select a 4-pin XH-4Y JST female socket from the JST connector kit. Using 4x female pin connectors and crimping tool, crimp/attach the other end of the 5-inch 4-wire bundle to the XH-4Y female socket. Ensure pins labeled Vs, Gnd,, SCL/SCLK, SDA/MOSI on the DHLR-F50D sensor, align with pins labeled VIN, GND, SCL, SDA on the 4-pin male connector on the Transducer board respectively (see Step 4)



Controller box assembly – STEP 9: install the two BMP280 sensors to the transducer board

1. Stick a double-sided tape on the bottom side and then insert header on the first BMP280 (airway pressure) sensor into the 'Adafruit 280' terminals, solder the pins and cut the excess length

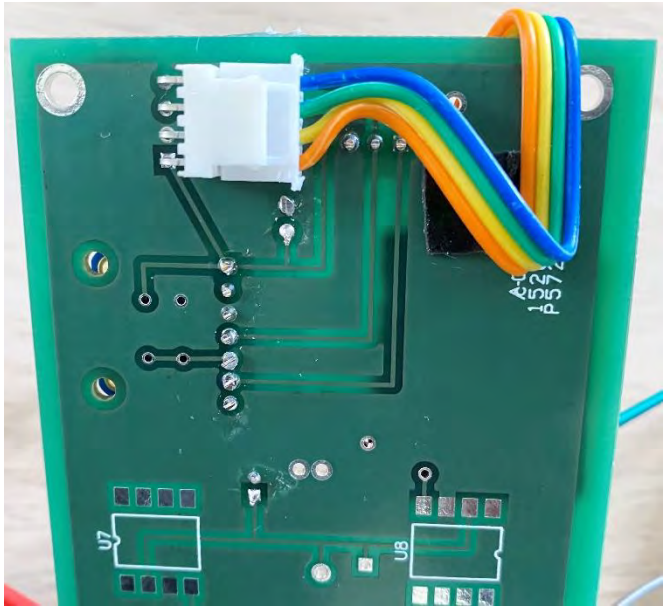


2. Solder the second BMP280 (ambient pressure) sensor to the 4-pin terminal in the space marked '280' towards the upper left. Ensure pins VIN, GND, SCK, SDI on BMP280 connect with pins labeled VIN, GND, SCL, SDA on the Transducer board respectively. Please ensure that the BMP280 sensor is on the bottom side **(shown above is incorrect, it should not be on top**)

3. Flip the second BMP280 sensor board and glue it with a glue gun to the transducer board, so it sits next to the first BMP280 sensor board as shown above. Please ensure that the **BMP280 sensor is on the TOP side of the board, after it is flipped**, before gluing.

Controller box assembly – STEP 10: install the Allsensors DLHR-F50D-E1BD on to the transducer board

1. Use a double-sided tape to attach the protoboard with Allsensors DLHR-50D sensor to the transducer board, right on top of the label 'Transducer board'. Orient the 4-wire bundle and the two ports from the sensor as shown.



2. Bend the 4-wire bundle and insert the male plug into the female socket and push it until it locks. Fold the excess length of the 4-wire bundle, if any and secure in place with a double-sided tape.

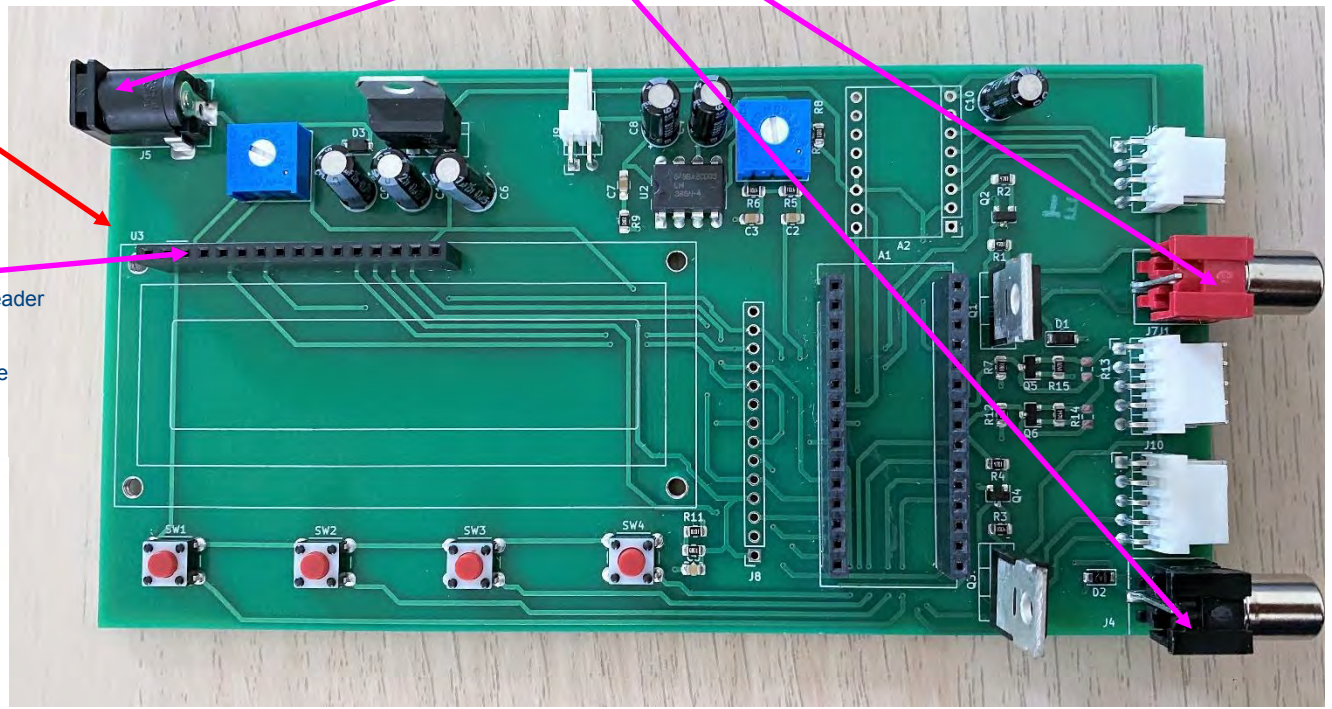
Controller box assembly – STEP 11: prepare controller board, basic assembly changes

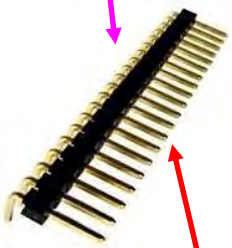
REMOVE

PV-PN-315

REPLACE
this 16-pin female header

WITH
this 16-pin right-angle
male header





PV-PN-316

Controller box assembly – STEP 12: prepare display, ribbon cable for assembly

PV-PN-316

PV-PN-316

1. Solder a 16-pin right-angle header to the display

PV-PN-311

PV-PN-318

2. Build a 16-pin 10-inch long flat ribbon cable female to female, from a flat rainbow cable and 4x 8-pin crimp connector housing female.

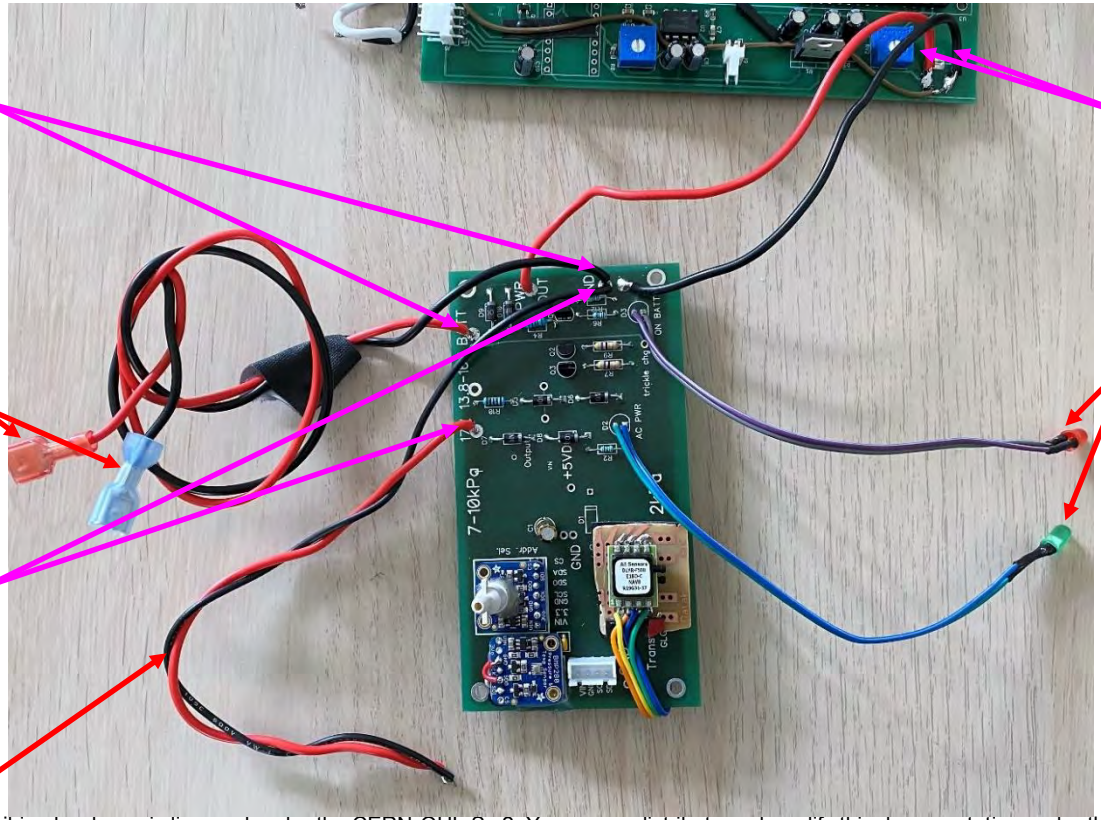
Controller box assembly – STEP 13: solder battery connectors, power jack wires, supply cables to Controller board and red & green LEDs

1. Battery connectors: Solder two ~15-inch long #16-#18 stranded wires, a RED wire to the positive terminal/pad marked ‘BATT’ and a BLACK wire to the negative terminal/pad marked ‘GND’. Note that the negative connector shares the GND pad with the power jack negative wire in the diagram. Connect the other end to female, insulated, crimp terminals of matching colors, if available.

PV-PN-320

2. Power jack wires: Solder two ~9-inch long #16-#18 stranded wires, a RED wire to the positive terminal/pad marked ‘17V’ and a BLACK wire to the terminal/pad marked ‘GND’, shared with battery negative wire. Leave the other end open, we will cover it in a later slide.

PV-PN-319



3. Controller board power: Solder two ~9-inch long #16-#18 stranded wires, a RED wire connecting terminal/pad marked “PWR OUT” on transducer board to positive terminal/pad for DC-power (J5) and a BLACK wire to the negative terminal/pad, as shown

PV-PN-321

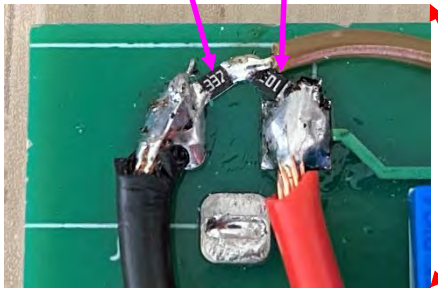
4. Extend the leads of a red LED and a green LED to approx. 6 inches long, solder red LED to pads at D3, marked ‘ON BATT’ and solder green LED to pads at D2, marked ‘AC PWR’. Please pay attention to the polarity for these diodes, else LEDs won’t light up.

Controller box assembly – STEP 14: build a voltage divider with resistors, install Arduino Nano, solder wires to solenoid terminals, solder jumper to A7

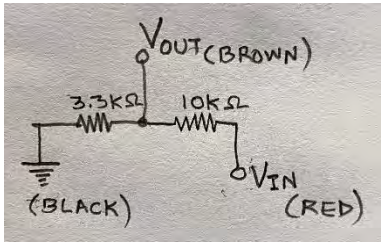
3.3K Ω

10K Ω

PV-PN-323

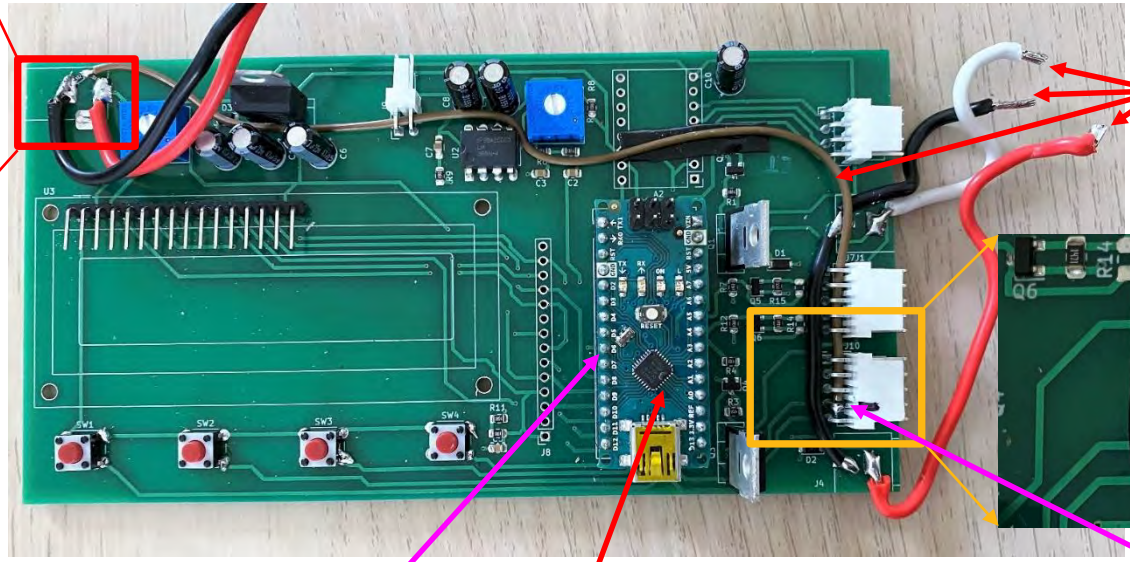


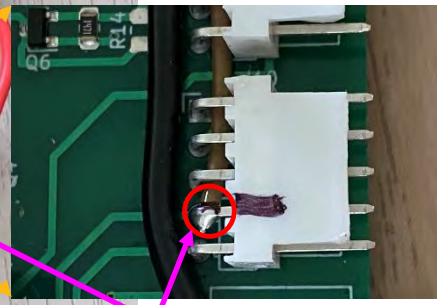
1. Build a voltage divider with a 10K and a 3.3K resistors between the positive and negative terminals of the supply voltage. Solder a brown wire at Vout in diagram and run it to pin 4 of Extension port J10.



3. Solder four wires (two pairs) approx. 3-4 inches long from Solenoid_A and Solenoid_B terminals. The BLACK wires connect to ground terminals and can be shorted, the WHITE wire to Solenoid_A positive terminal and the RED wire to Solenoid_B positive terminal.

PV-PN-319





J10 – Pin 4

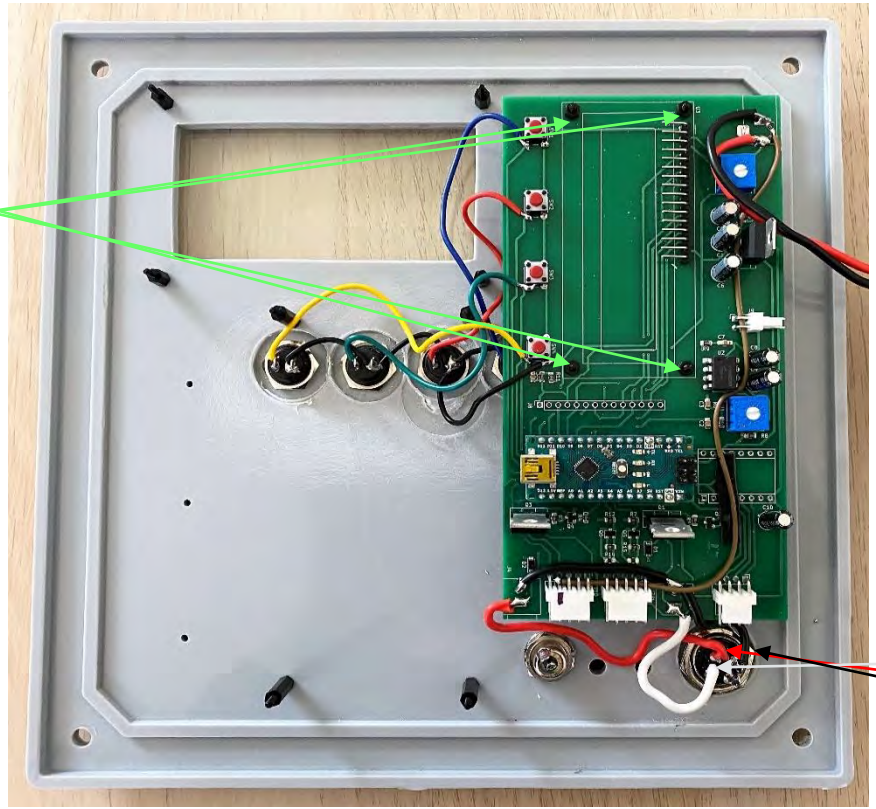
2. Install Arduino Nano into the 30-pin (15x2) header marked A1, by aligning pin 1, gently pushing it down all the way, careful not to bend any pins.

PV-PN-322

3. Solder the brown wire from step 1 to Pin 4 of Extension port J10, as shown. The goal is to build a fuel gauge for the 12V battery, which is approx. 13.2V when fully charged and drains to below 11.0V when we should alarm. The Vout is tied to **A7 analog pin on Arduino,** will be in range 0-3.3V and will work as a battery fuel gauge.

Controller box assembly – STEP 15: install controller board to the lid of the control box and solder wires to buttons and audio jack

1. Align the 4 through-holes on the controller board on top of the 4x 12mm standoffs (installed in step 1) and gently insert. Use 4x hex nuts from M2 standoff set (BOM) and hand-tighten to secure the board in place.

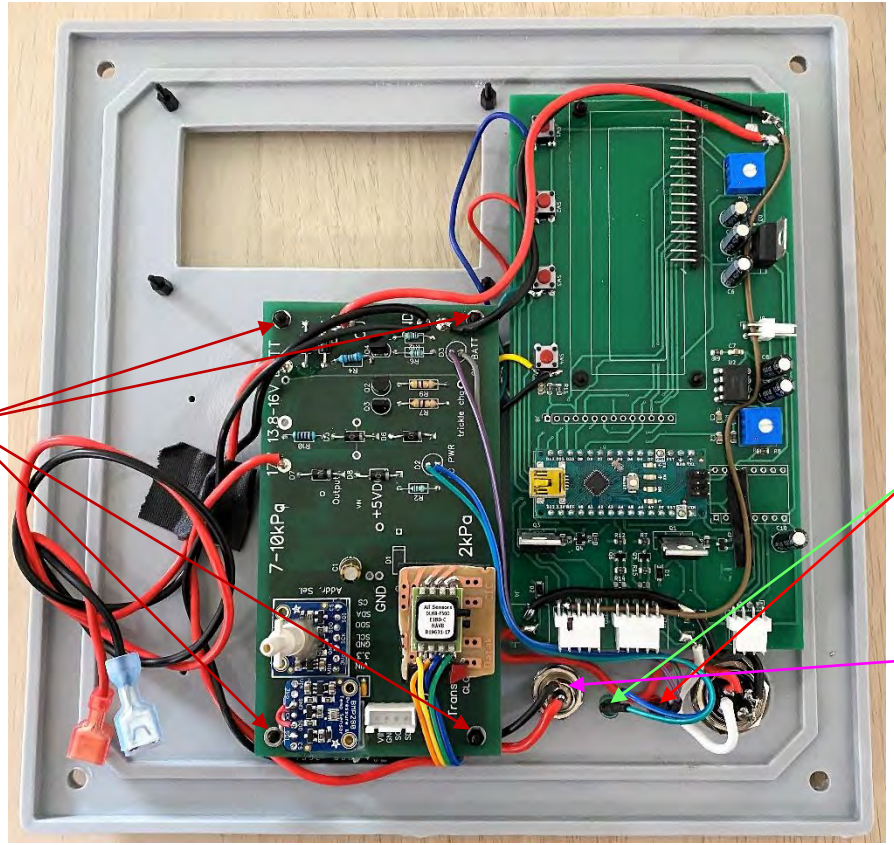


2. Solder the four wires (yellow, green, red, blue) from the buttons on the lid to the corresponding button terminal on the controller board. Please be careful on the order. Finally solder the common black wire to one of the button ground terminals on the controller board.

3. Solder the four wires for solenoid control from the controller board to the Audio jack as follows:
   - Pin 1 – Solenoid A positive – White
   - Pin 2 – Solenoid B positive – Red
   - Pin 3 & 4 – Ground - Black

Controller box assembly – STEP 16: install transducer board to the lid of the control box, insert LEDs and solder wires to power jack

1. Align the 4 through-holes on the transducer board on top of the 4x 15mm standoffs (installed in step 1) and gently insert the board onto the standoffs. Use 4x hex nuts from M2 standoff set (BOM) and hand-tighten to secure the board in place.



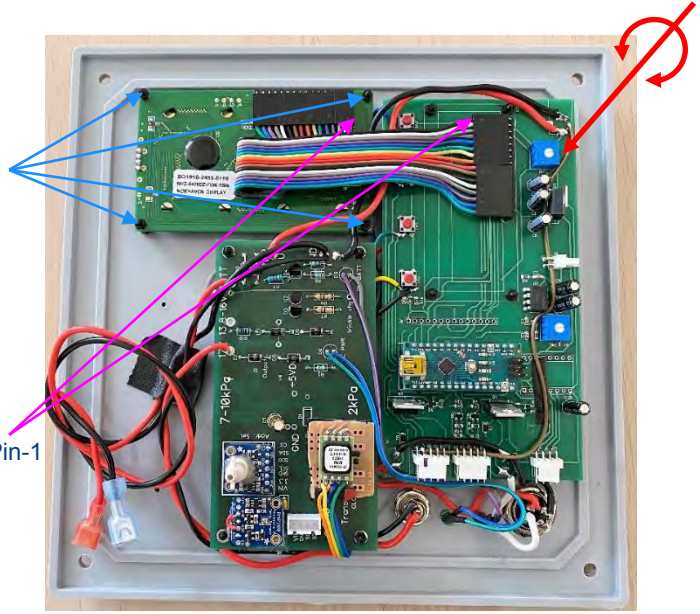
2. Insert the green LED into the hole next to the power jack. Insert the red LED into the hole next to the audio jack. Secure any excess length of the cables tucked under the board or tie with a cable tie.

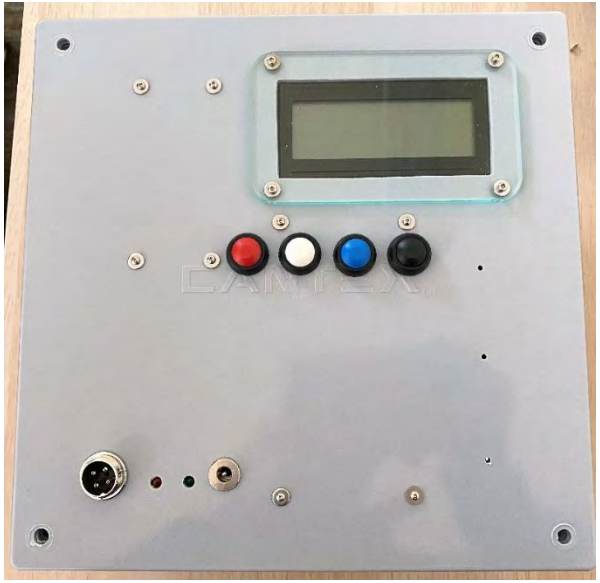
3. Solder the red wire to the center or positive terminal and the black wire to the negative or shield terminal of the power jack.

Controller box assembly – STEP 17: install 20x4 display to the lid of the control box, and connect the 16-pin cable to control board

1. Align the 4 through-holes on the display on top of the 4x 6mm standoffs (installed in step 1) and gently insert the display onto the standoffs. Use 4x hex nuts from M2 standoff set (BOM) and hand-tighten to secure the display in place. The display LCD should be visible and sit just below the window on the front side of the lid.

2. Carefully connect the 16-pin flat ribbon cable between the 16-pin headers on the controller board, followed by the display. Please ensure that pin-1 on controller board aligns with pin 1 on the display. Please note that the cable needs two folds or bends, a U-fold and a 45-degree bend for the alignment (see step 12 slide). Use a 2-sided tape to secure the folds and the cable on the display board.



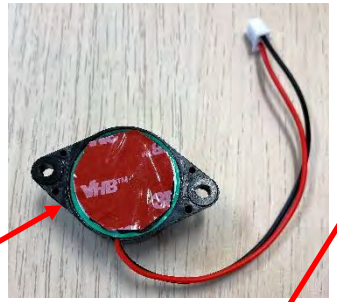


3. Front view of the display with bezel. Should be perfectly aligned and visible through the window.

Controller box assembly – STEP 18: install a buzzer/speaker and I2C cable to complete controller box assembly

1. Install a 2-pin female socket to the buzzer cable. Attach a double-sided tape on the back of the buzzer.

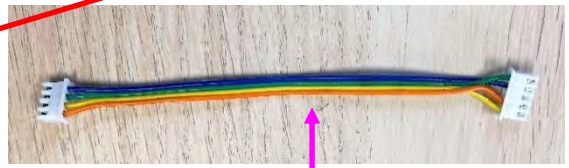
PV-PN-324



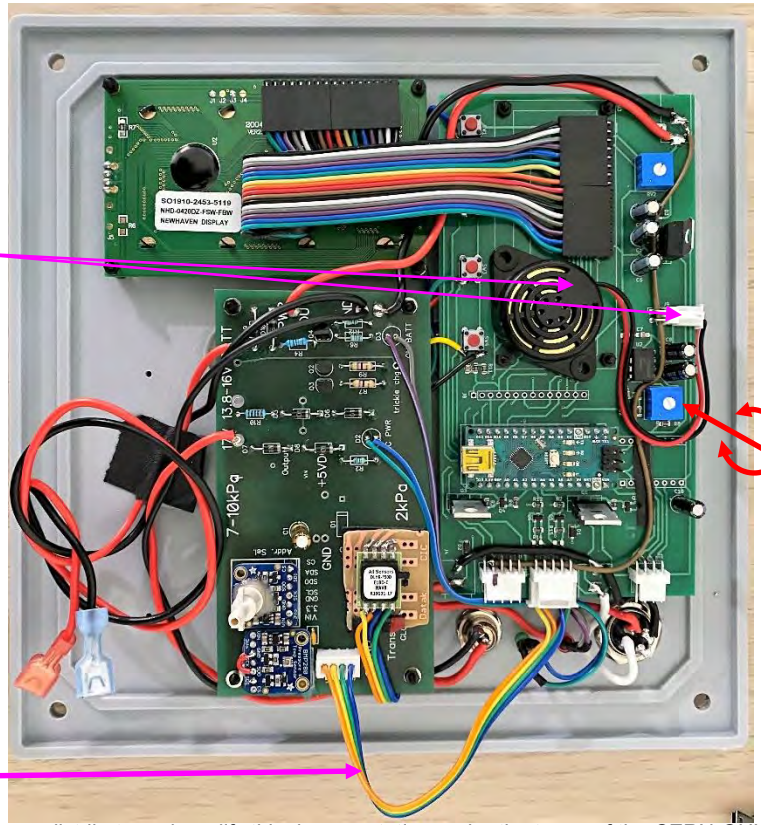
3. Stick the buzzer on the controller board as shown with a double-sided tape and insert the socket into the 2-pin plug J9.

PV-PN-310

PV-PN-310

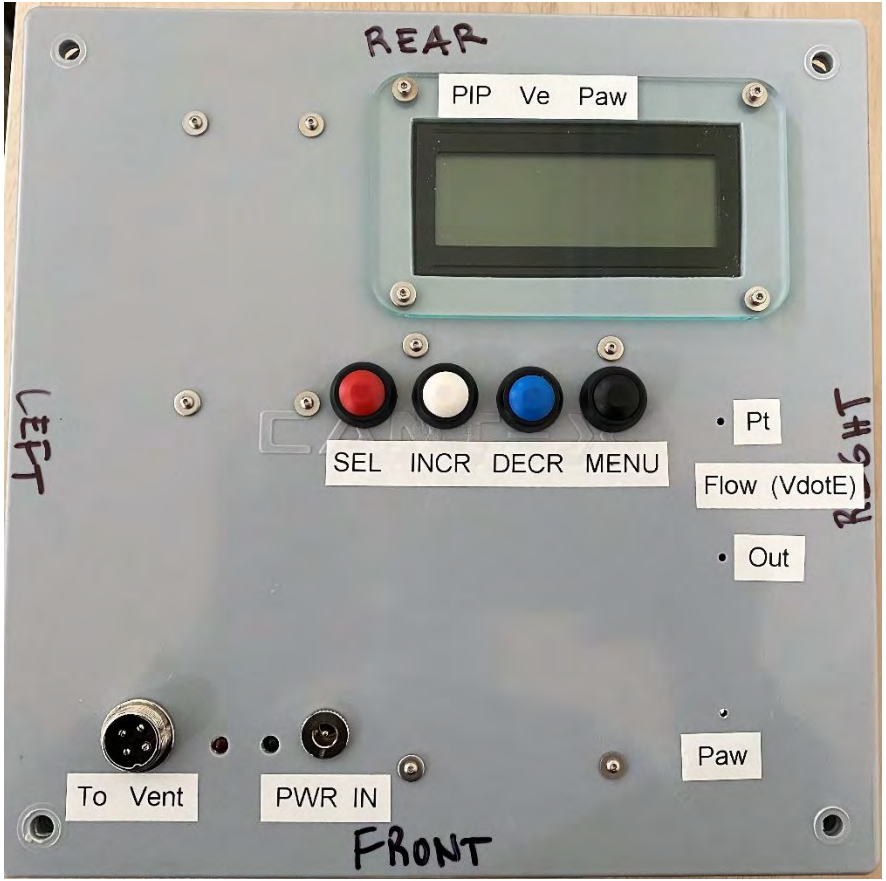


2. Build a 4-pin I2C cable with a 4-pin JST female socket on one end and a 5-pin JST female socket on the other end, aligning the I2C signals. Insert the cable between the transducer board and the controller board as shown



Potentiometer to adjust buzzer volume, by turning screw clockwise or counter clockwise

Controller box assembly – STEP 19: print labels and stick them to the control box



Controller box assembly – STEP 20: basic tests for some of the control box components

NOTE: THESE TESTS ASSUME THAT THE USER HAS SOME FAMILIARITY WITH ARDUINO CODE DEVELOPMENT ENVIRONMENT AND HAS APPRORIATE LIBRARIES DOWNLOADED

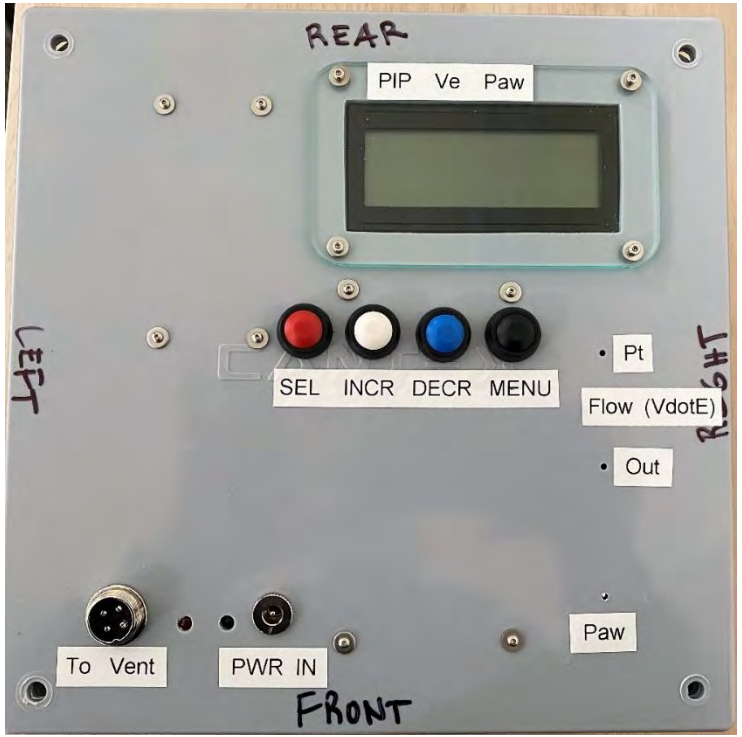
1. DISPLAY TEST: From Arduino (1.8.12) sketch, navigate and select File->Examples->LiquidCrystal->HelloWorld example. Map the LCD interface pins for our Arduino as shown:
rs=13, en=12, d4=11, d5=10, d6=9, d7=8;
Verify and Upload the code. You should see "hello, world!' on line 1 and a seconds counter on line 2 of the display. Note: If display is blank, please adjust the display contrast as shown in Step 17

2. SPEAKER TEST: From Arduino sketch, select File->Examples->Digital->toneMultiple example. Verify and Upload the code. You should hear a 200-ms 'beep' from the buzzer every second.

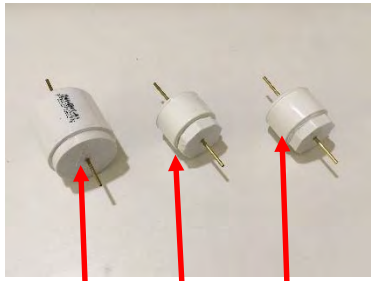
3. BMP280 TESTS:. Download and use sSense_BMx280 library. From Arduino Sketch, select File->Examples->sSense_BMx280->sSense_BMx280_example. Search code for I2C Address setting. Use the default address 0x76 to test the ambient BMP280. Change address to 0x77 to test the airway BMP280. Open the Tools->Serial Monitor, set the baud rate to 19200. You should see valid Temp and Pressure values printed every second. Perform test for both sensors.

4. ALLSENSOR DLHR TEST: Download and use Allsensors DLHR library. Select File->AllSensors DLHR->ReadSensor example. Verify and Upload the code. Open the Tools->Serial Monitor, set baud to 115200. You should see valid Differential Pressure and Temperature printed every 100 ms.

5. LED TESTS: Connect only AC Supply to "PWR IN", you should see Green LED lit. Connect only DC 12V battery, you should see Red LED lit.



PV-PN-A14 – plastic enclosure full assembly – STEP 1: glue plenums to inside of box



PV-PN-A12

PV-PN-A11

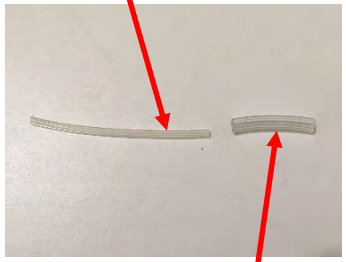
PV-PN-A11

PV-PN-223

Ensure enough epoxy is used to fill the gap beneath the base of the plenums

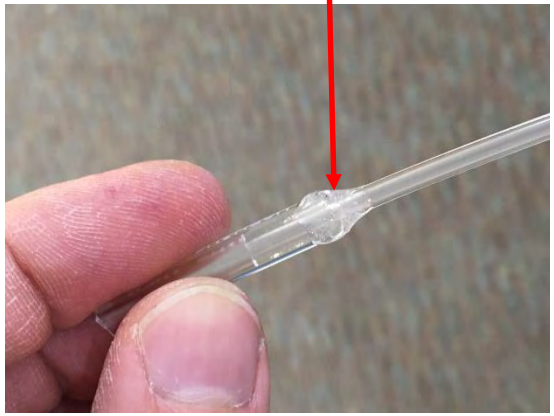
PV-PN-A14 – plastic enclosure full assembly – STEP 2: glue big plenum tubes together

PV-PN-218 Cut tubing to **3 inches**

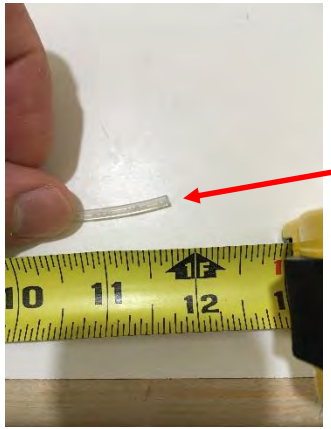


PV-PN-246 Cut tubing to **1.4 inches**

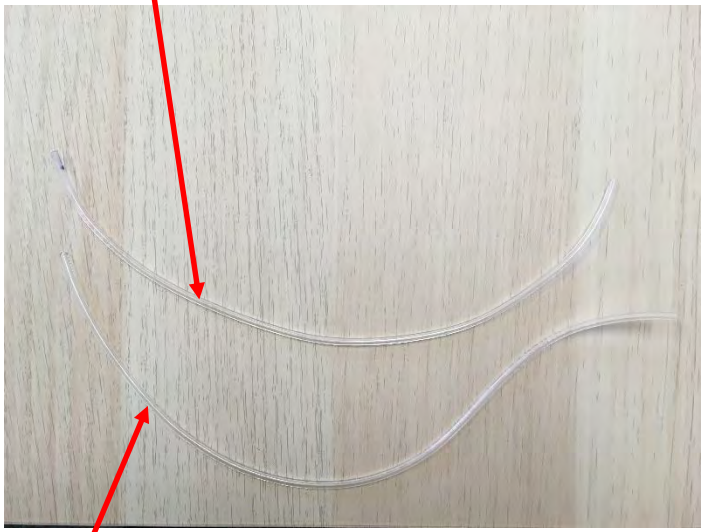
PV-PN-224



PV-PN-A14 – plastic enclosure full assembly – STEP 3: cut small plenum tubes

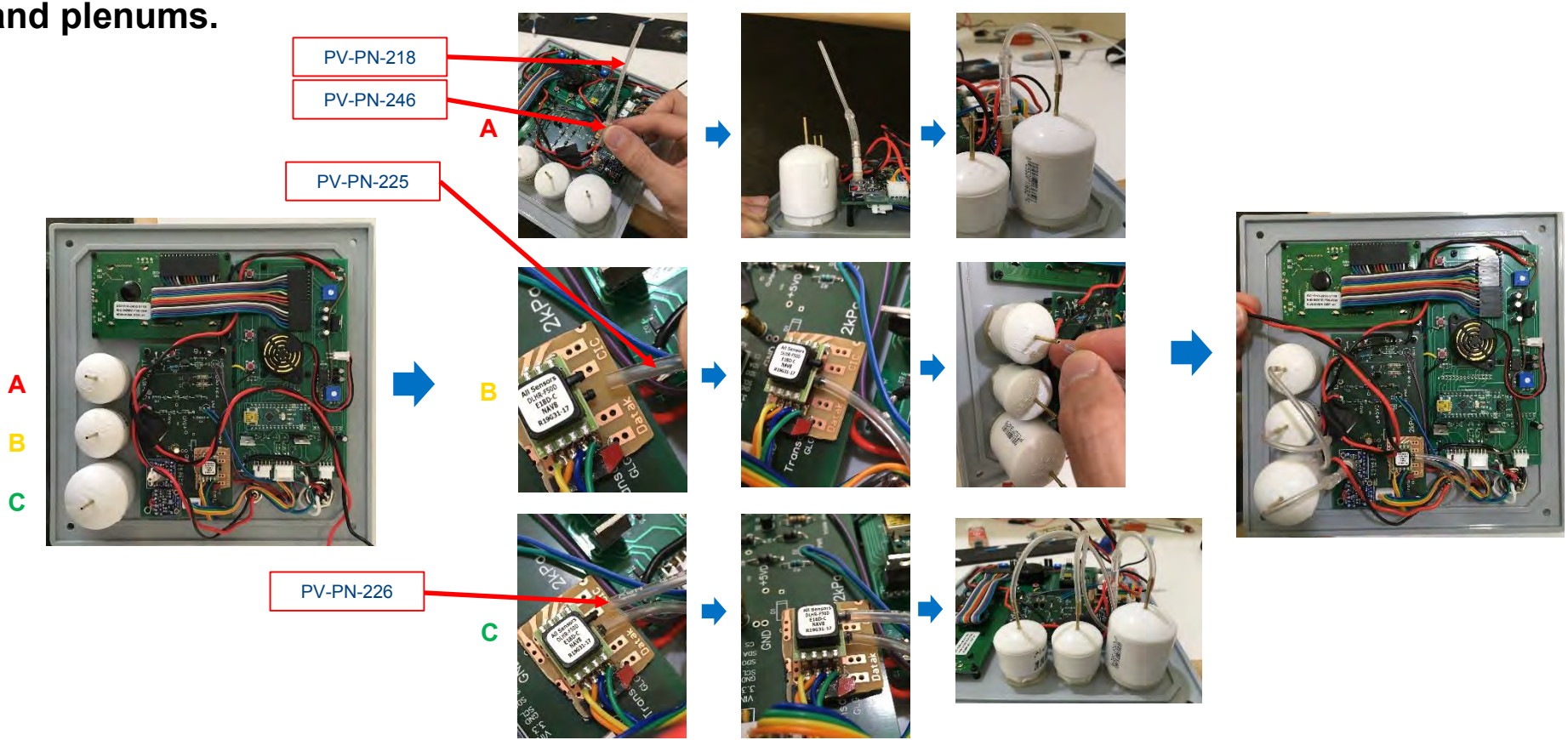


PV-PN-225 Cut tubing to **11.75 inches**



PV-PN-226 Cut tubing to **13 inches**

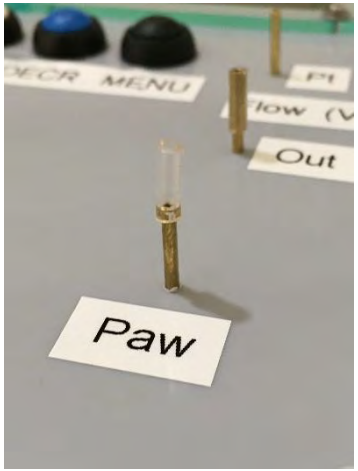
PV-PN-A14 – plastic enclosure full assembly – STEP 4: connect tubes to respective sensors and plenums.

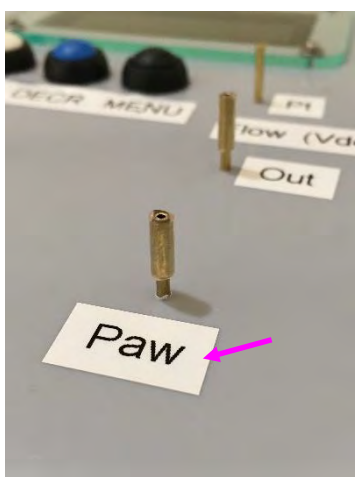


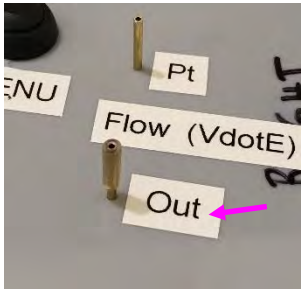
PV-PN-A14 – plastic enclosure full assembly – STEP 5: carefully push small bits of tubing over the outer brass tube of big plenum.

PV-PN-247

Cut **Qty: 2** bits of tubing to **0.4250 inches**



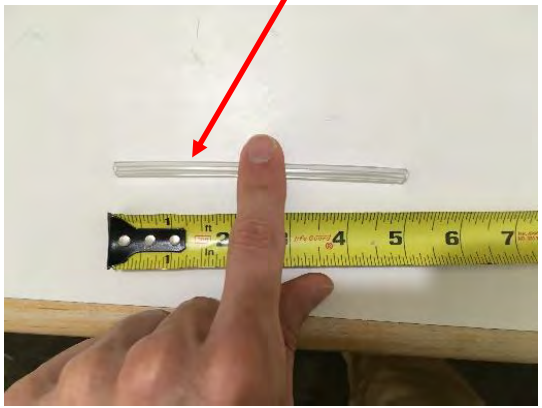


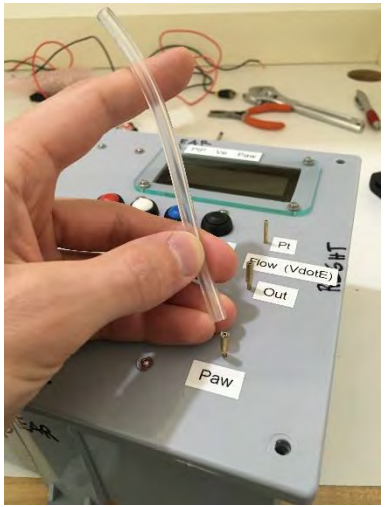


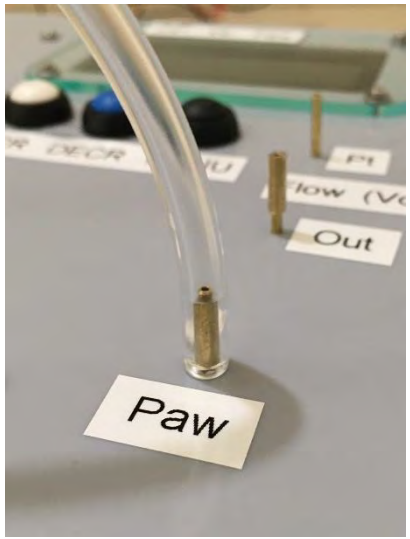
PV-PN-A14 – plastic enclosure full assembly – STEP 6: push larger tubing over the new piece of smaller tubing.

Cut tubing to **5.0 inches**

PV-PN-248



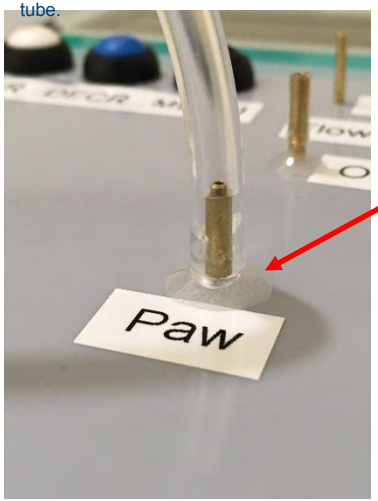


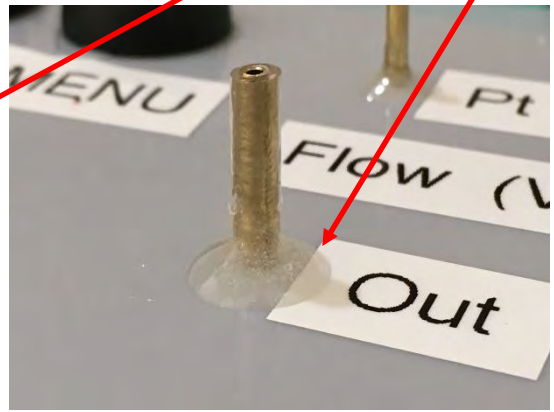


PV-PN-A14 – plastic enclosure full assembly – STEP 7: add a bit of epoxy to the base of each of the plenums.

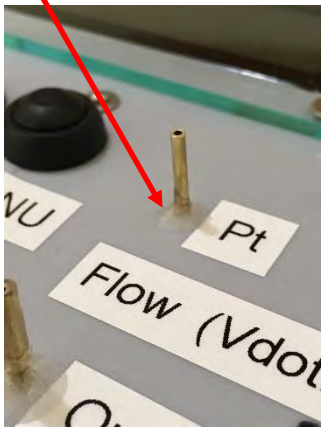
PV-PN-224

Ensure epoxy glob goes up over the plastic tube.





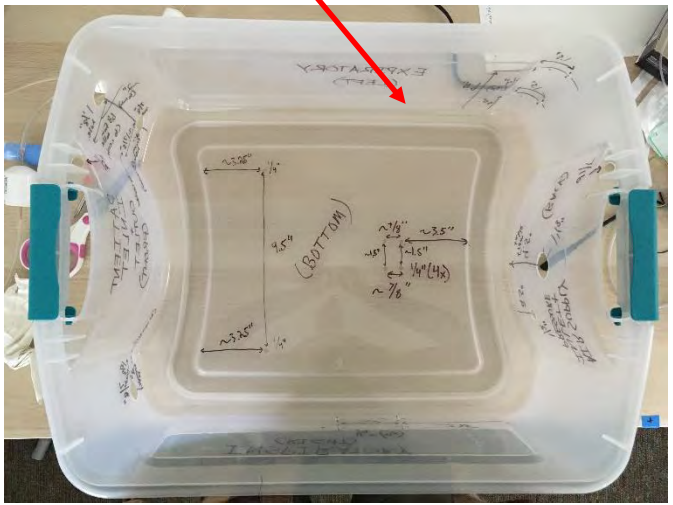
Ensure epoxy glob goes up over the plastic tube.

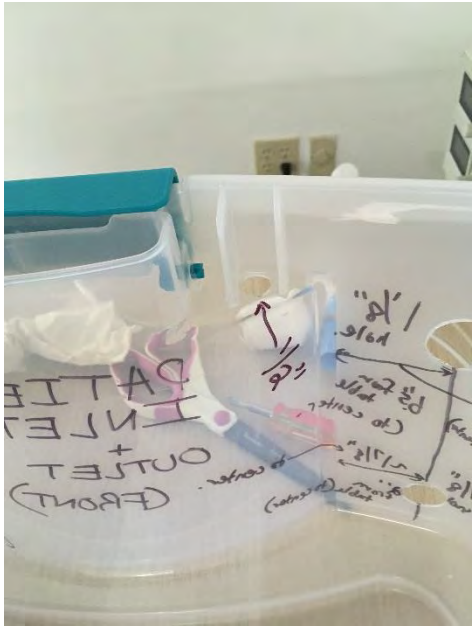


PV-PN-A14 – plastic enclosure full assembly – STEP 8: drill holes in the box

NOTE: top is removed here.

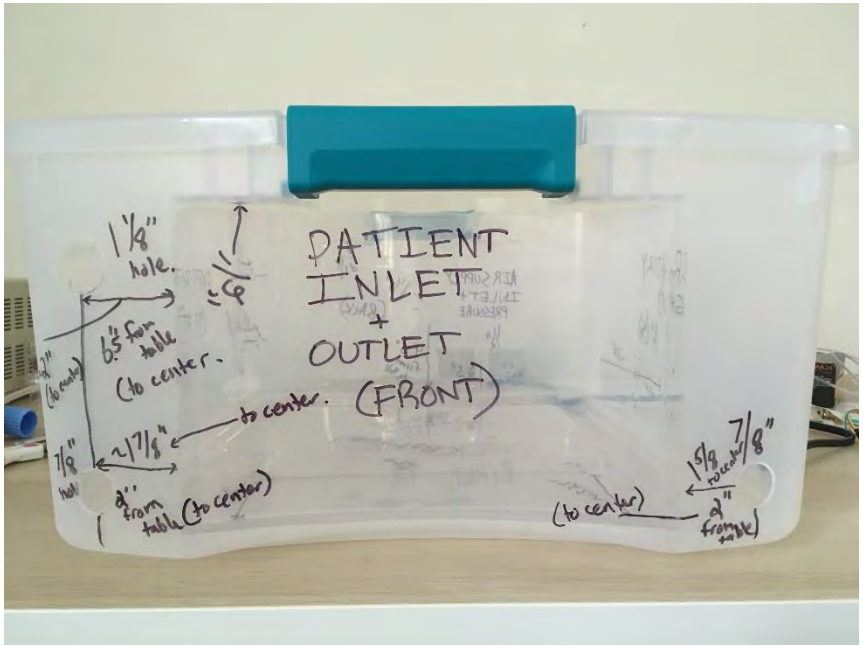
PV-PN-242

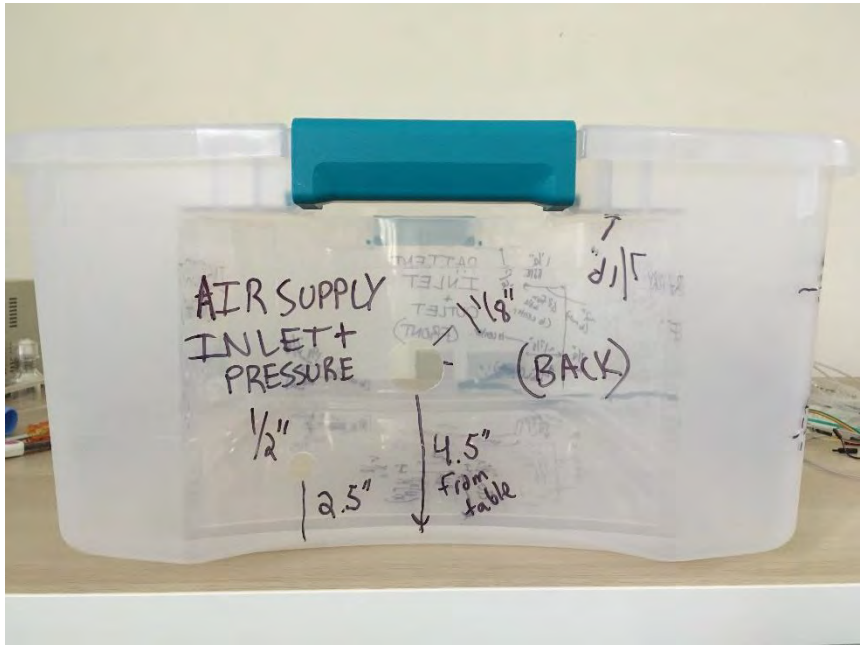




Use dimensions shown in permanent marker here.
- tip: start with small drill bit and work your way up to larger. Or use a “step drill”.

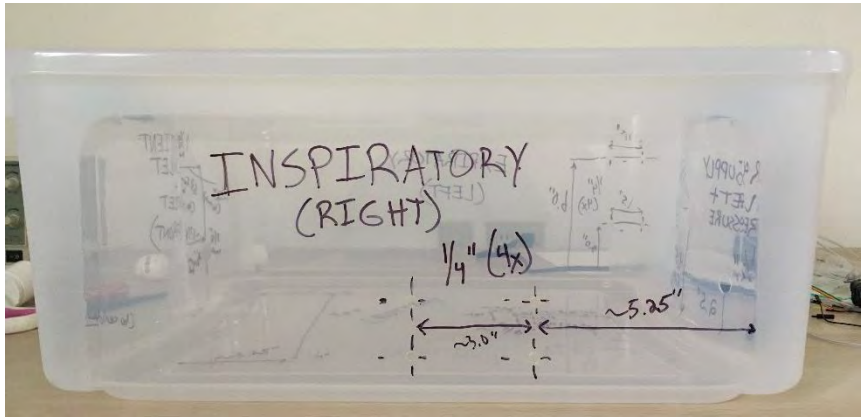
PV-PN-A14 – plastic enclosure full assembly – STEP 9: drill more holes in the box

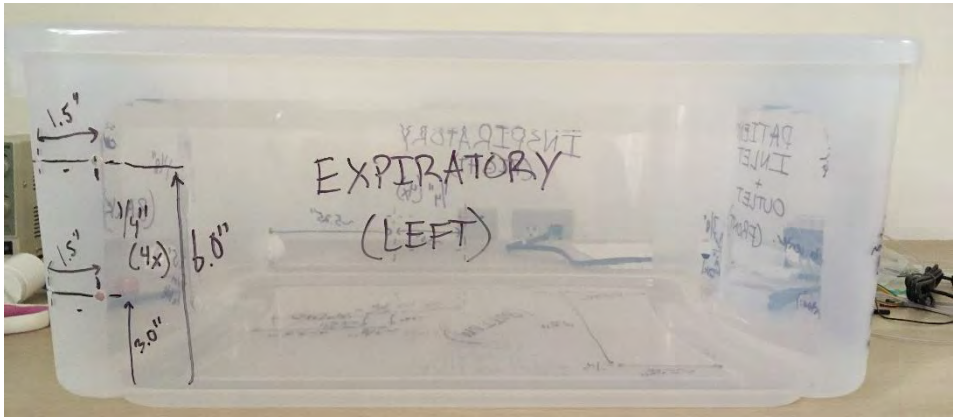




Use dimensions shown in permanent marker here.
- tip: start with small drill bit and work your way up to larger. Or use a “step drill”.

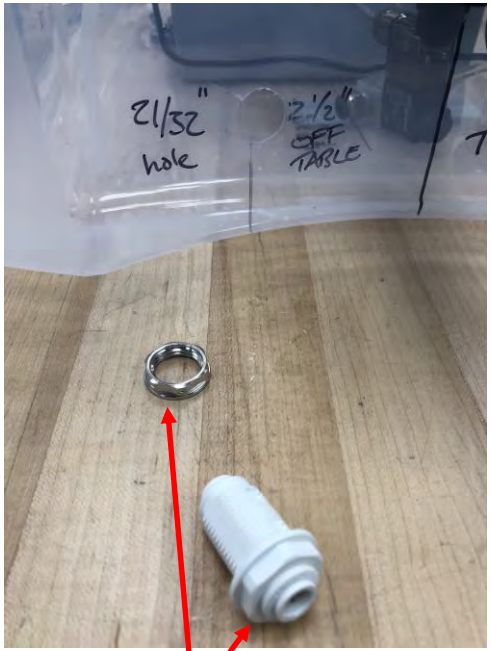
PV-PN-A14 – plastic enclosure full assembly – STEP 10: drill more holes in the box





Use dimensions shown in permanent marker here.
- tip: start with small drill bit and work your way up to larger. Or use a “step drill”.

PV-PN-A14 – plastic enclosure full assembly – STEP 11: insert bulkhead push-to-connect

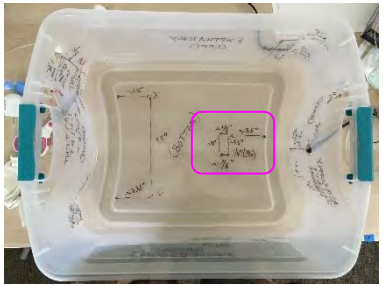


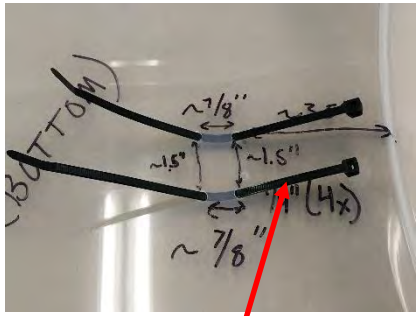
PV-PN-097

Use dimensions shown in permanent marker here.
- tip: start with small drill bit and work your way up to larger. Or use a “step drill”.

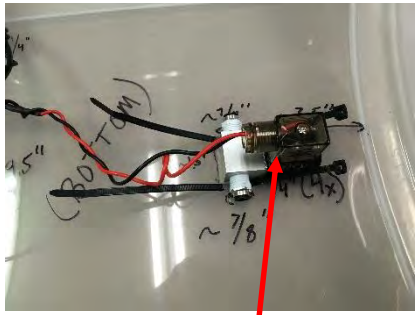
Note: PV-PN-268, PV-PN-269, and PV-PN-099 (NPT-to-male DISS) are needed to connect to a female DISS connector coming from an oxygen supply.

PV-PN-A14 – plastic enclosure full assembly – STEP 12: zip tie in the solenoid wiring harness.

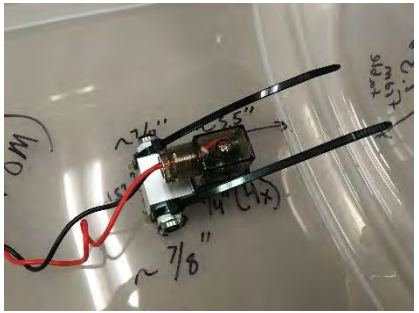


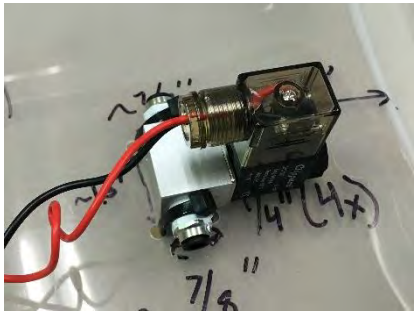


PV-PN-244



PV-PN-A15





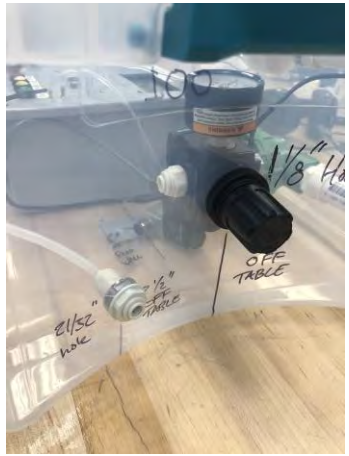
Snip ends of the zip ties off for a cleaner layout.

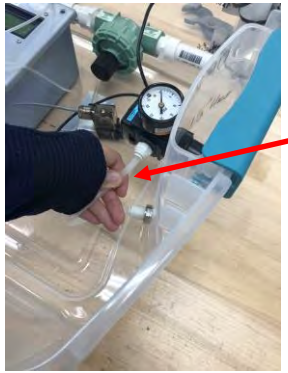
PV-PN-A14 – plastic enclosure full assembly – STEP 13: install regulator and plug in tube.

PV-PN-007

In subassembly:

PV-PN-A06

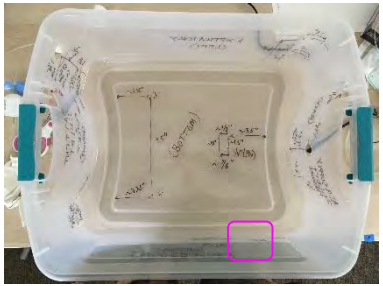


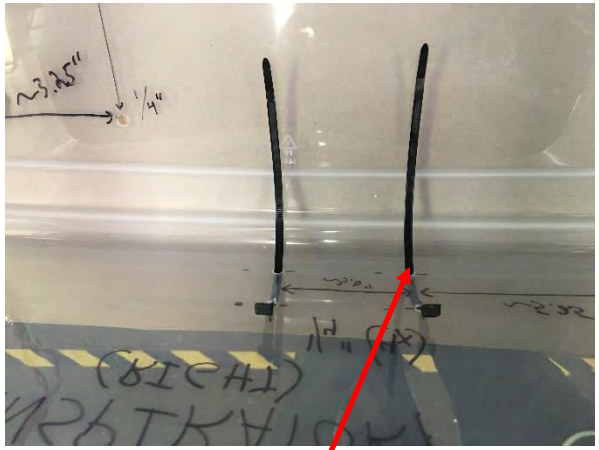


PV-PN-096

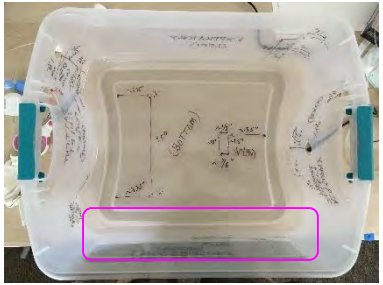
Push tubing from regulator into the connection on the tub

PV-PN-A14 – plastic enclosure full assembly – STEP 14: add zip ties to assembly.



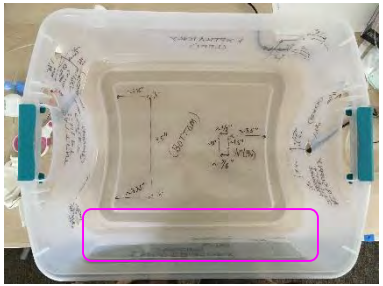


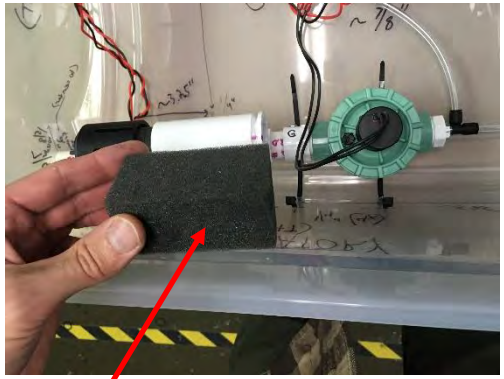
PV-PN-A14 – plastic enclosure full assembly – STEP 15: add the inspiratory limb to the assembly.

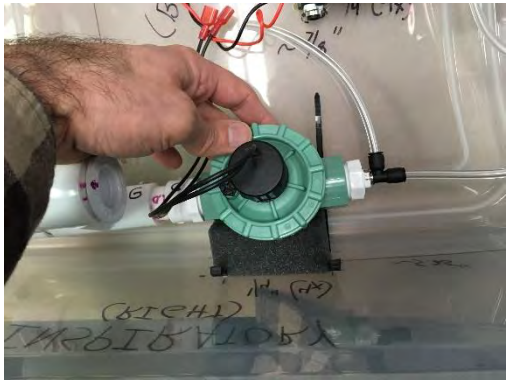


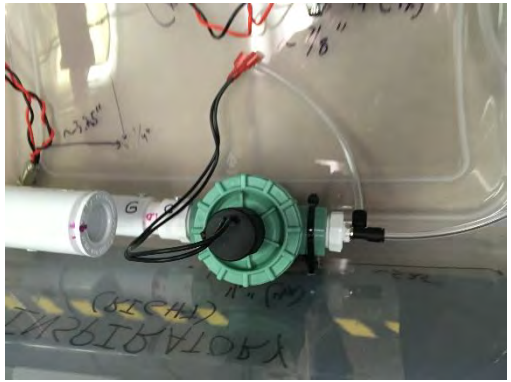
Push outlet through the hole in the tub first.

PV-PN-A14 – plastic enclosure full assembly – STEP 16: place optional supportive foam in behind valve.



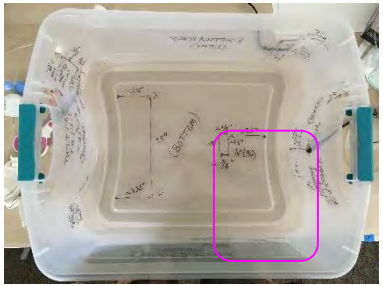


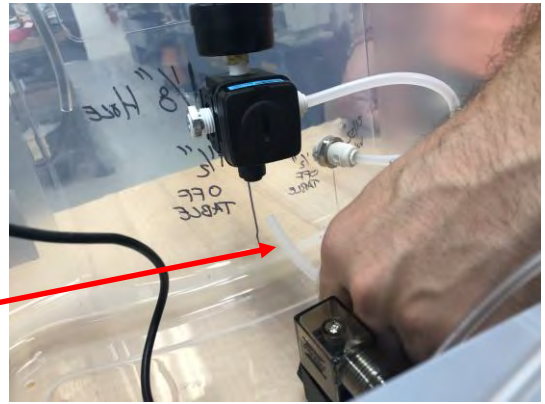


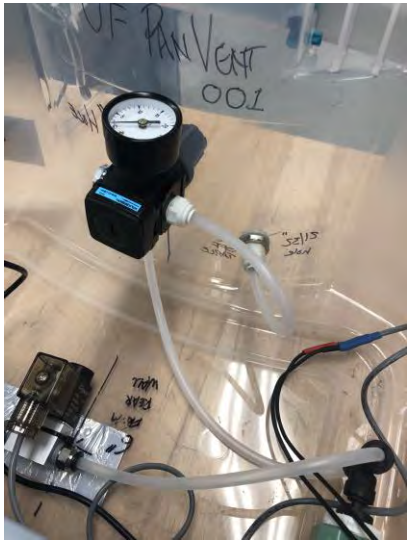


Ensure the Orbit valve rests in the VERTICAL orientation.

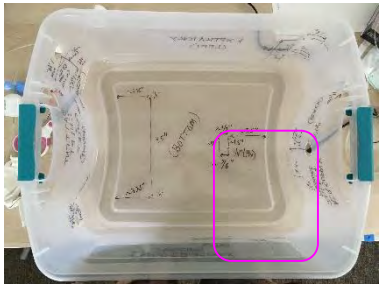
PV-PN-A14 – plastic enclosure full assembly – STEP 17: plug tube into regulator.

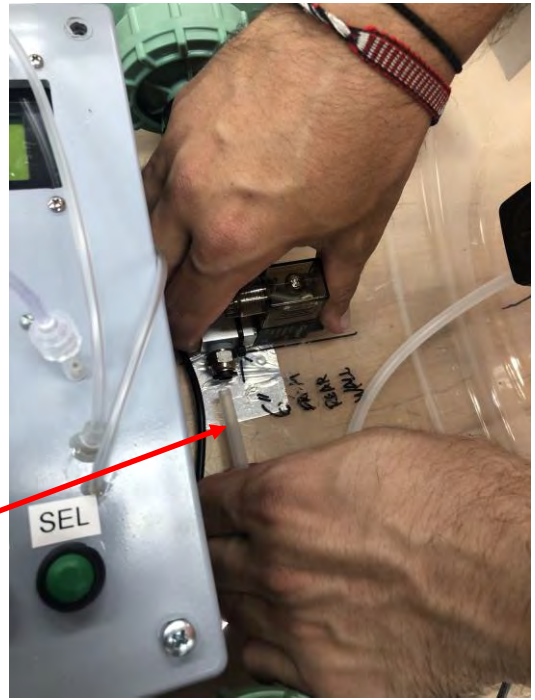




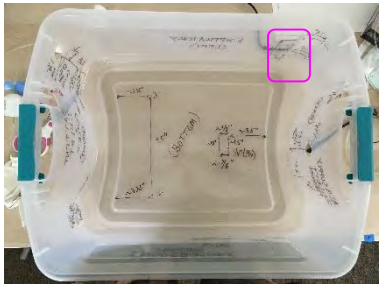


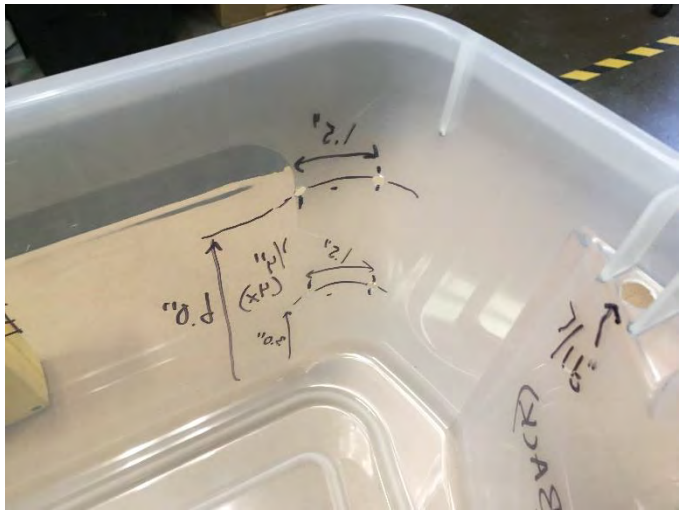
PV-PN-A14 – plastic enclosure full assembly – STEP 18: plug tube into valve block

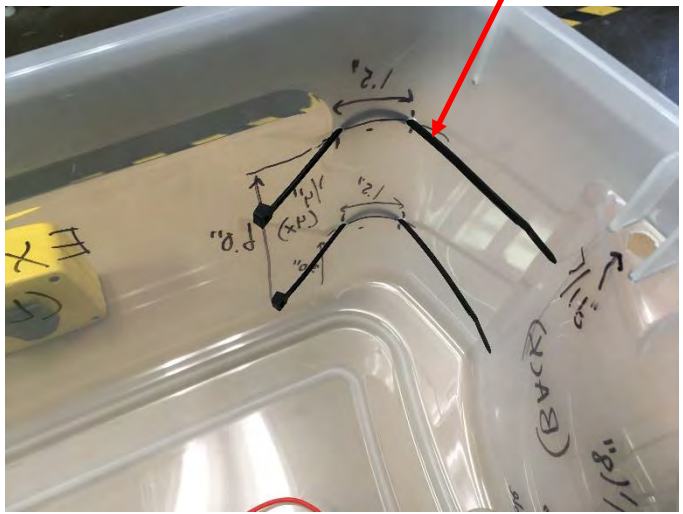




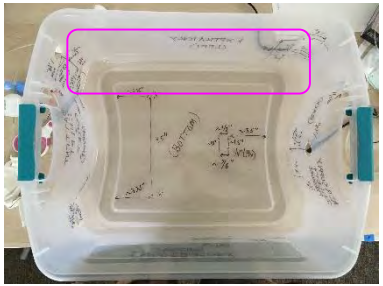
PV-PN-A14 – plastic enclosure full assembly – STEP 19: add supportive zip ties to corner



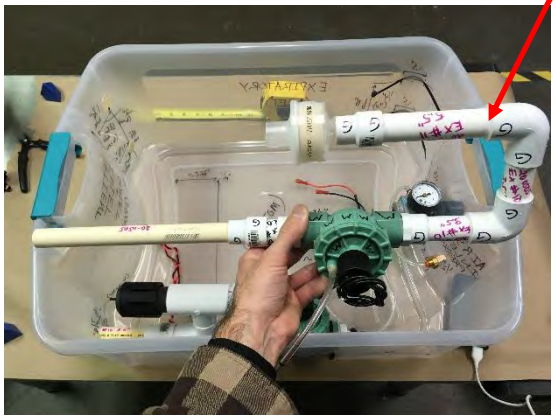




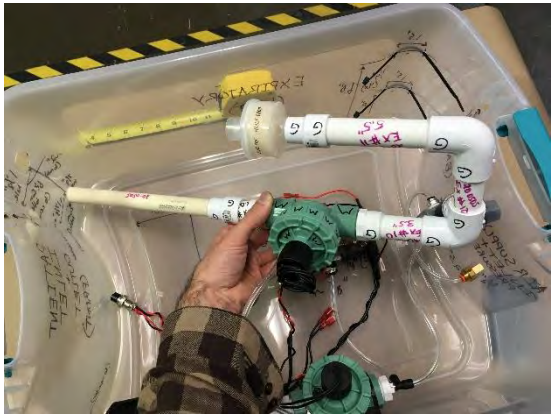
PV-PN-A14 – plastic enclosure full assembly – STEP 20: add expiratory arm to assembly



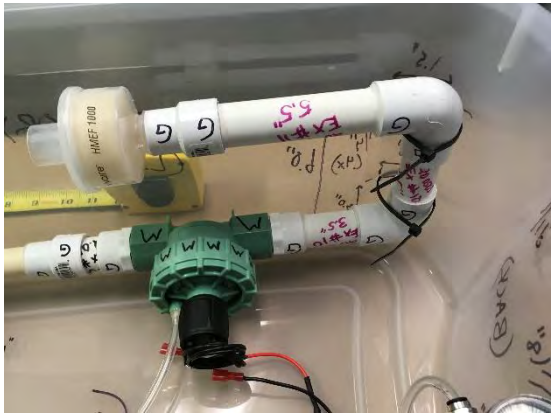
PV-PN-A02



Note that the flow meter assembly is not installed yet

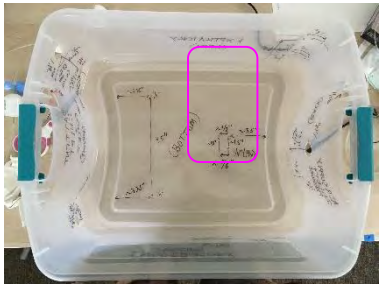


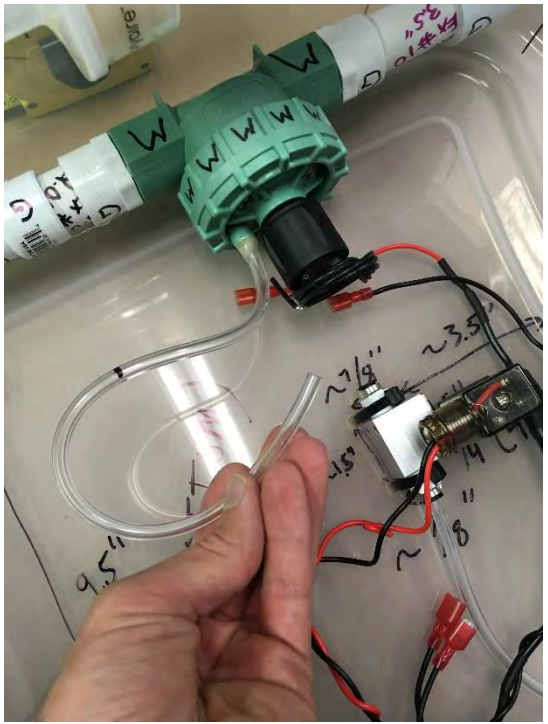
Put the CPVC tube in first

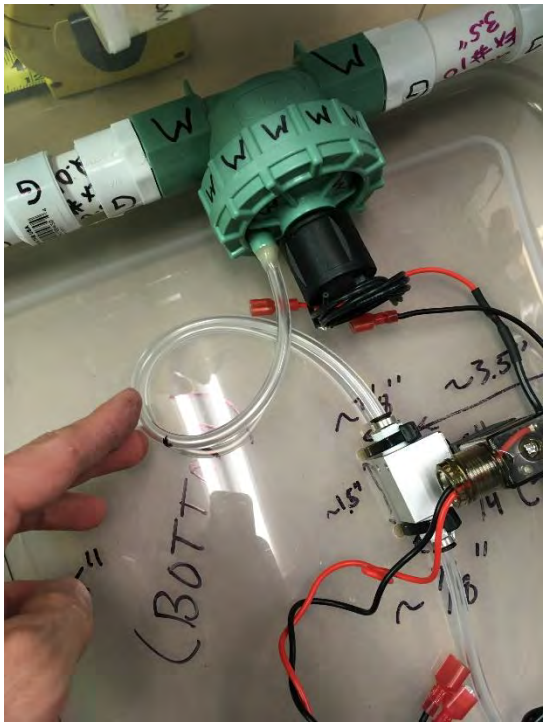


Secure with zip ties.

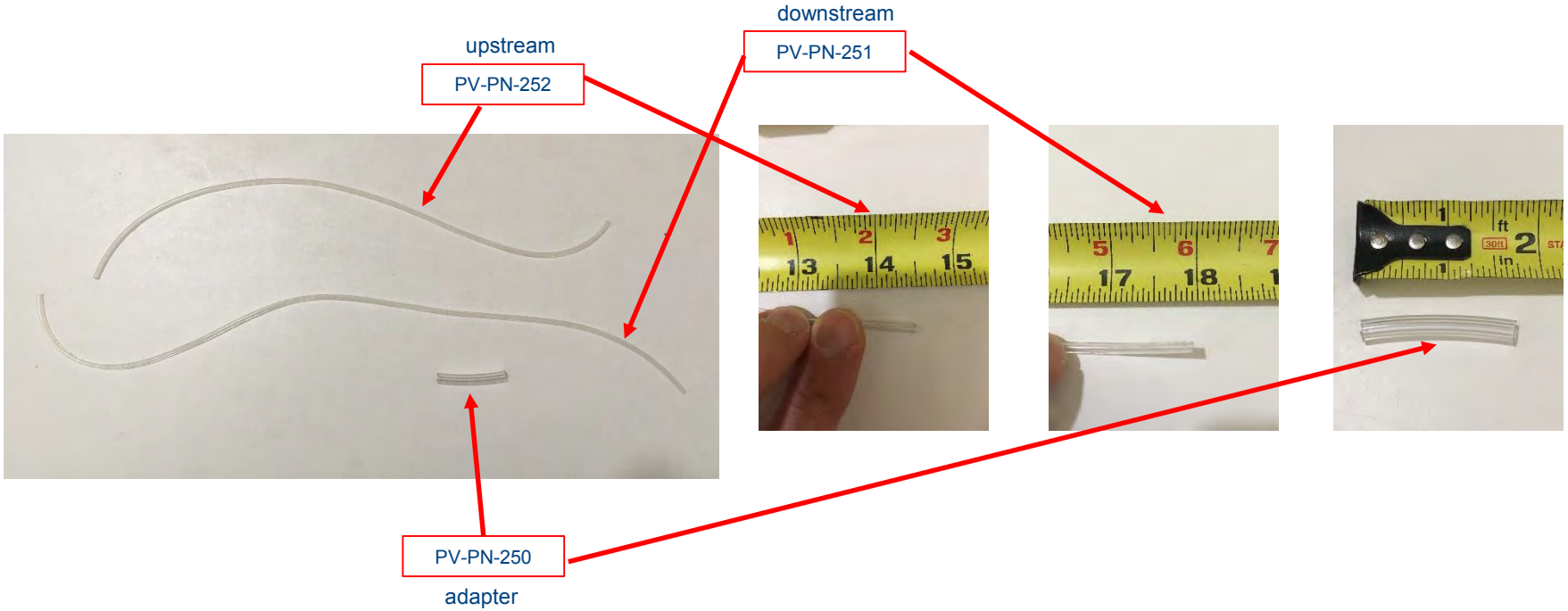
PV-PN-A14 – plastic enclosure full assembly – STEP 21: plug in tube to valve block



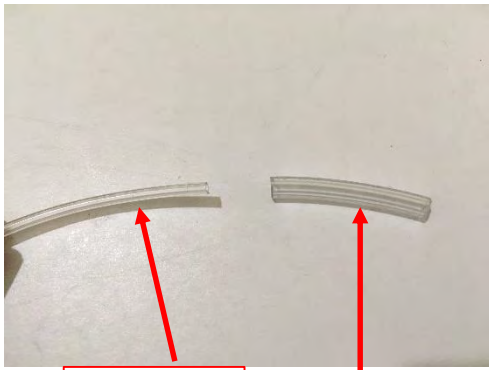




PV-PN-A14 – plastic enclosure full assembly – STEP 22: size and cut flow meter connection tubes.



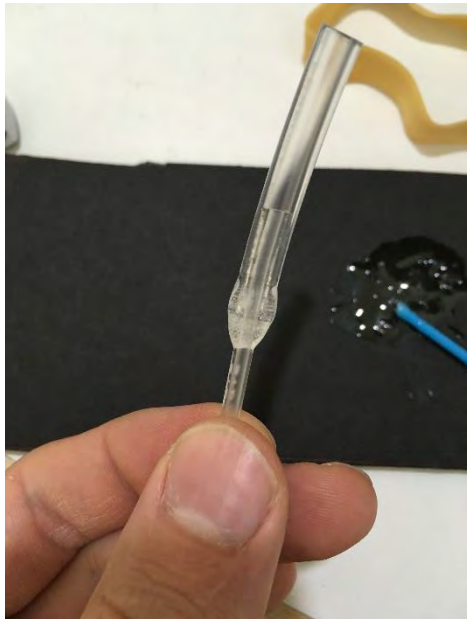
PV-PN-A14 – plastic enclosure full assembly – STEP 23: glue adapter tube to the downstream tube



PV-PN-251

PV-PN-250

PV-PN-224



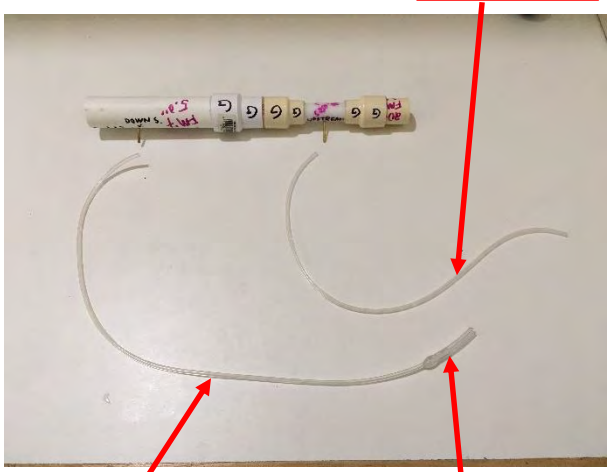
PV-PN-A14 – plastic enclosure full assembly – STEP 24: push plastic tubes onto the brass tubes.

Be very gentle or you might push the brass tube in too far.

Triple check the end of the brass tubes is still in the middle of the PVC pipe.

upstream

PV-PN-252



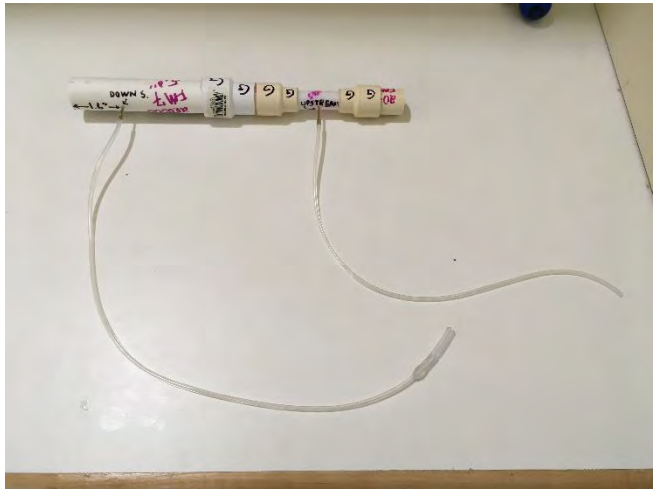
PV-PN-251

downstream

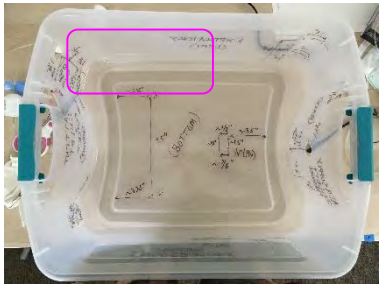
PV-PN-250

adapter

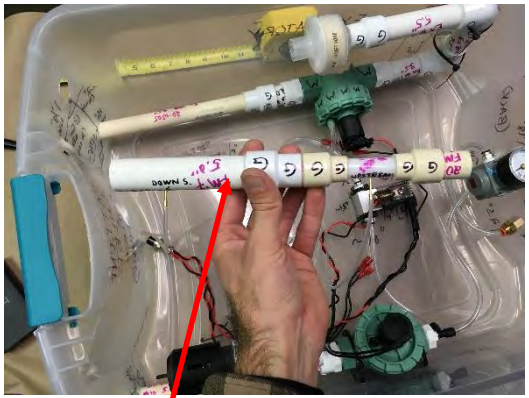
Be very gentle or you might push the brass tube in too far.



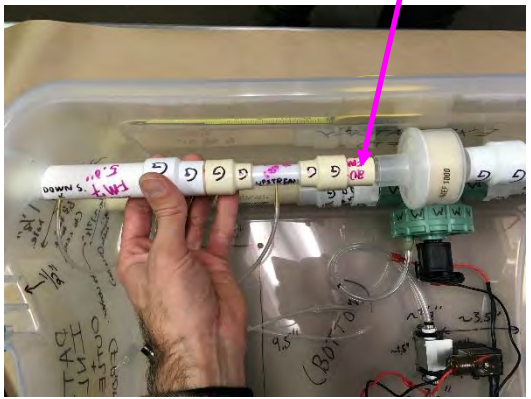
PV-PN-A14 – plastic enclosure full assembly – STEP 25: add the flow meter assembly to the main assembly.

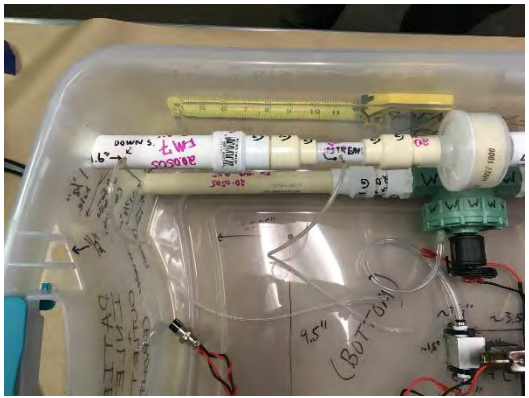


PV-PN-229

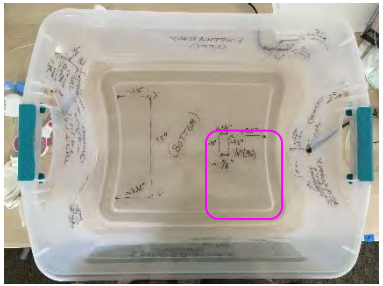


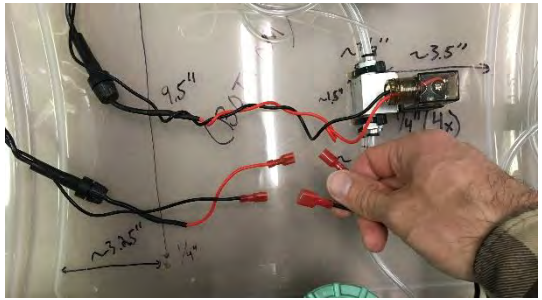
PV-PN-A10

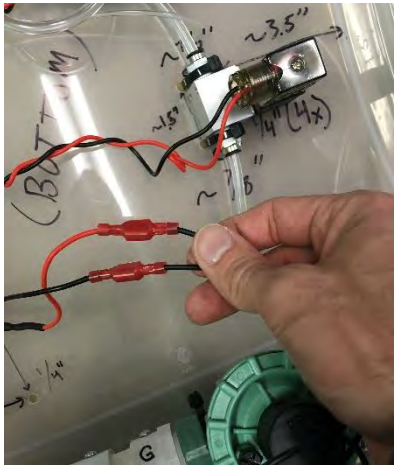




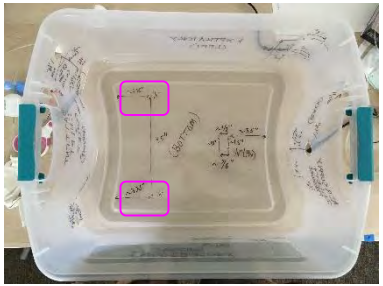
PV-PN-A14 – plastic enclosure full assembly – STEP 26: connect the harness to the inspiratory valve.

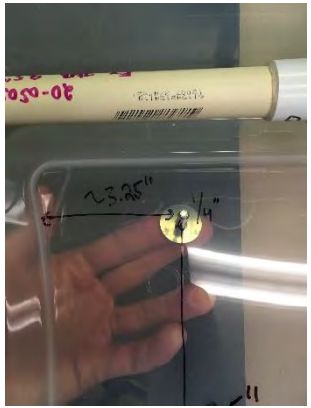


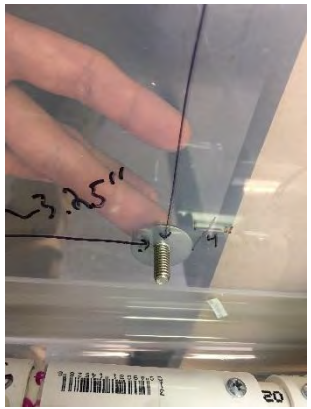




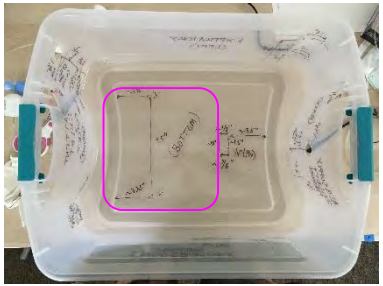
PV-PN-A14 – plastic enclosure full assembly – STEP 27: preinstall the hardware to attach controller box.

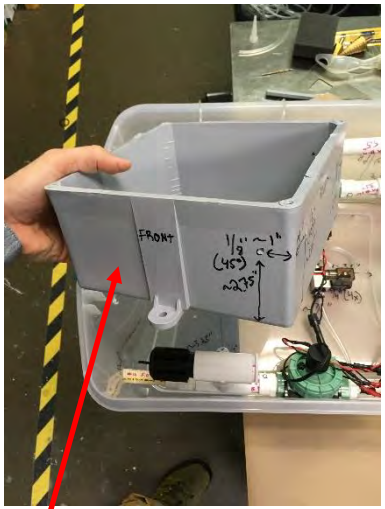


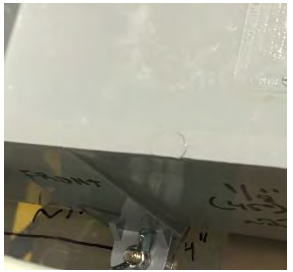




PV-PN-A14 – plastic enclosure full assembly – STEP 28: place bottom of controller box in tub.



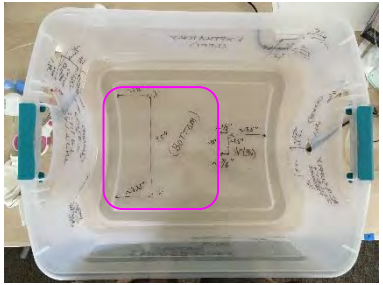




PV-PN-209 (part of PV-PN-A13)

Tighten from bottom of tub.

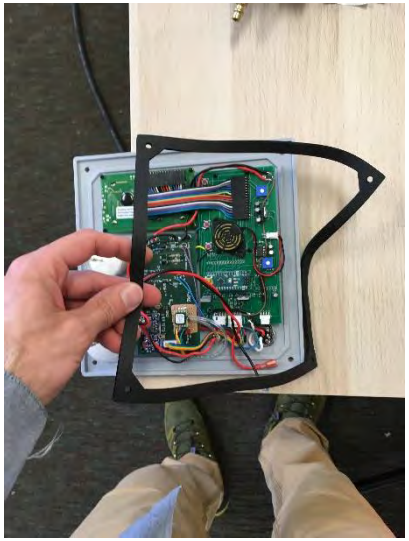
PV-PN-A14 – plastic enclosure full assembly – STEP 29: secure battery in the bottom of the controller box.



or

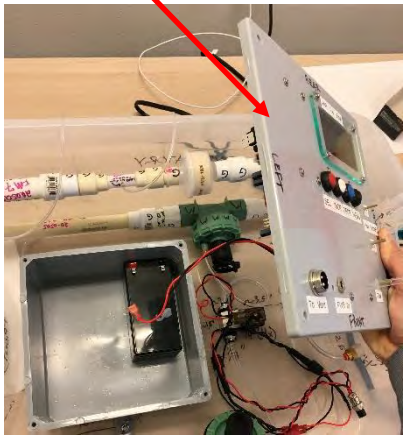
PV-PN-223

PV-PN-299

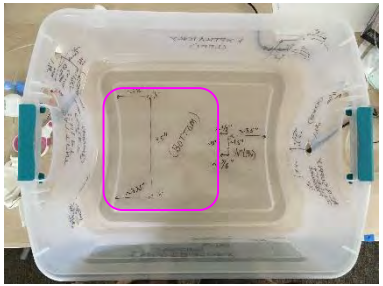


Connect the battery wires from the top of the controller box to the battery before closing the thing up.

PV-PN-A13

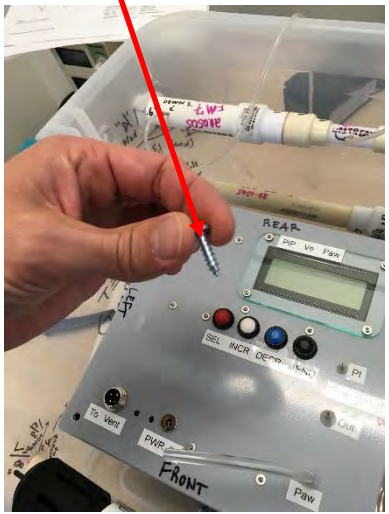


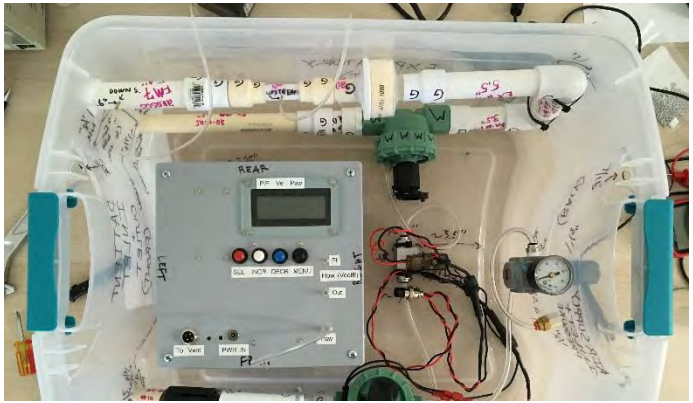
PV-PN-A14 – plastic enclosure full assembly – STEP 30: screw down the top of the controller box.



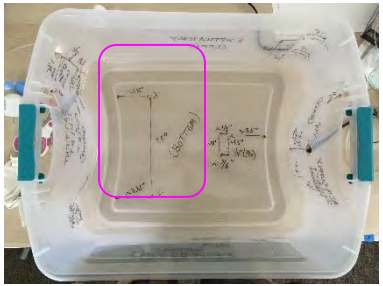
These are included with the box

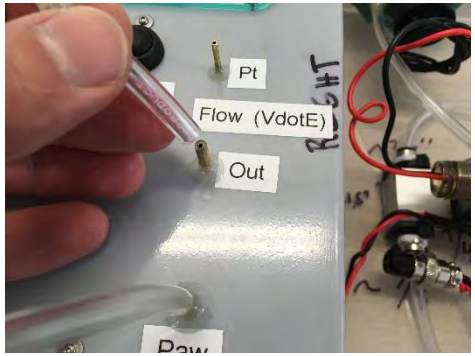
PV-PN-209



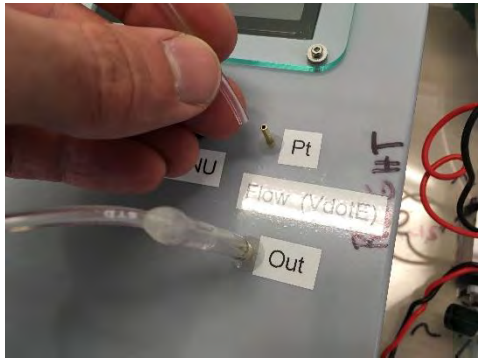


PV-PN-A14 – plastic enclosure full assembly – STEP 31: connect the flow meter tubes to the box



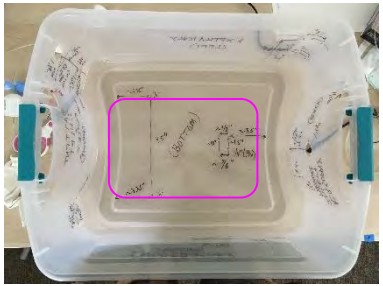


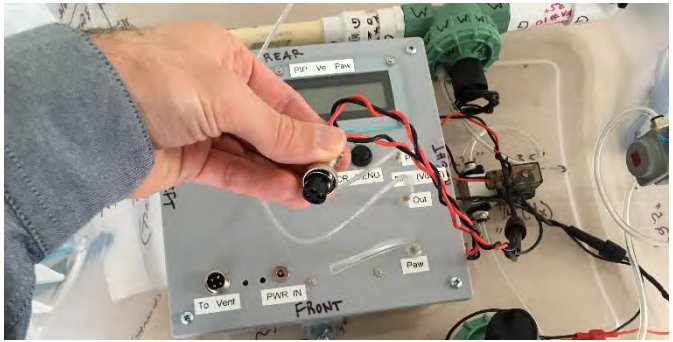
Upstream → “Out”



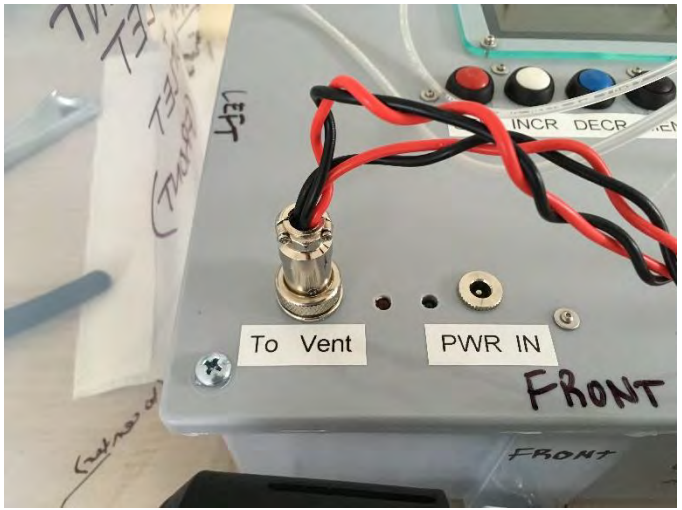
downstream → “Pt”

PV-PN-A14 – plastic enclosure full assembly – STEP 32: connect solenoid wiring harness to controller box.

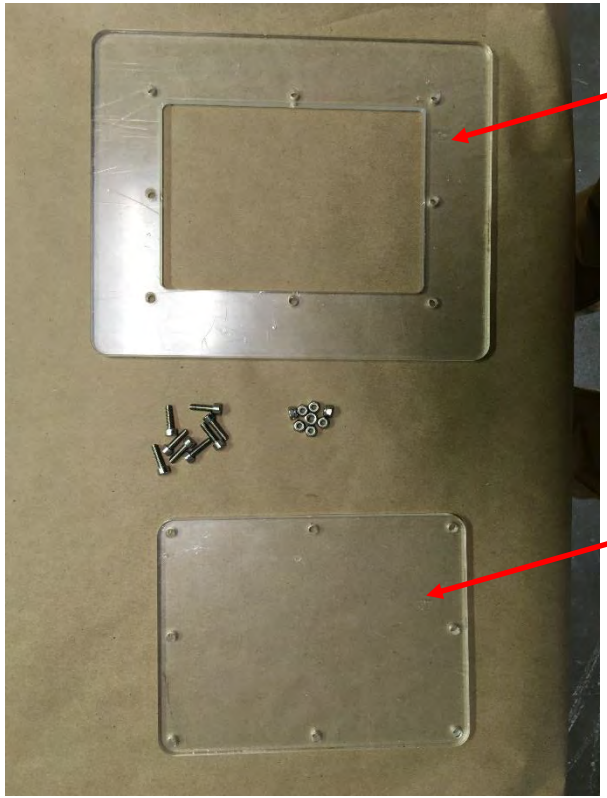




Sometimes it take a push to get the plug to go in. Screw down ring to secure.



PV-PN-A14 – plastic enclosure full assembly – STEP 33: create jig and window using acrylic.



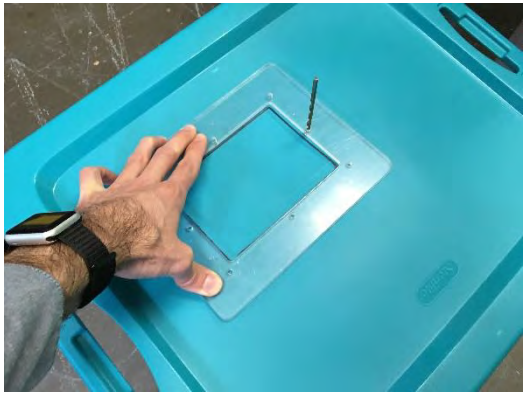
PV-PN-T202

20-0515_20_window_jig_for_enclosure_v1_t1.dxf

PV-PN-243

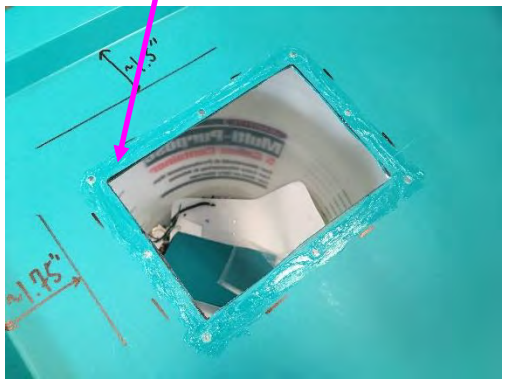
20-0515_20_window_for_enclosure_v1_t1.dxf

PV-PN-A14 – plastic enclosure full assembly – STEP 34: drill hole in tub top

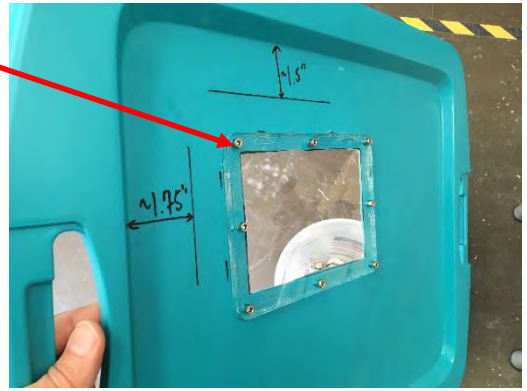


PV-PN-A14 – plastic enclosure full assembly – STEP 35: Apply silicone adhesive and bolt window down.

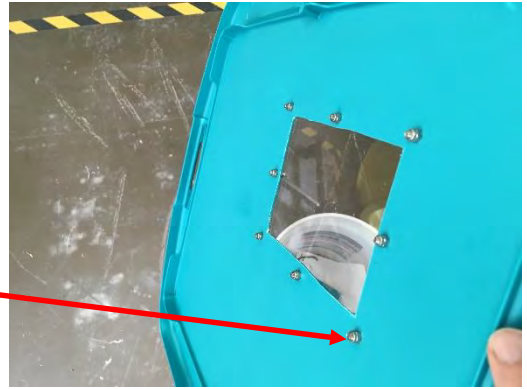
PV-PN-229



PV-PN-258

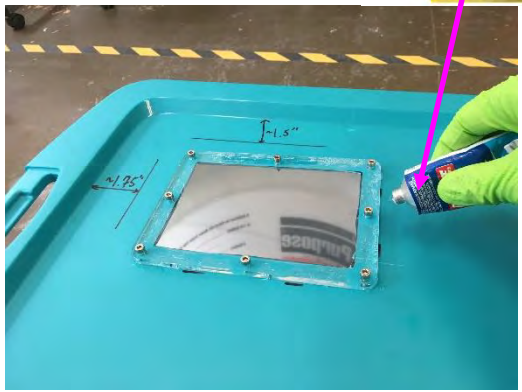


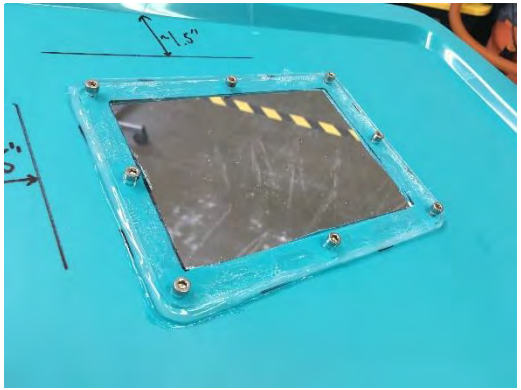
PV-PN-259



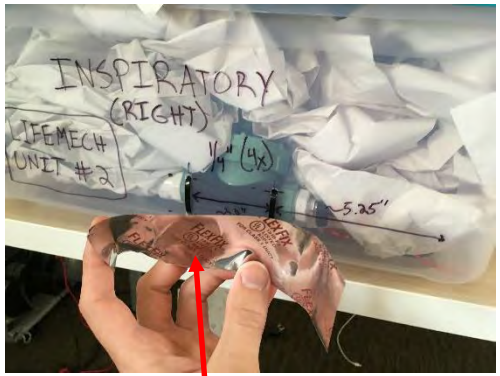
PV-PN-A14 – plastic enclosure full assembly – STEP 36: apply adhesive around the window to seal it.

PV-PN-229



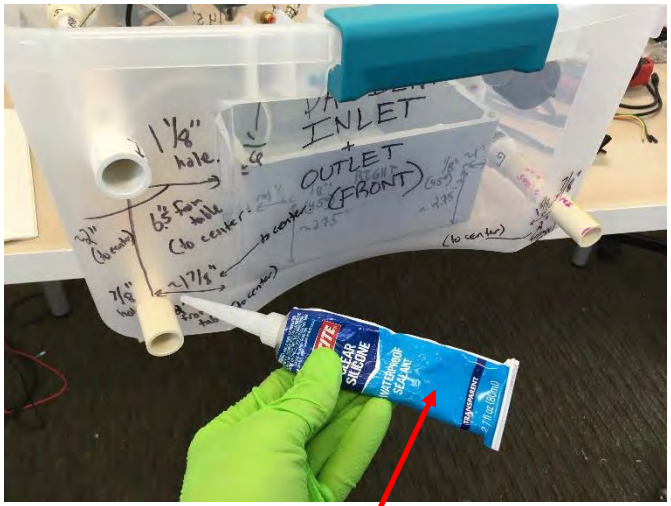


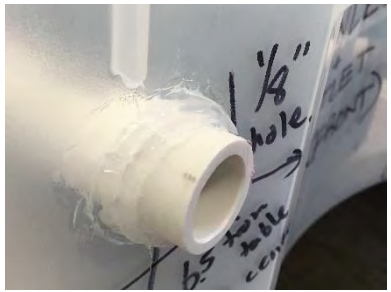
PV-PN-A14 – plastic enclosure full assembly – STEP 37: apply sealing tape over the holes in the box.

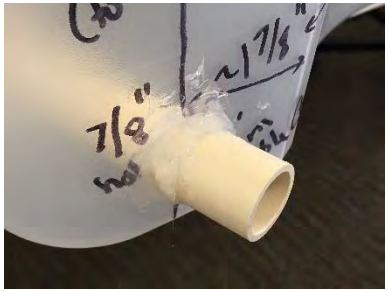


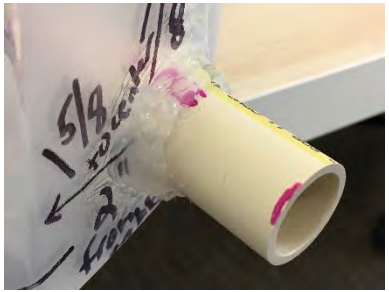
PV-PN-245

PV-PN-A14 – plastic enclosure full assembly – STEP 38: add silicone adhesive around protruding tubes









PV-PN-A14 – plastic enclosure full assembly – STEP 39: add power supply and cable

PV-PN-253

PV-PN-254

FEED POWER SUPPLY CABLE THROUGH THIS HOLE. I THINK A SECOND HOLE WILL BE NEEDED TO ZIP TIE THIS IN PLACE.

COMPLETED ASSEMBLY!