

DISCLAIMER: This UVC system is a homemade device that is being utilized to help mitigate the risk of COVID19 in office spaces. I built these because comparable systems took too long to be received (wait time of most UVC manufacturing plants at the time of this writing is greater than 10 weeks). Additionally, some businesses cannot afford those UVC systems from those other companies. As such, an affordable and quickly buildable UVC system was needed. You should note that COVID19 has not been explicitly shown to be killed by UVC. This is because research has not been conducted on this yet - Surrogates of COVID19, such as the original SARS virus, are inactivated by UVC energy.

The UVC lamps installed in this unit are comparable to a unit that passes the same CFMs through it. UVC energy is DANGEROUS to your health, skin, eyes etc and should be treated with respect. Do NOT install these units below a height of 7 feet. Also, ensure that the openings of the unit are away from any individuals, pets, plants, etc. If you want to be doubly sure that there is no UVC exposure to you or anyone else, invest your money and get a UVC meter.

I do not make any claims about the safety of this device with regards to upper air treatment nor do I make any claims of safety (although I am a safety freak, I encourage you to validate my work to ensure that it works to your satisfaction.

The last thing you should know is that UVC damages plastics. It is estimated that plastics lose about 10% of their life expectancy with UVC exposure. So, if you have any plastics in the way of the UVC device, you have been warned.

On a final note, this build assembly is being published after 1 month of observation on the performance of our UVC systems. While this should not be used to imply reliability, I did not want to just make something and then throw it online immediately.

A word of warning: this unit has substantially more UVC output than the smaller UVGI system published earlier. It is estimated that direct exposure to the lamps will result in skin / eye damage in approximately 20 seconds. These units do not contain safety interlocks. So when you are cleaning or servicing the unit ensure that the unit is fully unplugged to prevent exposure.

Component cost: Approx 530-550 USD as of 1/27/2021 (excludes tools/fasteners)
Air volumes treated: ~450-470 CFM on 50%, ~730-790 CFM on 100%

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** Denotes optional component

Components:

- Lund Aluminum Box (180 USD): <https://amzn.to/3a6Fd8a>
- Cloudline 8 inch inline duct fan (170 USD): <https://amzn.to/2YlnRyW>
- Lithonia Lighting Dual T8 Fixture (30 USD – **You will need two of these**): <https://amzn.to/3r07QKL>
- **AU-LG30T8** 36 inch 30.5 Watt UVC Bulbs (20 USD as of 1/27/21 – you will need 4 of these, but I would recommend you get extras): <https://tinyurl.com/ngu9xdj>
- 150 feet foil tape (11 USD): <https://tinyurl.com/yyaxqnl>
- 8 inch starting takeoff collar (6 USD): <https://tinyurl.com/ybnlarme>
- 8 inch 90 degree adjustable elbow (If doing on wall install – see page 10 for photos. 8 USD): <https://tinyurl.com/y2x3gqc9>
- 12 inch stainless steel shelf bracket (15 USD): <https://tinyurl.com/yxayy72f>
- Black Spray Paint (6 USD): <https://tinyurl.com/y4lywhoy>
- Pan head cabinet screws (12 USD): <https://tinyurl.com/1gliucrw>
- UVC warning sign (8 USD): <https://tinyurl.com/1anfs5gn>

- ******½ inch Plain Sight Glass (11 USD): <https://tinyurl.com/y4ggt32u>
- ******Louvered vent (if doing in closet / in cabinet install – see page 11 for details. 15 USD): <https://tinyurl.com/qjnysdnc>

You will also need the following tools / fasteners if you do not already have something comparable:

** Denotes optional component

- 7 Inch Wire Strippers (12 USD): <https://thd.co/2YivoOL>
- Stepped Bit Set (30 USD): <https://tinyurl.com/y6cuxgfl>
- #8 x ½ inch self tapping screws (100 pieces for 6 USD): <https://tinyurl.com/yxnosac3>
- ¾ inch truss head self tapping screws (100 pieces for 10 USD): <https://tinyurl.com/y647a86r>
- 1/2 in. 2 Screw AC/MC/MCI-A/NM Connectors, 100-Pack (75 USD – you don't need 100, just a few): <https://tinyurl.com/y5myptzx>
- 10 foot 18 gauge 3 prong computer cable (7 USD – you will need two of these): <https://tinyurl.com/y2anm8r8>
- 8 inch hole saw (32 USD): <https://tinyurl.com/y33f7uph>
- B-Connectors (100 pieces for 12 USD): <https://tinyurl.com/y59wetnk>

- ******Straight cut tin snips (15 USD) : <https://tinyurl.com/yyklymq9>
- ******HVAC Anemometer (57 USD): <https://tinyurl.com/y324ar8e>
- ******GeneralTools UV512C UVC Meter, 220-275nm (470 USD): <https://tinyurl.com/yxtl35fr>
- ******Cordless power drill and associated drill bits (60 USD): <https://tinyurl.com/yyzy7j9d>
- ******Assortment of wire nuts (12 USD): <https://tinyurl.com/yxnshbqr>
- ******Drill Side Handle (30 USD): <https://tinyurl.com/y657g3he>
- ****** Non-Contact Voltage tester (17 USD): <https://tinyurl.com/12u4sng8>

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Instructions for construction:



- 1) Drilling the fan and air exit holes: Open the lid to the box and place the inline fan assembly into the box. Center the fan in the side of the box. Then, using a sharpie or some other marker, mark at least half of the circle to the inside of the box. This arc will become part of the template for your hole saw. Do this on BOTH sides of the box.
- 2) Once you have transferred your marking, remove the fan and take your 8 inch hole saw and attach it to your drill. You want to use a side handle with your drill to give you more stability. Make sure the pilot drill is attached to the arbor as shown in the photo.



Orient the hole saw such that the upper curve of your marker matches the curve of the hole saw. Once you are satisfied, drill into the side of the box from the inside such that the arbor drill bit pokes through the outside of the box. This will be used to guide the hole saw from the other side of the box.

- 3) Set your drill to medium speed. Double check your side handle on your drill. **Put on your safety goggles** as this step will produce aluminum shavings. **CAREFULLY**, with two hands on your drill (one on the drill itself and one on the side handle) begin drilling with the hole saw from the outside of the box into the inside of the box. Hold the hole saw slightly above the surface so that the hole saw does not get caught in the side of the box. **Do not try to push through the side of the box too quickly**. There is a lot of surface area here for the hole saw to get through and the hole saw suddenly stopping / binding down can easily damage your wrist. Continue until the first hole is made.
- 4) After the first hole is made, carefully remove any aluminum chips and remove the aluminum disk that you cut out. Be careful as the edges will be sharp. Flip the box over and repeat the process to cut the second hole out of the other side of the box.
- 5) Now that both ends have holes cut out, ensure that the inside of the box is clean and free from any aluminum chips. On the air intake side of the box (whichever side you choose), insert the fan into the box press the body of the fan tightly possible into the side of the box where you just cut the hole. Note the fan should be **INSIDE** the box (see page 6 for an overview diagram). **Do not shove the fan to fit in the box** as you can compress the fan against the fan housing.
- 6) Insert the two light fixtures into the box and roughly position them near the center of the box. Give spacing between the two fixtures to maximize the light intensity over the diameter of the air column in the box. **Don't secure the lights just yet**. We need to wire them up first. We are only placing them in here for fitment purposes before screwing the fan into position.



- 7) Note the position of the fan. Then, from the underside of the box, drill four self tapping screws through the underside of the box until it engages and eventually drills through the metal plate that the fan is connected to.



8) With the fan secured, let's prepare the light fixtures. Remove the two light fixtures from the box and

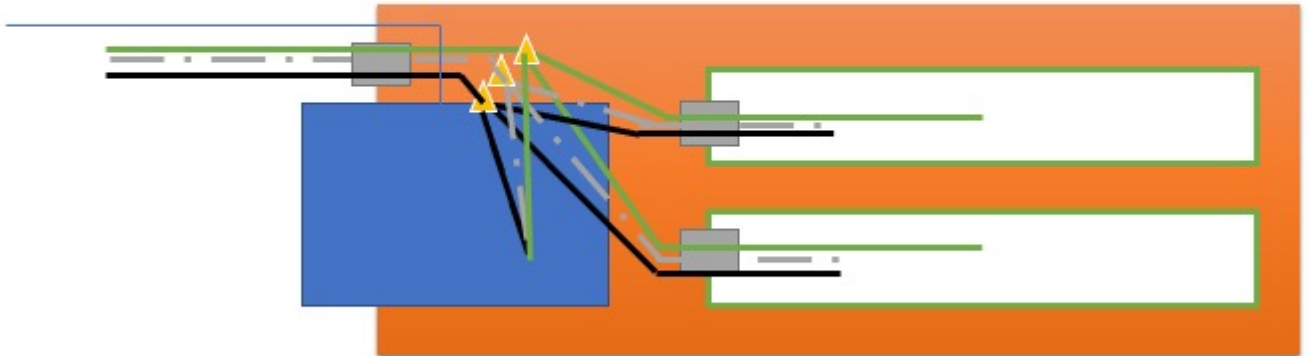


place them on a work bench. Cut the end off of one of the computer cords. Strip the ends using the wire strippers. Use the inner most part of the strippers to lightly score the wire so that the outer jacket can be removed. Then, strip the individual wires using the appropriately sized “teeth” of the stripper. Give yourself about an inch of stripped space on each line. Set this wire aside – we will use this as the main power cord to the box lights.





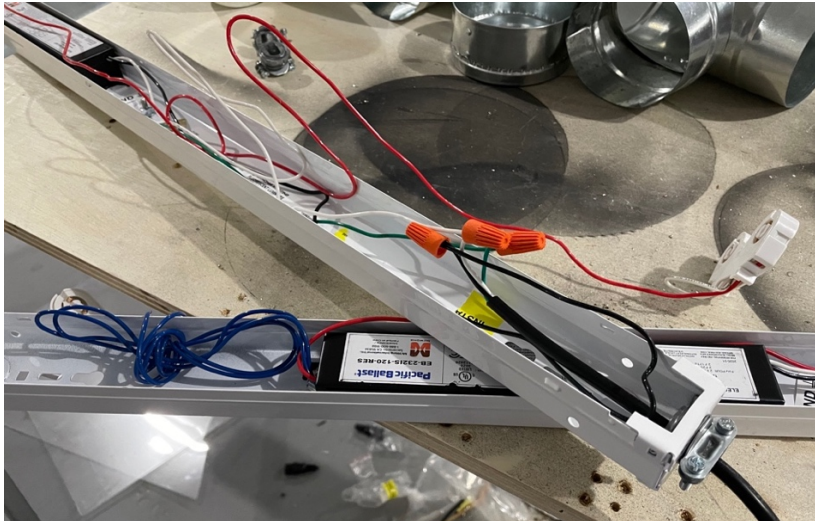
- 9) Cut the end off of a second computer cord. Then measure a 3 foot piece of computer cable. Cut the cord again with the wire strippers. Strip the wires as described above. Repeat this again so that you have two small 3 foot pieces of wire with stripped ends on either side. These small pieces of stripped wire on both ends will act as a “jumper” to connect the light fixtures to the first wire prepared in step 8. See the diagram below for details.



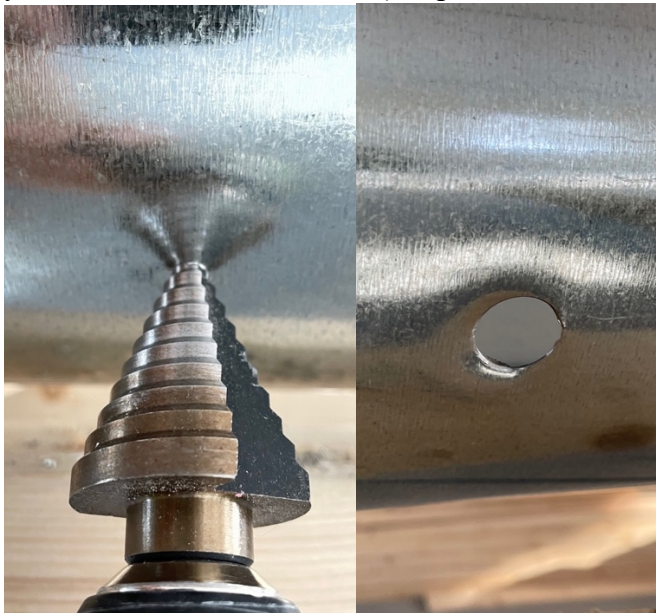
Lightbox wiring diagram. Legend: Blue box – fan; Orange box – aluminum box; Green boxes – light fixtures; Black line – supply (“hot”); Grey dashed line – white “neutral”; Green line – ground (“earth”); Yellow triangle – wire nuts; Thin blue line – fan power control cable; Gray boxes – wire connector.

- 10) Turning our attention to the fan briefly, cut the power cable of the fan off using the wire strippers, leaving a 3 foot lead from the fan body. Strip the power cables and ends as per step 8. We will be attaching the fan, the light fixtures, and the long wire from step 8 together (see the lightbox wiring diagram above).
- 11) Because of the tight fitment of the light fixtures in the box, we will need to use the knockouts on the end of the light fixture to run our wires through. Using a flat head screw driver and a hammer, knockout the end knockouts on the side FURTHEST away from the ballast (black box in the light fixture – see photo below). Insert a wire connector into the knockout and tighten the collar using your wire strippers. You may have to take the endcap off to do this part. Pass one wire into the box and wirenut the wires to the wires inside the light fixture. Repeat this for the second light fixture. The result should look like the photo below:

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- 12) Install the light fixtures into the box, spacing the fixtures apart as you had previously done in step 6. Using a 5/32nd inch drill bit, drill a hole through one of the mounting holes on each end of the light fixture. Then pass a pan head bolt through the bottom of the aluminum box and use a nut to capture the bolt **inside** of the light troffer. *IMPORTANT: The pan head must be flush with the outside of the aluminum box. If it is not, wall mounting it will be that much harder.* Do this to the second light fixture. This will allow the light troffers to be secured to the box so that they do not move out of position.
- 13) Now we need to prepare the aluminum box. Using the same 5/32nd inch drill bit, drill a hole into the side of the aluminum box near the fan. Enlarge this hole with your stepped bit, drilling from both sides, for your 1/2 inch wire connectors (see photos below for example from the smaller UVGI system).



- 14) We now need to attach the fan speed motor controller to the outside of the box. The fan should have come with two small pan head screws to affix the motor controller. If it does not, your pan head kit should have something to fit the smaller holes of the motor controller. Cut the motor controller wire 3 feet from where it goes into the fan. Then using the small pre-existing hole on the corner of the box (see photo below) pass the motor controller wire from the inside of the box to the outside of the box. Cut the



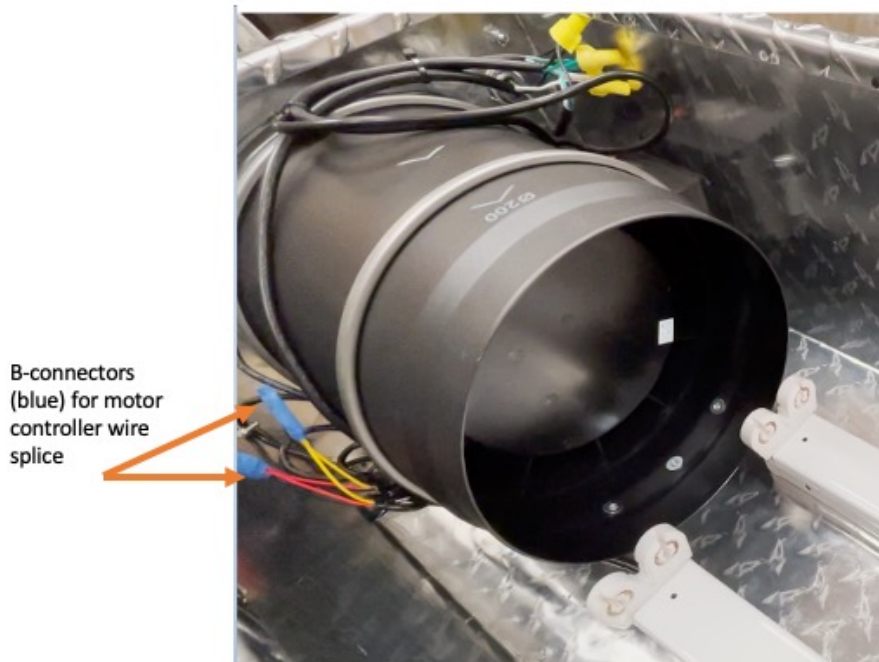
motor controller wire again, leaving a 3 foot lead of wire from the

(Molex connector)

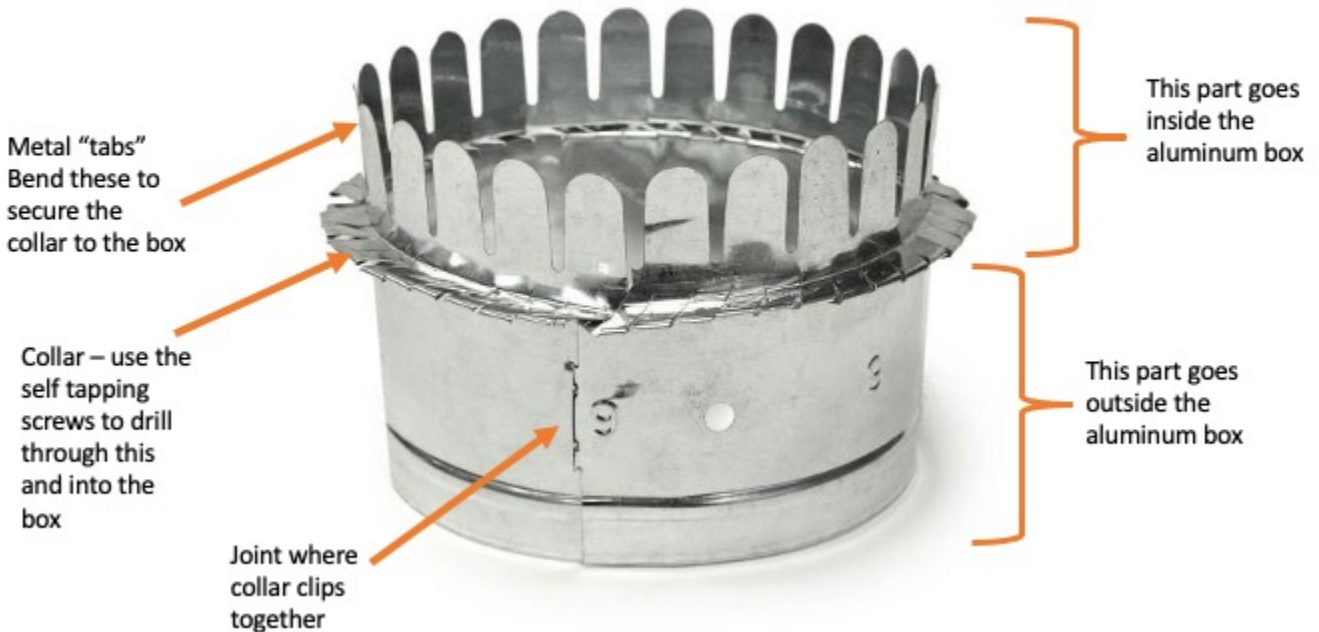
that goes into the motor controller. The mounted motor controller should look like this on the side of the aluminum box (see photo below). **Very important: Offset the motor speed controller the width of the controller from the side of the box.** If you don't you will find it very difficult to attach the mounting brackets when wall mounting. See the reference photo below:



15) On the inside of the box, strip the motor controller wires using your wire stripper. We will now take a few of our B-connectors and splice the individual wires together. If you haven't used a B-connector before, don't worry. All you need to do is insert the individual wires into the box. You don't need to strip the smaller wires inside the motor controller wire. Insert the two wires you wish to splice into the open end of the B-connector. Push firmly until the wire is inserted into roughly the length of the B-connector. Grab a pair of pliers and crimp the B-Connector down. This will allow the small teeth inside the B-connector to grab onto the wires and make the connection between the two wires. The result will look like the reference photo below:



16) Now that the light fixtures are secured, it's time to attach our starting takeoff collar. The starting takeoff collar allows us to interface the unit with any ducting if such is necessary. Insert the tabbed end of the collar into the side opposite of the fan. Bend the tabs so that they fit against the interior side of the aluminum box. Note: some of the tabs will get in the way of the lights. Cut these tabs off with your straight cut tin snips. Then, secure the collar to the aluminum case with two to three self tapping screws. See the photo below for details:



17) Before we get ready to hang the unit, let's doublecheck a few things. Test the unit out by plugging it in. Click the fan speed controller on. It should turn on and the fan speed controller should be able to run the fan at different levels. This is also a good time to verify the CFMs the fan produces using your anemometer. Doublecheck that the light fixtures work **BY USING A REGULAR FLORESCENT BULB – DO NOT USE THE UVC BULBS FOR TESTING**. If you don't have a regular fluorescent bulb, you can use a non contact voltage tester to verify that electricity is present at the light fixture's tombstones. You can also use a multimeter. Finally, ensure that the lid of the aluminum box can close completely. If it cannot, most likely the lid is stuck on the fan assembly or on the starting take-off collar. Use your straight cut tin snips and cut the aluminum box so that the lid fits around these. Now is also a good time to foil tape the wires inside the aluminum box to protect them from UVC exposure.

18) It is time to hang the unit onto the wall. This can be done with one person (ideally two). Preparation is key. First, find a suitable section of wall to hang this unit to. Ideally, you would hang this unit up not near any sprinklers (i.e. more than 8-12 inches away) or other light fixtures, and you have space above 7 feet to install this unit. Find your studs in the wall first. Mark them with a pencil. Once you have that, measure the length of the box and mark out the length of the box, with one edge of the box starting at where you marked your first wall stud. Next, measure the height of the box with the lid open; we are going to offset the brackets so that when the unit is hanging on the wall, the lid can be open. This is so we can service the unit in the future. In general, I offset 5 inches from the height of the box.

When you are ready, install one of your brackets (see below) into the stud using the screws appropriate for your stud type. Then, using your tape measure, measure out the appropriate spot for the second bracket. Most likely you will not have a stud to go into. In that case, you will want to use two toggle bolts.



- 19) Slide the box onto the bracket (if you are doing this alone, prop the box up on your shoulder and walk it up a ladder – it's not heavy, just bulky). Secure the anchors to the box **with ¾ inch** self tapping screws.
- 20) Open the box up. Note the position of the other studs that you had made in step 18. Translate these positions into the box. Drill pilot holes into the box before installing pan head cabinet screws through the box and into the wall studs. This is to doubly ensure that the box does not fall off the wall.

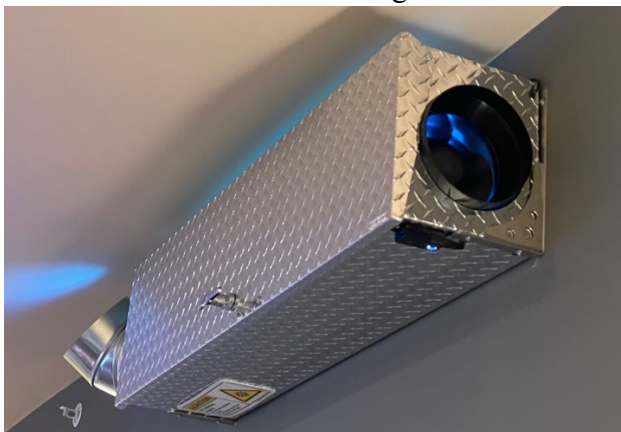


Inside view of the aluminum box. Note, this photo is from an earlier design of the large UVC system when I used 4 individual light fixtures instead of two duplex fixtures. The principal for attaching the aluminum box to the wall, however, is the same.

- 21) If you are using this unit out in the open, you will want to install a 90 degree elbow to point the air stream towards the ceiling. To minimize UVC exiting from the elbow, spray-paint the inside of the elbow black. Install the elbow onto the duct end of the starting takeoff collar and angle the duct upwards towards the ceiling. Secure the elbow to the takeoff collar with ½ inch self tapping screws.
- 22) Install the UVC light bulbs into the troffer. Close the lid of the box. Put your UVC warning sign on the side of the box.
- 23) While standing on the floor, turn the system on and test.

Final installation photos

On wall installation with 90 degree elbow:



In closet installation, no 90 degree elbow, louvered vent:



END OF INSTRUCTION