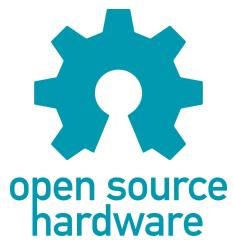


Assembly Manual

M19O2 Oxygen Concentrator



[Maker's Asylum](#) | House Number 661, Mapusa-Moira Rd, Moira, Goa 403507

Release date : 3 Sept 2021

INDEX

1. DESCRIPTION	5
2. INTRODUCTION	6
3. FRAME SUB-ASSEMBLY	7
4. SIEVE SUB-ASSEMBLY	15
5. SURGE TANK SUB-ASSEMBLY	32
6. COPPER COOLING COILS SUB-ASSEMBLY	35
7. COOLING COIL FAN SUB-ASSEMBLY	39
8. COMPRESSOR COOLING FAN SUB-ASSEMBLY	45
9. COMPRESSOR SUB-ASSEMBLY	50
10. ELECTRONICS SUB-ASSEMBLY	54
11. FRONT PANEL SUB-ASSEMBLY	61
12. MOISTURE SEPARATOR SUB-ASSEMBLY	64
13. OVERALL ASSEMBLY	67
14. REPRESENTATION & WARRANTIES	85
15. FAQ	86
16. CONTACT US	87

1. DESCRIPTION

The M19O2 Oxygen Concentrator is designed to provide over 90% concentrated oxygen between 10 to 15 litres per minute. It uses the Pressure Swing Adsorption (PSA) process to trap and remove Nitrogen from ambient air, thereby allowing enriched Oxygen to be available at the output. It achieves this using Lithium based molecular sieve zeolite. The built in 2.4 hp (1.8 kW) high flow rate, oil free compressor provides sufficient capacity for the desired concentrated Oxygen output. Ambient, dry air has a concentration of 78.08% Nitrogen, 20.95% Oxygen, 0.93% Argon, with the balance consisting mainly of CO₂. By capturing this ambient Nitrogen, the concentration of Oxygen can be increased up to a maximum of 95.55% using Lithium based zeolite using the PSA process.

To enable use in high humidity conditions, it incorporates a moisture removal stage with a built-in auto-drain valve. An electro-chemical oxygen sensor is included in line at the output stage to allow continuous monitoring of the concentration. A color coded LED indicator lights red for concentration below 80%, blue for 80% to 90% and green for more than 90% thus visually indicating when it is safe to use the machine even from a distance. The digital display shows oxygen concentration, ambient humidity, ambient temperature, and compressor status (on/off). The compressor can be turned on/off using the push button control on the front panel. The safety emergency switch can be used at any time to turn off the machine instantly. The front panel also has a 10 Amp fuse (5x20 mm) for protection in case of over current faults. Inside the machine is a pressure overload switch adjusted to switch off the compressor if pressure exceeds a safe limit. The machine is built on a rigid, aluminum extrusion frame with acrylic and composite aluminum panelling suitable for use in hospital environments. A tilt handle and two caster wheels allow the machine to be tilted and moved around easily. The machine can be powered from a standard, 230 V / 16 A socket outlet.

The M19O2 Oxygen Concentrator is a result of the collaborative effort of the M19 Collective - a collection of makerspaces, community organisations, foundations, industries, universities, researchers and individuals making a collaborative effort to foster open innovation and especially open hardware around the country using decentralised approach and knowledge sharing.

More information about the M19 initiative can be found at this link

: <https://www.makersasylum.com/m19o2/>

Detailed engineering information can be found on our Github repository at this link

: <https://github.com/MakersAsylumIndia/M19O2>

For additional information, comments or feedback, please EMail us at

: info@makersasylum.com

Open Source Hardware Certification at

: <https://certification.oshwa.org/in000029.html>

LICENSES

Hardware

[CERN Open Hardware License Version 2 - Strongly Reciprocal \(CERN-OHL-S-2.0\)](#)

Software

[MIT open source license](#)

Documentation

[Creative Commons Attribution 4.0 International License](#)

2. INTRODUCTION

This manual provides assembly instructions for building the M19O₂ Oxygen Concentrator.

Several sub-assemblies need to be put together first, after which the main assembly can be put together.

This assembly manual only includes granular instructions with a basic level of detail. It is assumed that the user of this manual has the proper knowledge, information, skill and ability for assembling the machine.

Add a more descriptive INTRODUCTION text about the purpose and usage of this manual.

3. FRAME SUB-ASSEMBLY

Parts Required

- As per BoM : <https://docs.google.com/spreadsheets/d/1hJWsOK6Ha9TGgY7TqO4Dt78tM5ed4X8MCPeQvz6Lhic/edit#gid=1174625766&range=A1>

Tools Required

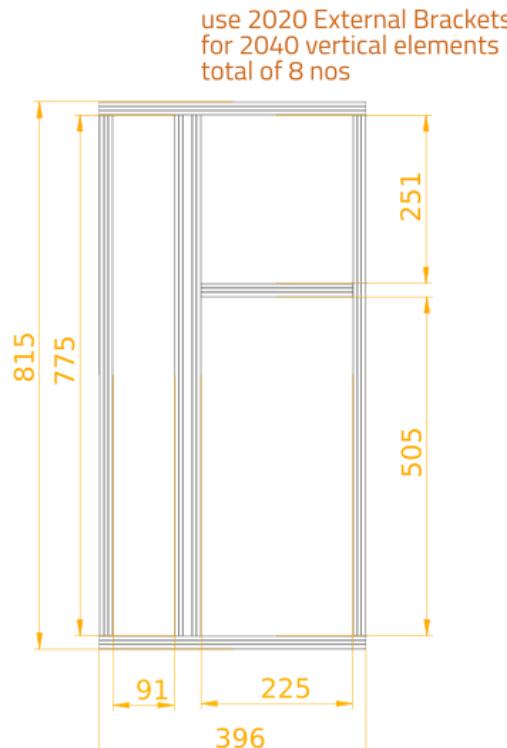
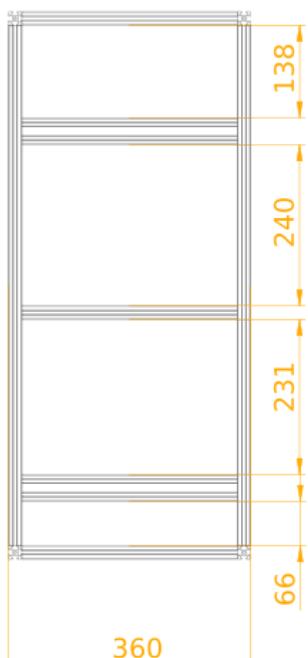
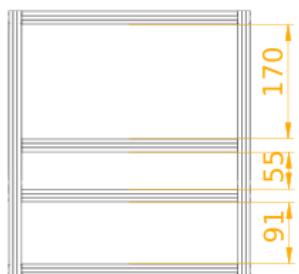
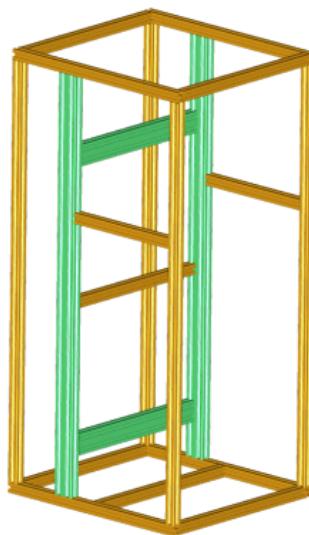
- Set of Allen Keys
- Hammer (optional)
- File tool (optional)
- Set square (optional, for checking right angles)

Process

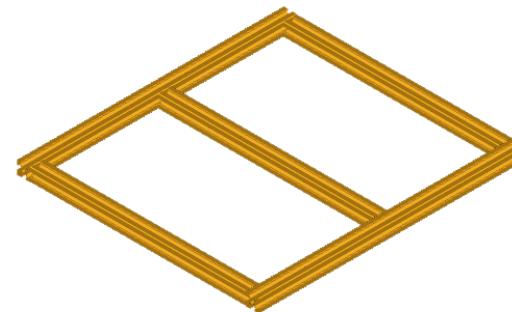
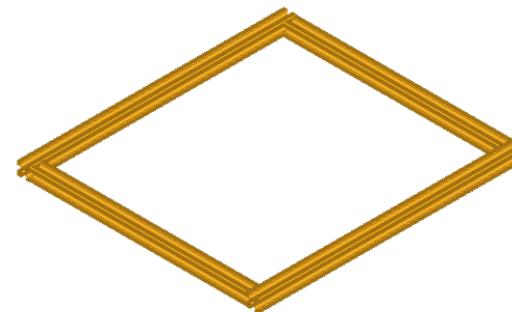
- The Frame is built from 2020 aluminum extrusions with some heavy duty 2040 elements added for structural rigidity.
- Refer to the attached images for assembly process details.



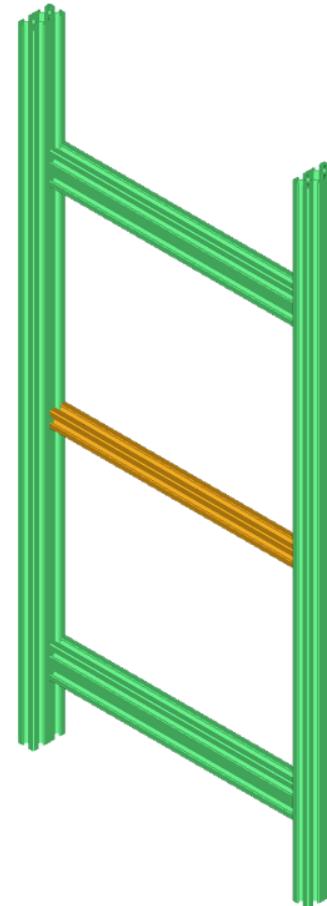
M19O2 structural frame
using 2020 and 2040
Aluminum Extrusions
See BoM for details
all dimensions in mm



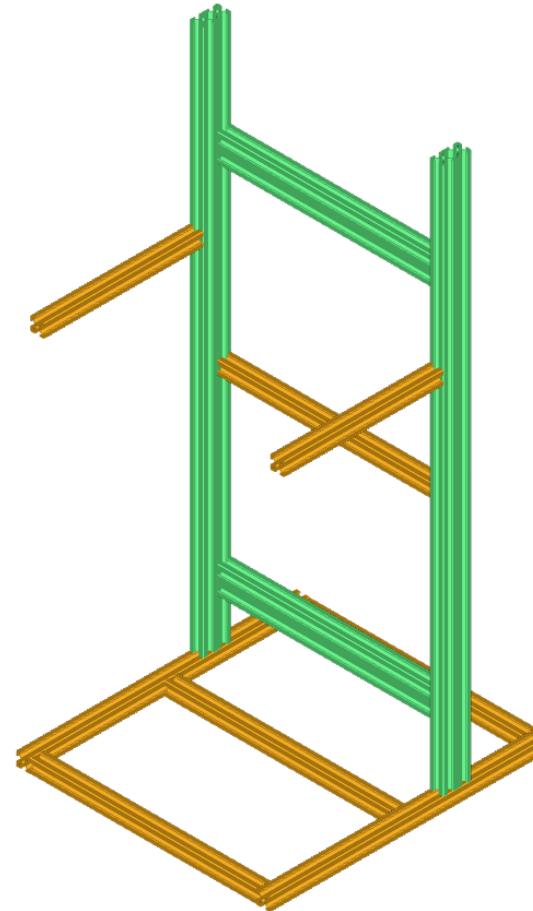
Frame dimensions and spacing of various elements
High resolution PNG, PDF format images [at this link](#)



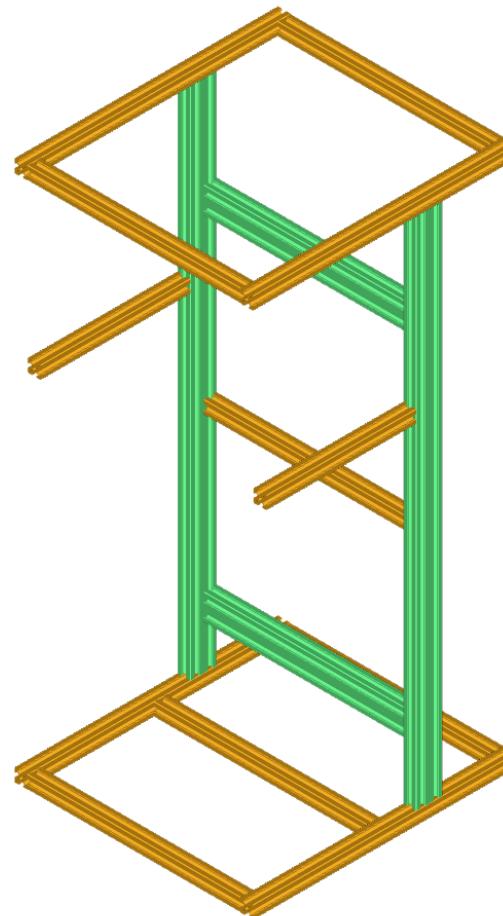
Assemble and prepare top / bottom frame sub-assemblies (bottom frame has extra support element for compressor), size 2020



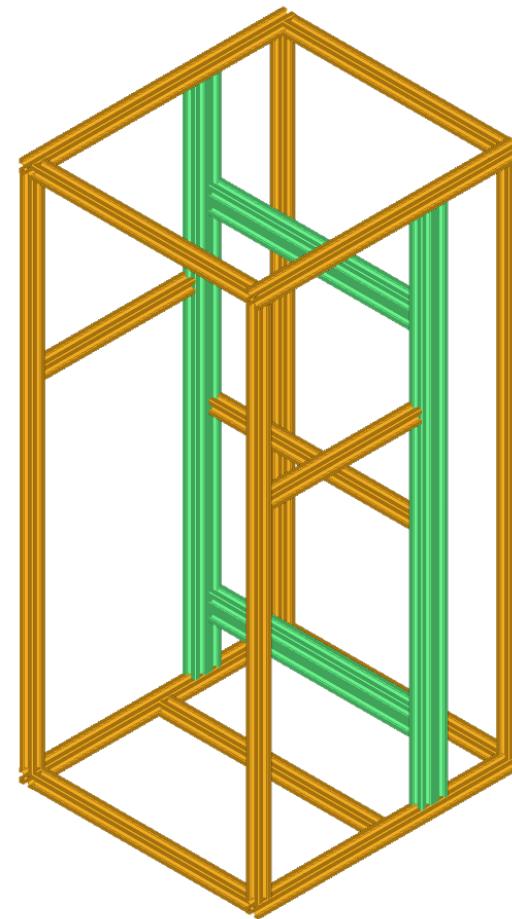
Assemble central support sub-assembly, (aka Ladder). Green elements are 2040



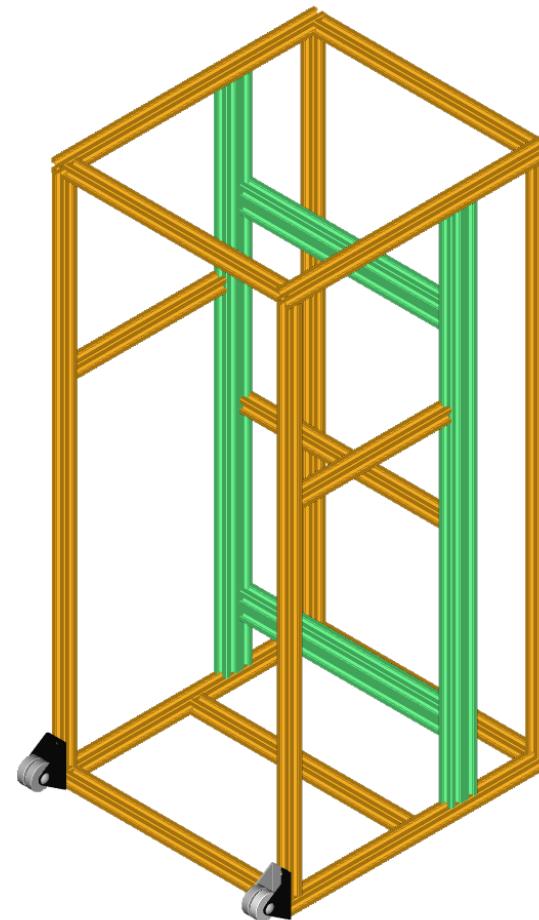
Add short 2020 horizontal elements to ladder, and then fix the ladder sub-assembly to the bottom frame sub-assembly



Fix top frame sub-assembly.



Fix the four corner vertical support elements.



Complete the frame sub-assembly by adding caster wheels (x2), bottom nylon feet (x4) and a tilt handle at the centre of the top, rear 2020 element

4. SIEVE SUB-ASSEMBLY

Parts Required

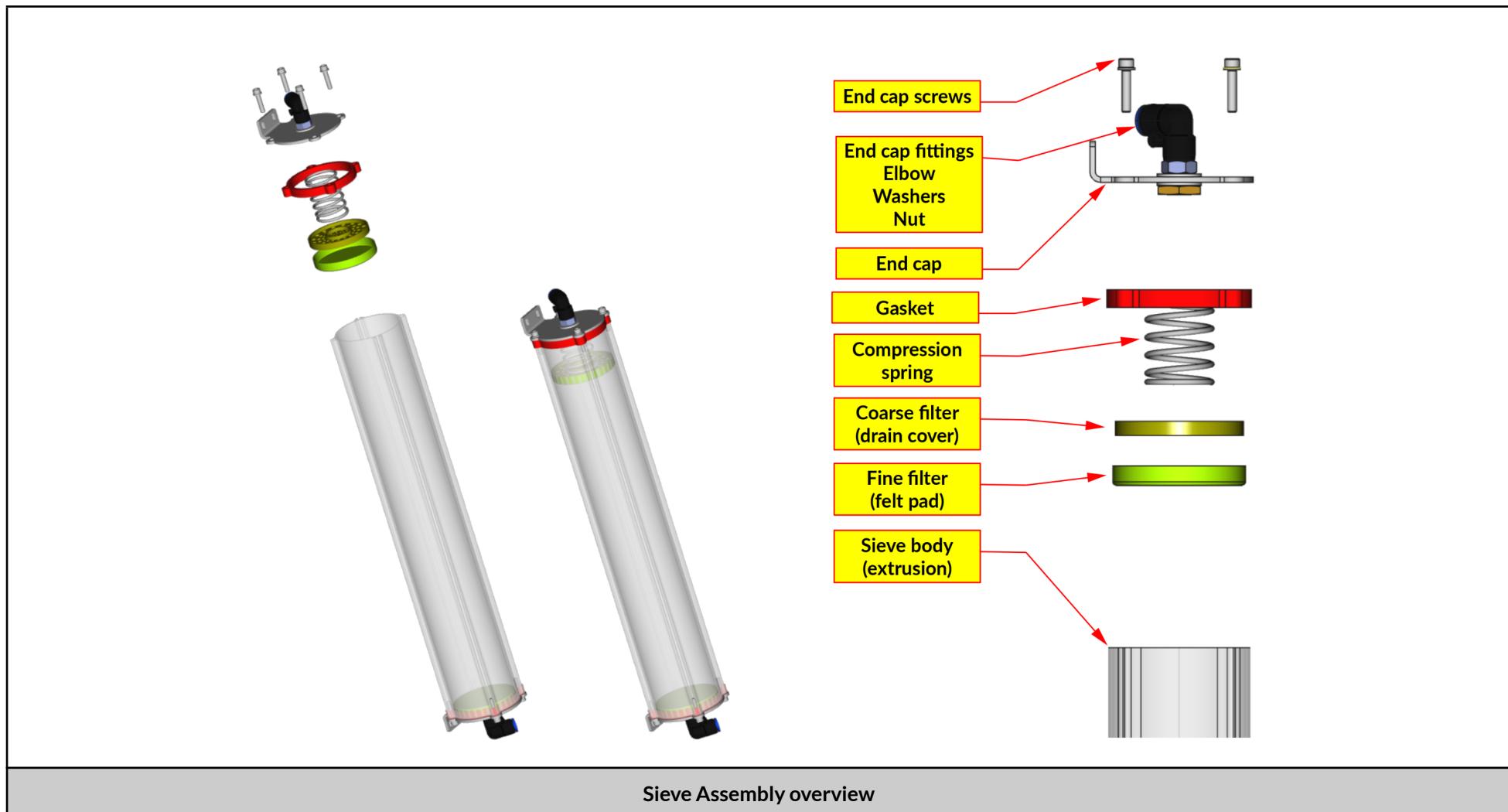
- As per BoM : <https://docs.google.com/spreadsheets/d/1hJWsOK6Ha9TGgY7TqO4Dt78tM5ed4X8MCPeQvz6Lhic/edit#gid=0&range=B29>

Tools Required

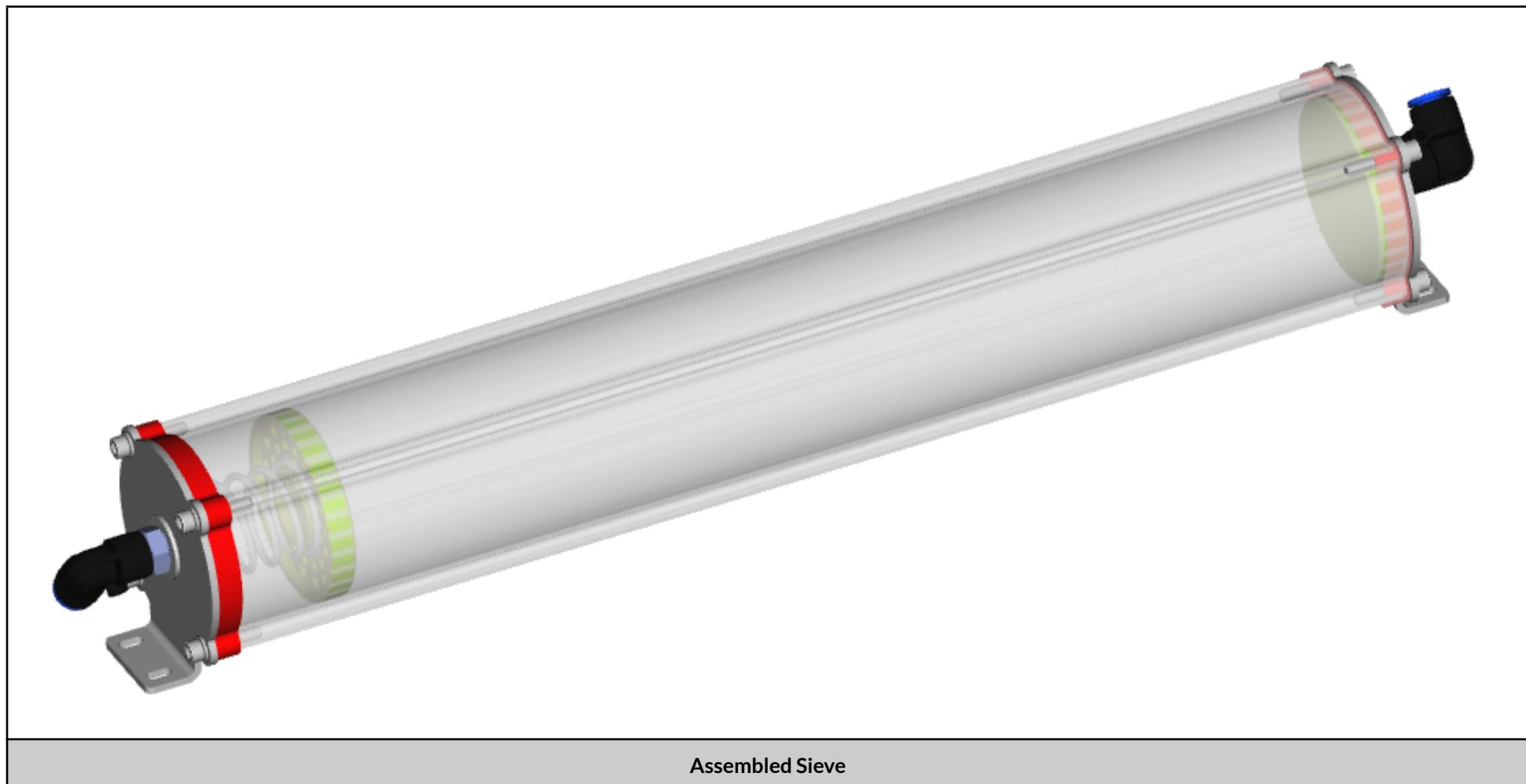
- Set of Allen Keys
- Sieve compression jig : https://github.com/MakersAsylumIndia/M19O2/tree/main/engineering/CAD/M19O2/Sieve_compression_jig
- Vacuum pump or vacuum cleaner
- Sieve vibration jig (or use any electric hand tool that can provide sufficient vibratory movement to compact the zeolite)
- Funnel (for pouring zeolite)
- Face masks
- Gloves

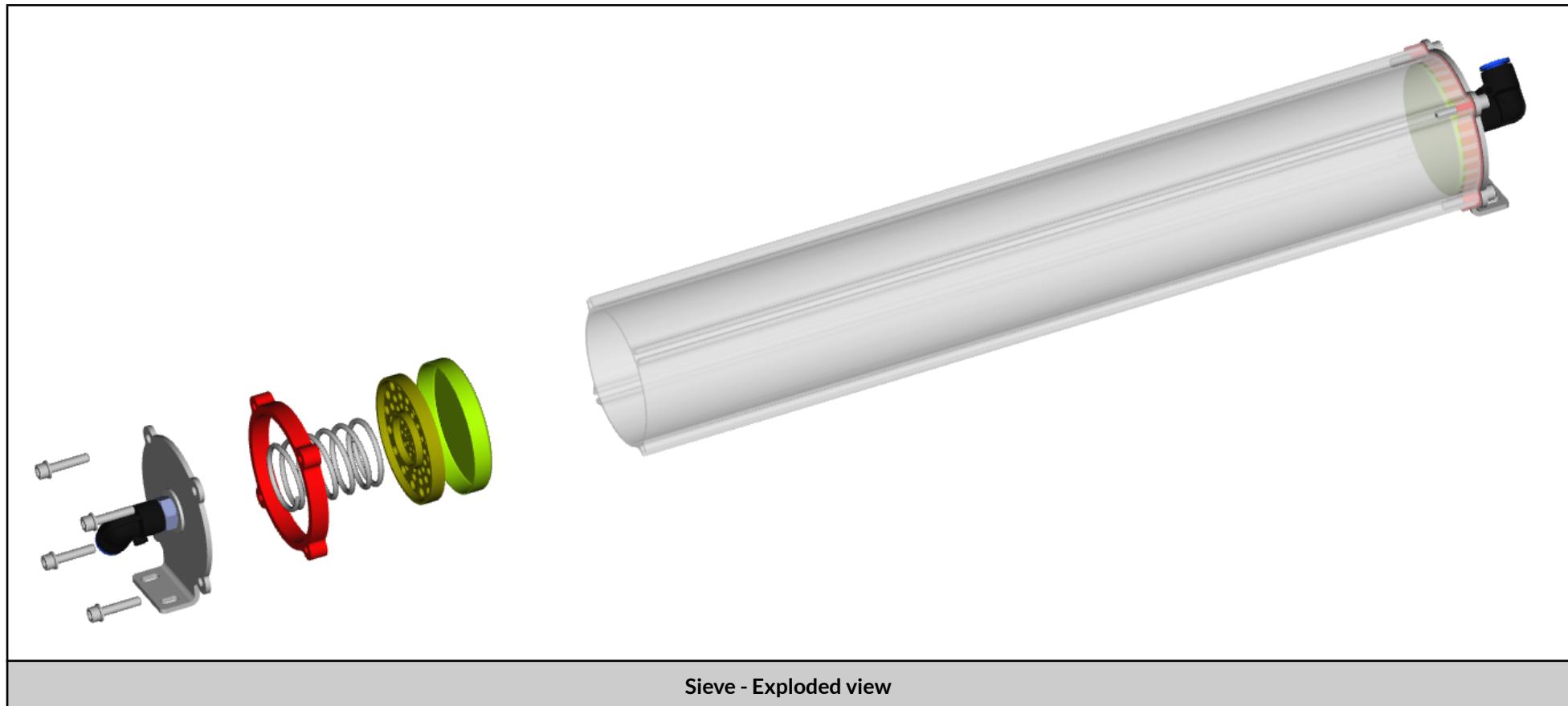
Process

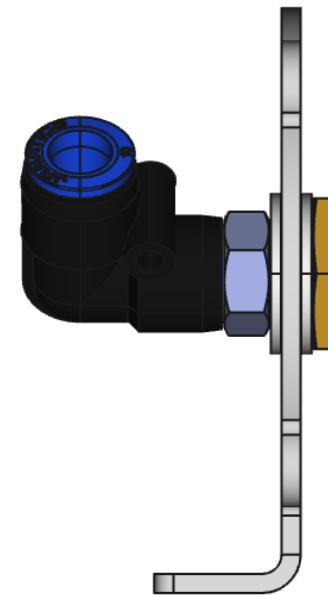
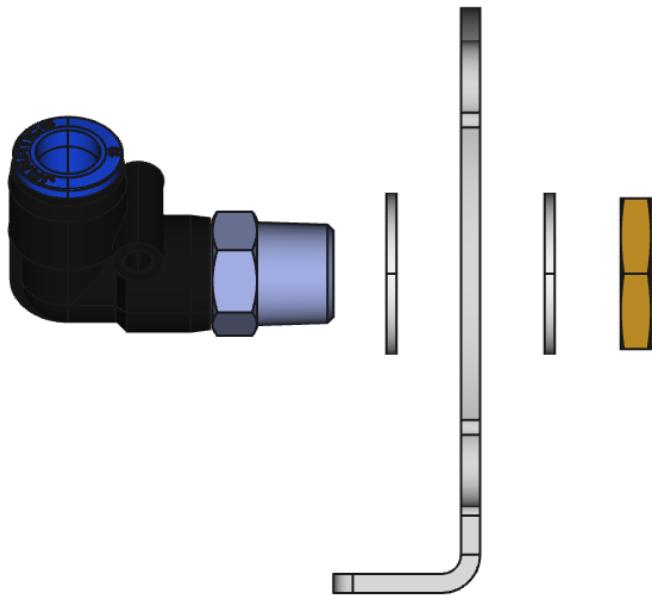
- Sieve assembly is critical for proper functioning of the oxygen concentrator
- Check the assembly video on the Maker's Asylum YouTube channel
- Perform this operation in as dry an environment as possible - preferably in an air conditioned room.
- Minimise the exposure of the zeolite to the ambient atmosphere since it absorbs moisture quickly.



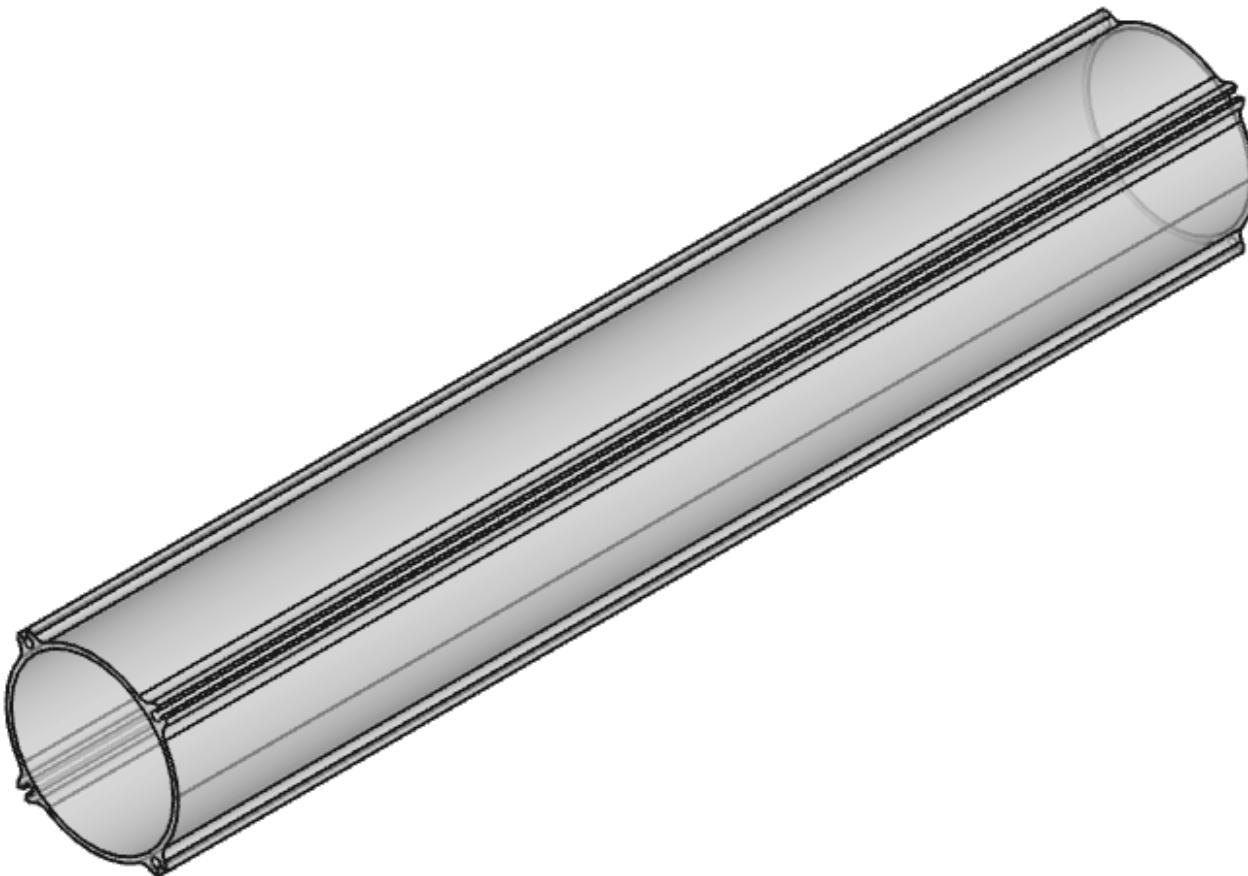
Sieve Assembly overview



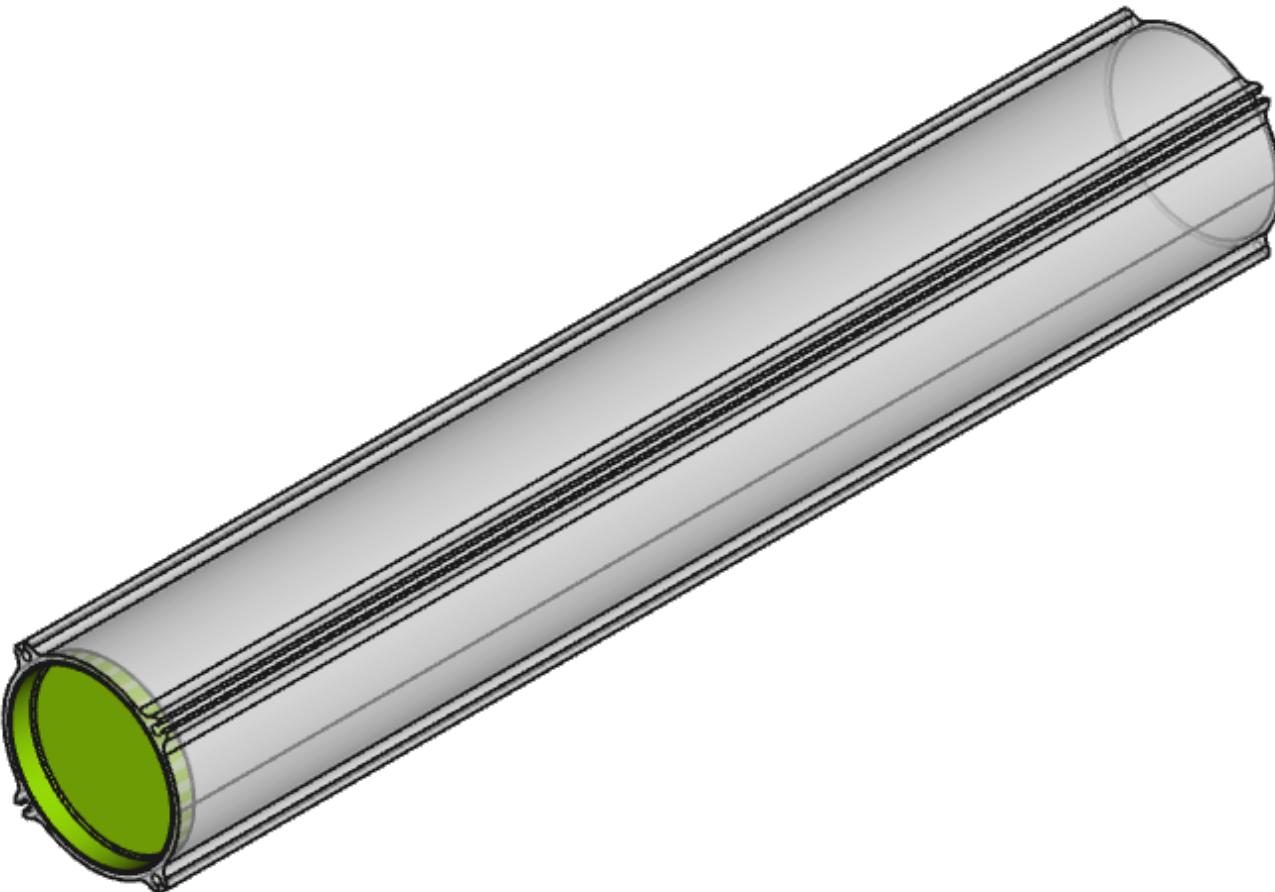




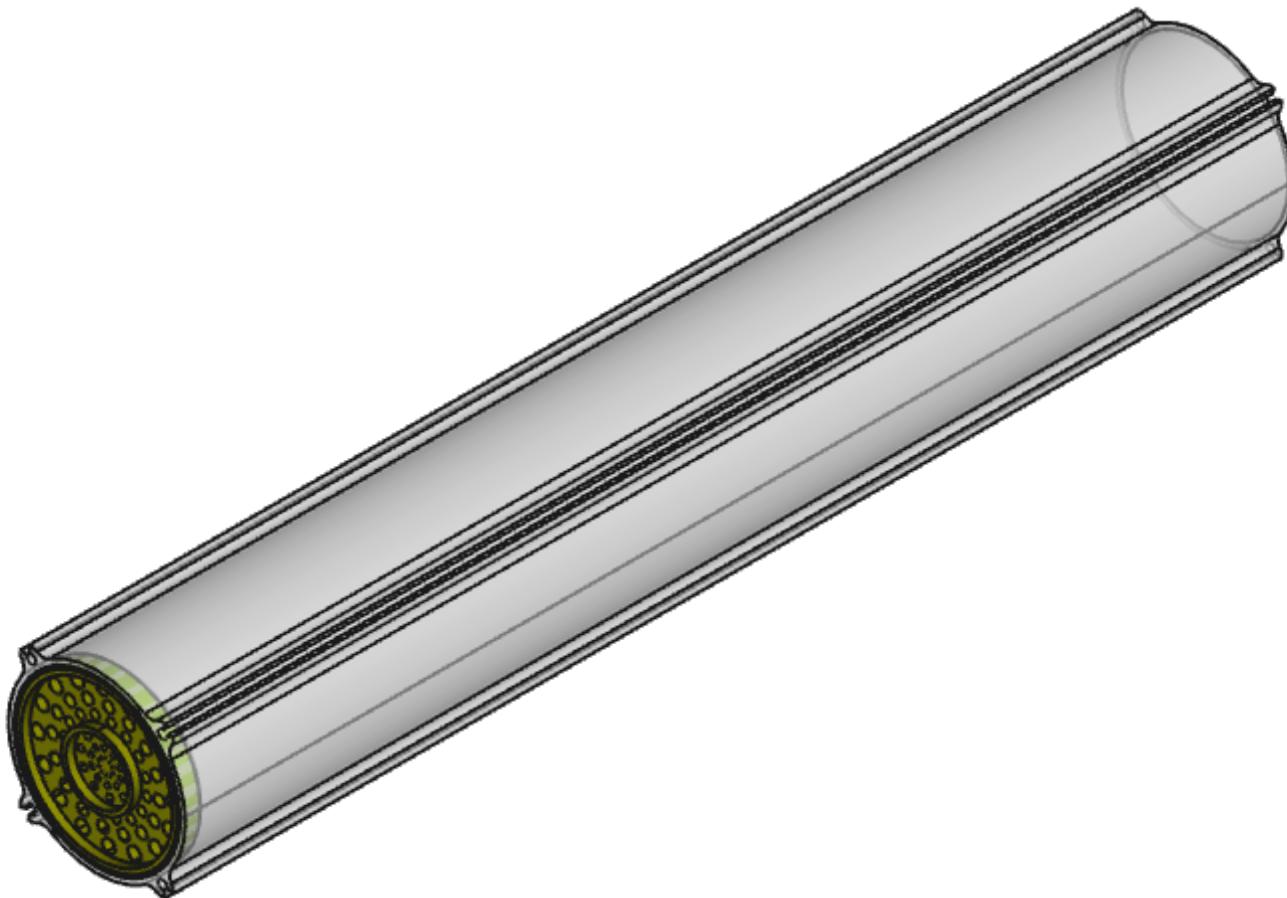
Assemble end-caps, 6 nos, with elbow push fit connector, two washers (EPDM or similar, 0.5 mm thick), and a nut



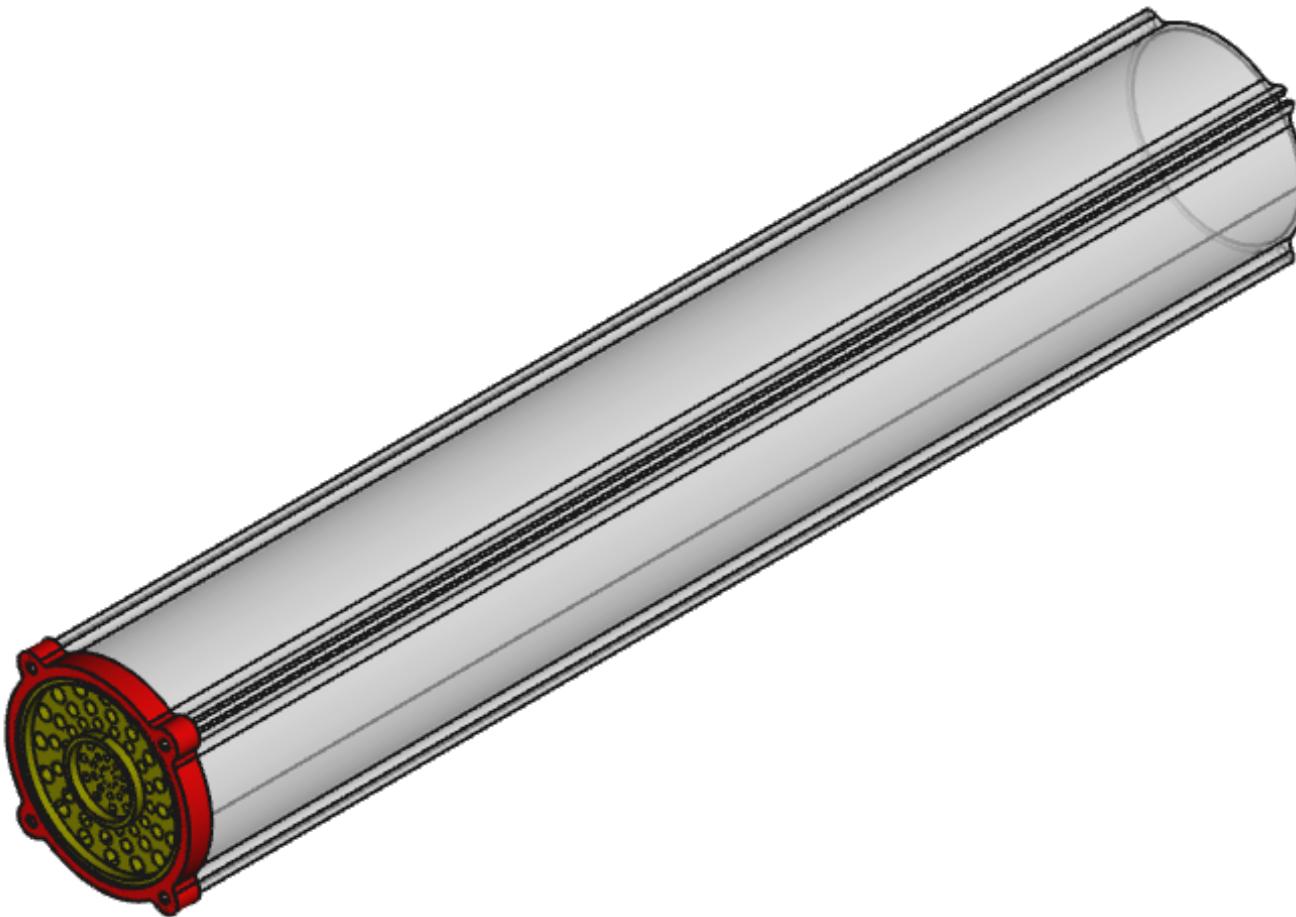
Sieve - main body (aluminum extrusion)



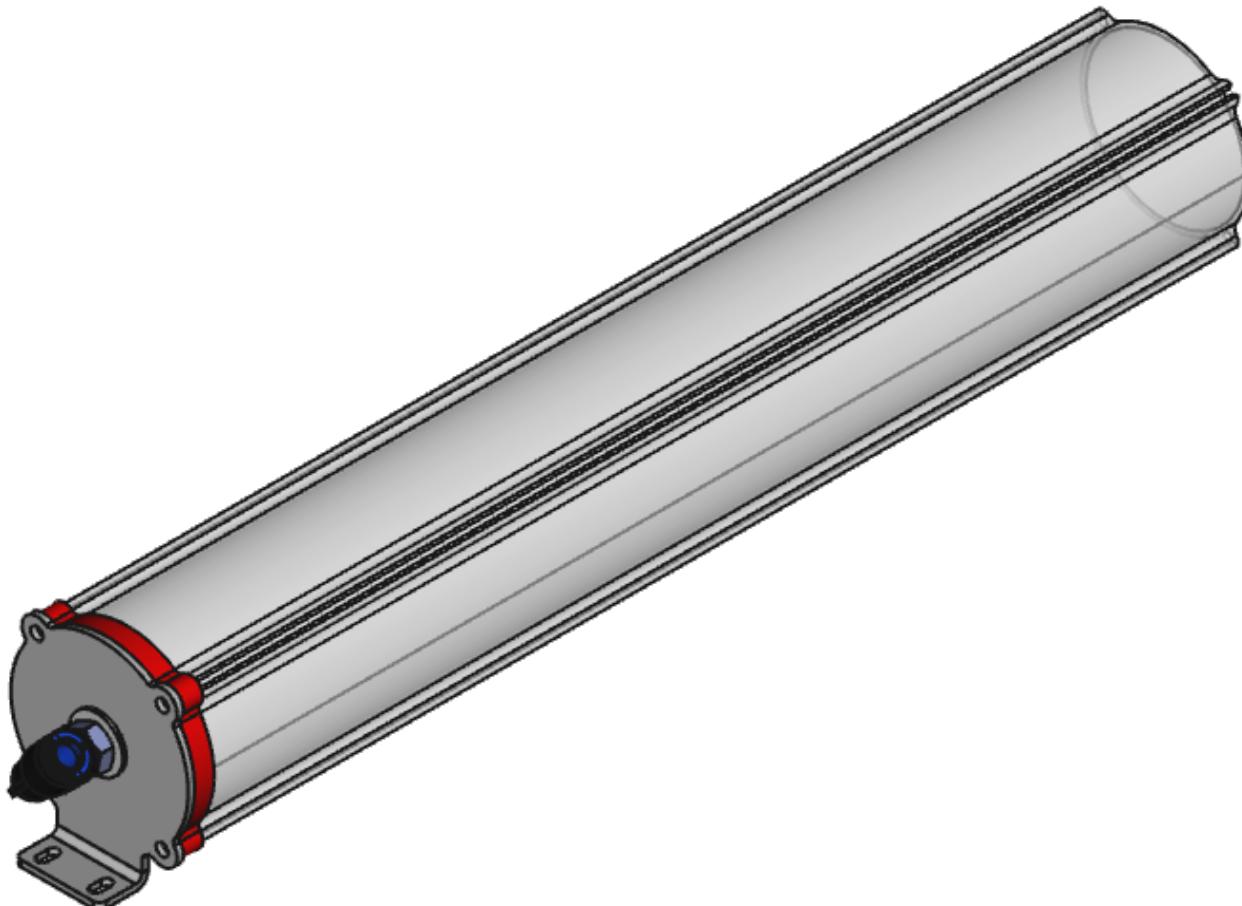
Sieve - insert felt pad (fine filter) at one end of sieve extrusion



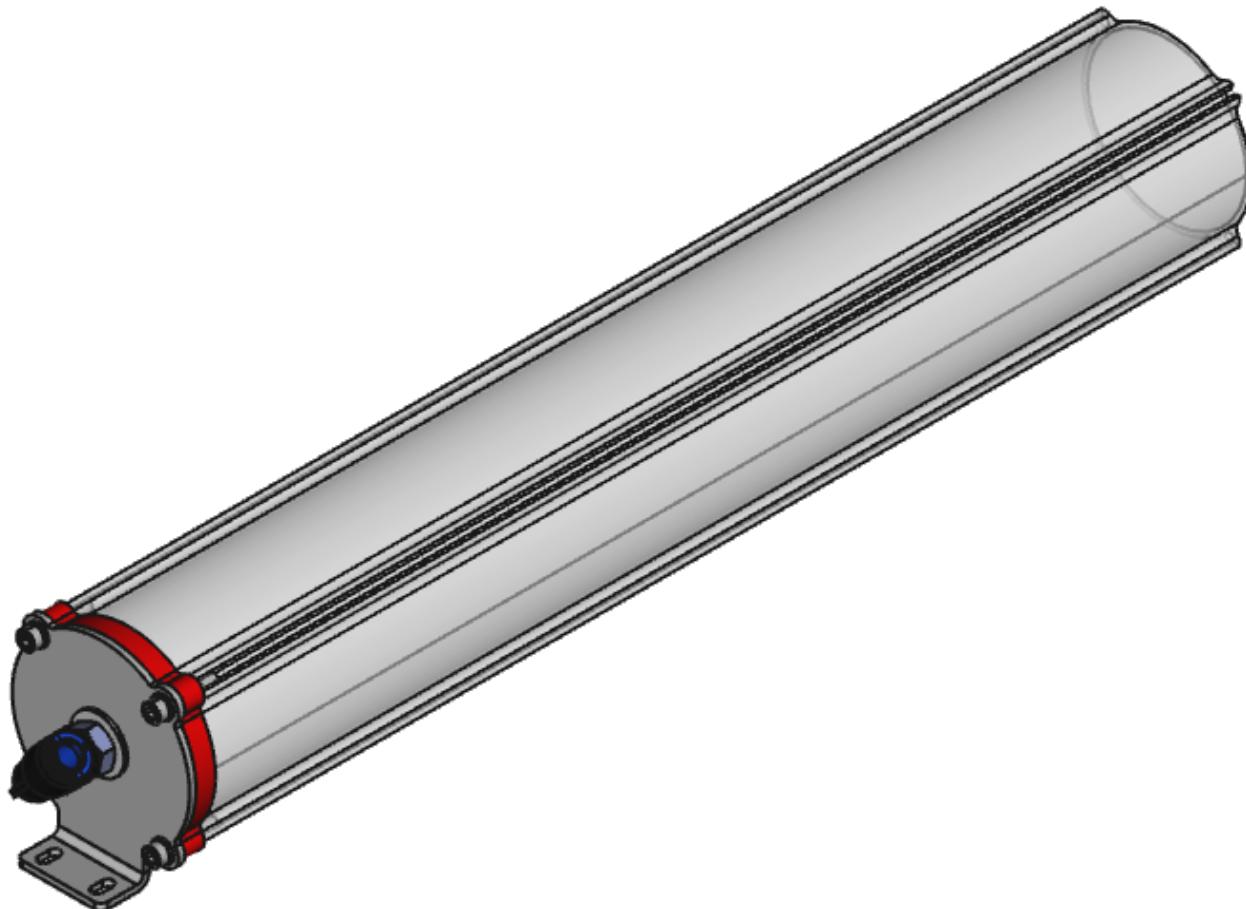
Sieve - insert acrylic, laser cut coarse filter over the felt pad fine filter



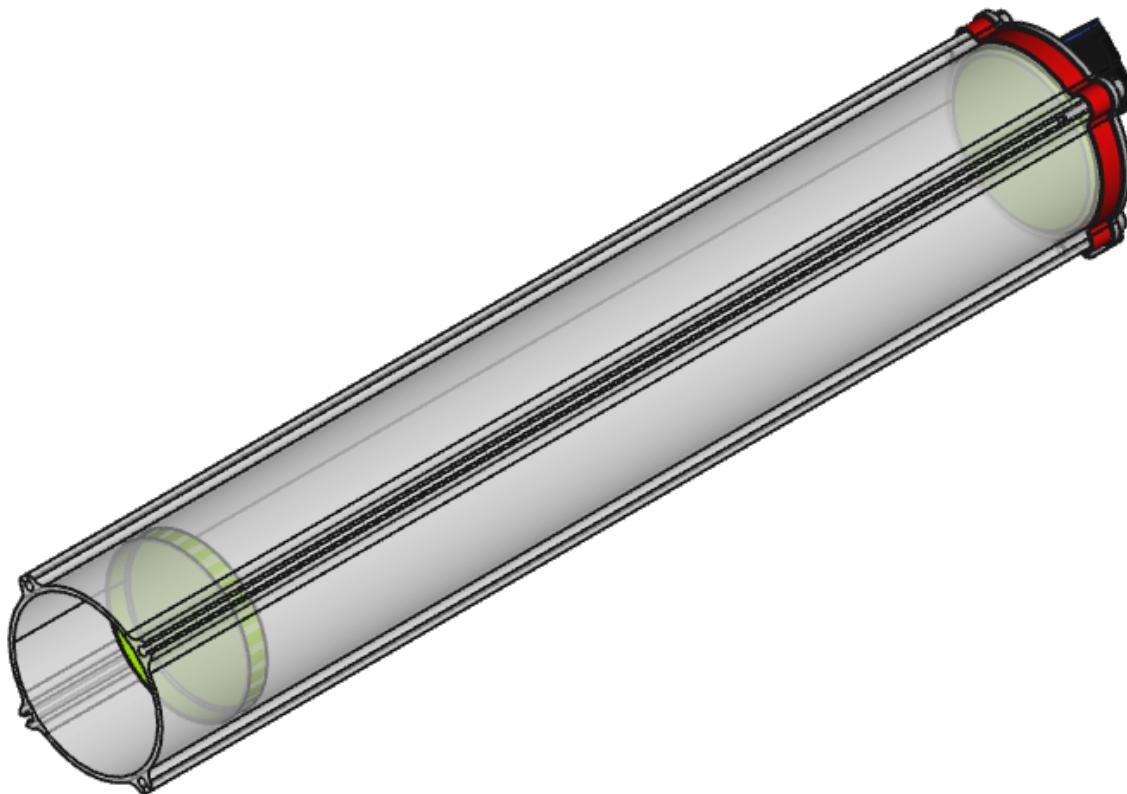
Sieve - add rubber gasket



Sieve - fix end cap

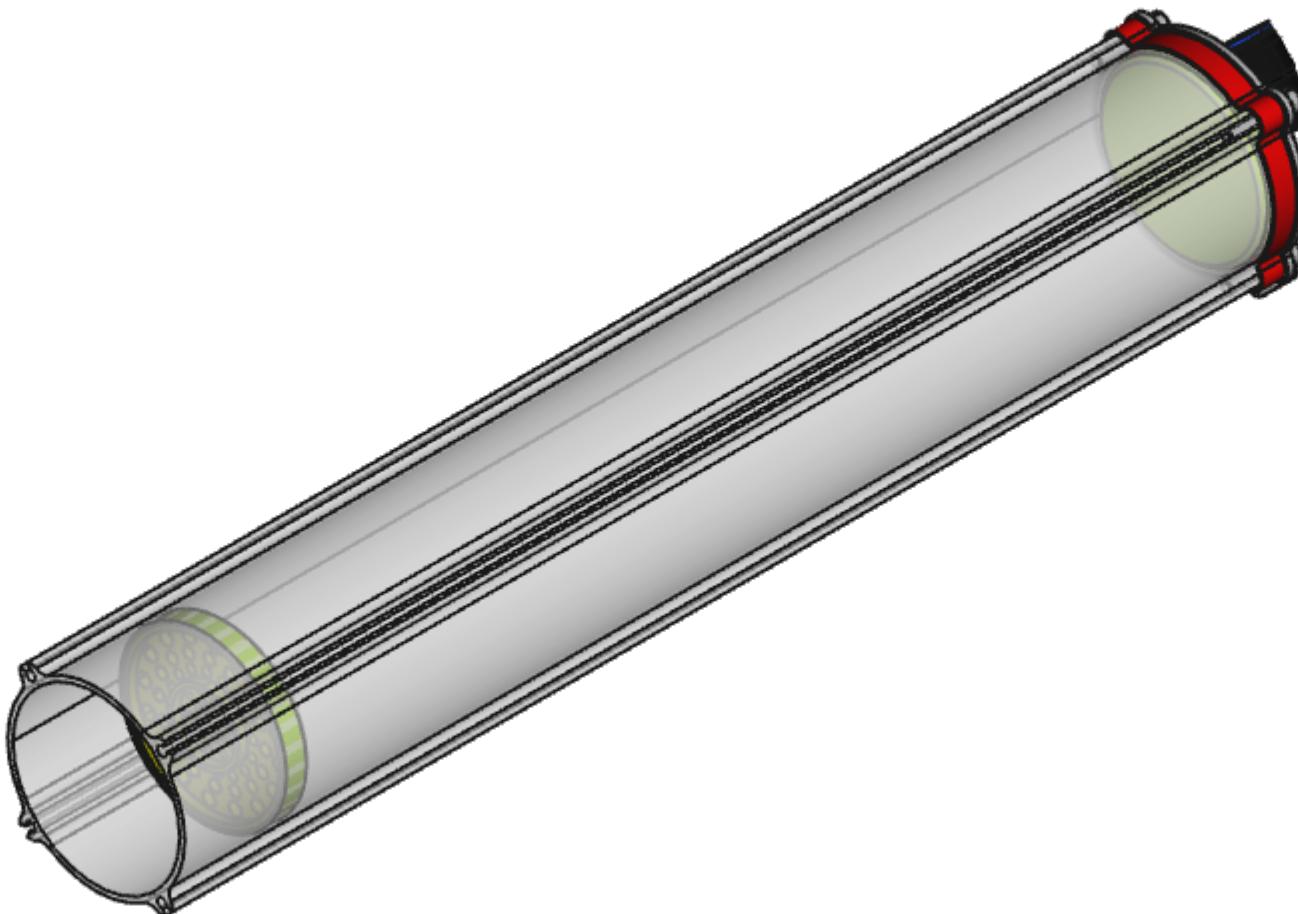


Sieve - fix the end cap using stainless steel, allen head, M5 bolts (use spring washer and plain washer for each bolt)

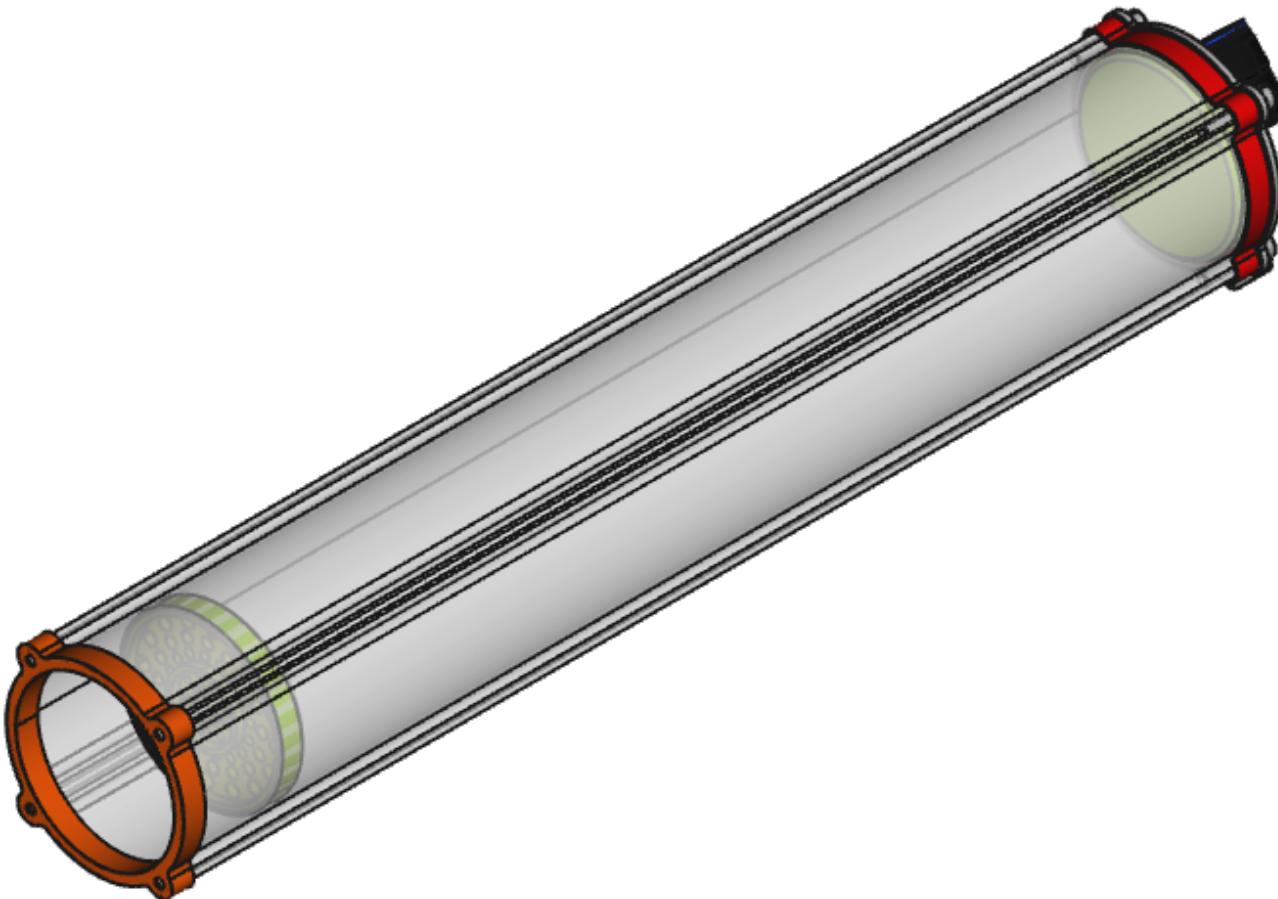


Sieve - fill the sieve with Zeolite. Make sure it is well compacted using a vacuum pump/machine connected to the fixed end cap, and using a vibratory table or powered hand tool to shake and compact the zeolite. Do this in a clean, cool and dry environment (such as an air conditioned room). Once filled with Zeolite, add the felt pad fine filter.

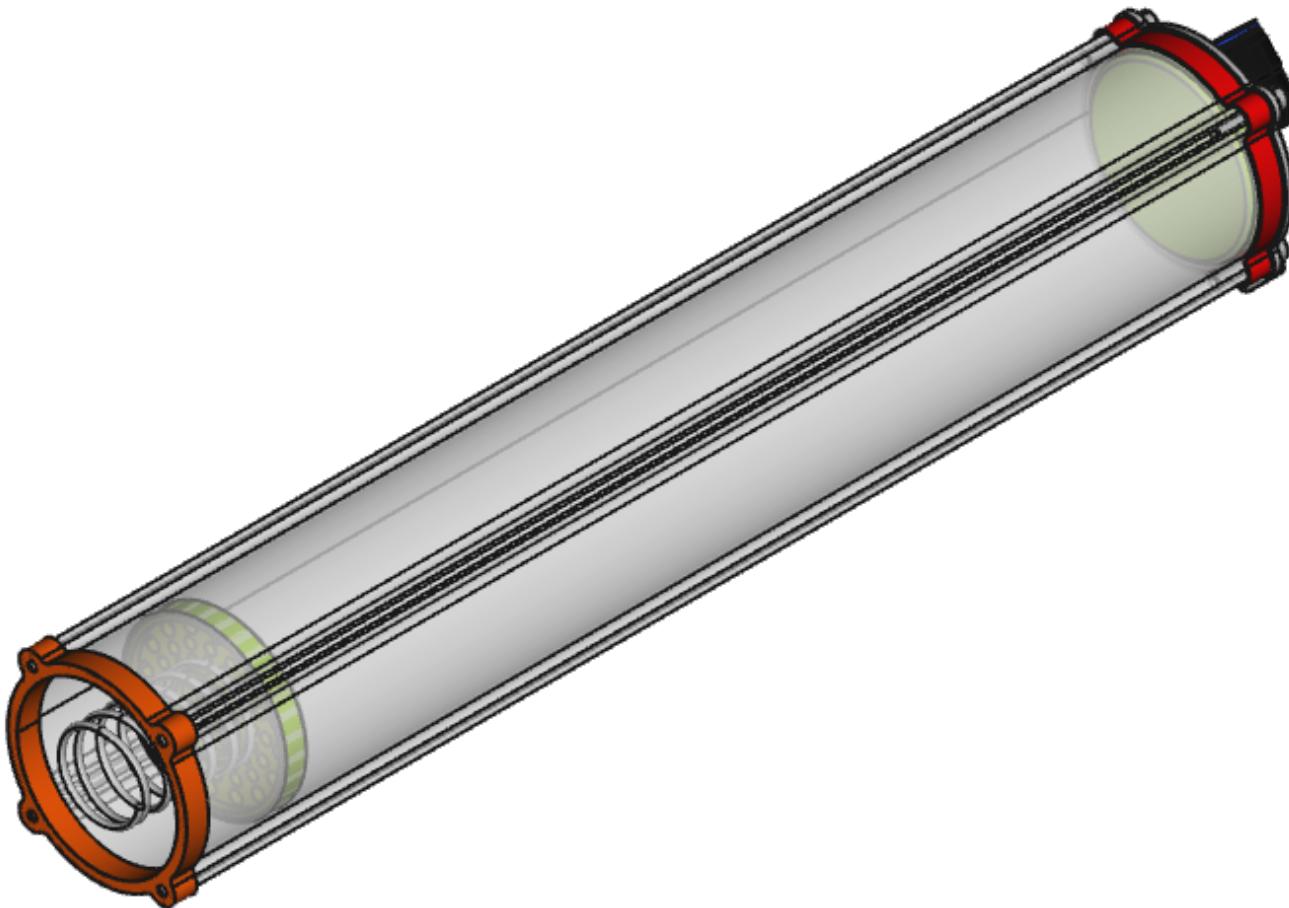
CAUTION : Wear masks and Gloves while handling Zeolite.



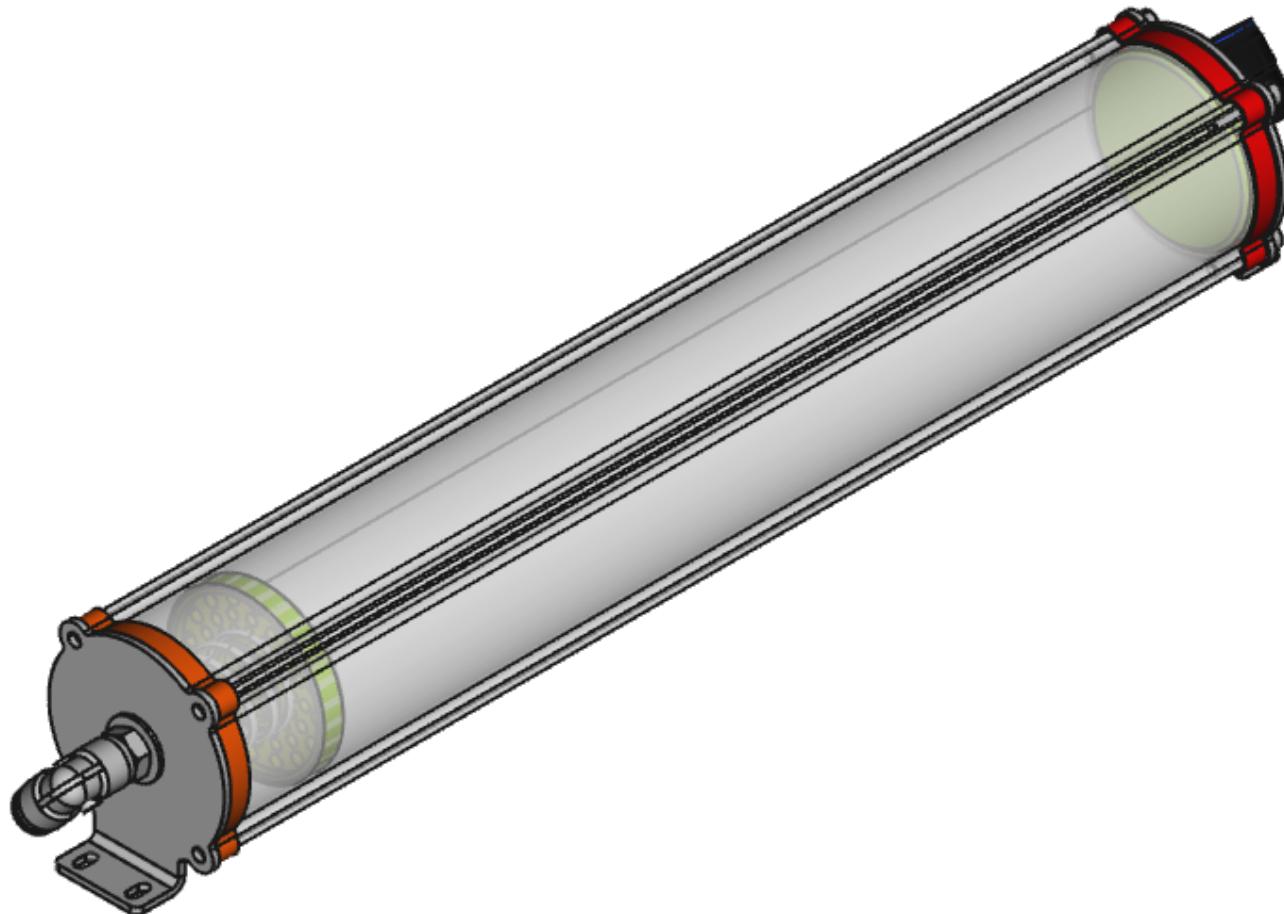
Sieve - insert acrylic, laser cut coarse filter over the felt pad fine filter



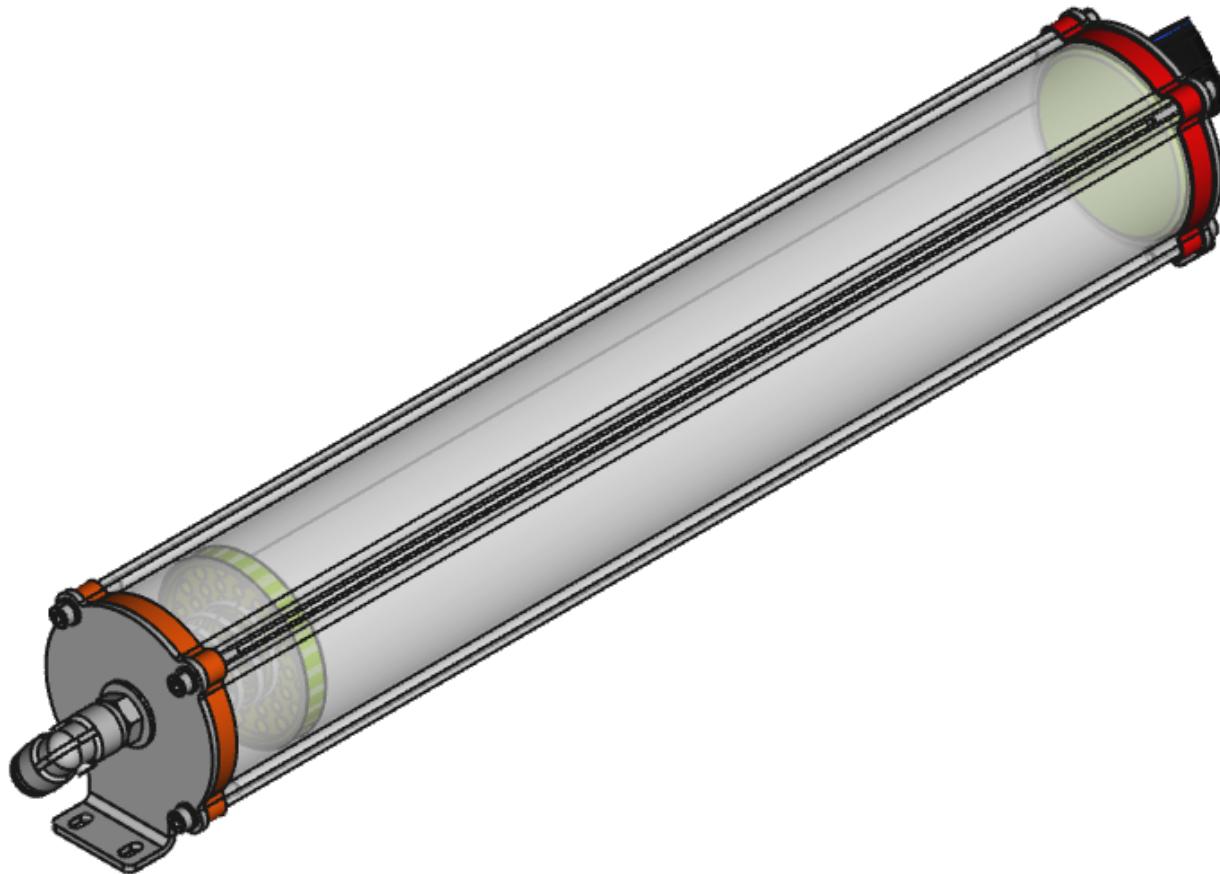
Sieve - add rubber gasket



Sieve - add the compression spring



Sieve - add the end cap



Sieve - fix the end cap using stainless steel, allen head, M5 bolts (use spring washer and plain washer for each bolt)
This completes the Sieve Assembly. Two such sieve assemblies are required for each oxygen concentrator.

5. SURGE TANK SUB-ASSEMBLY

Parts Required

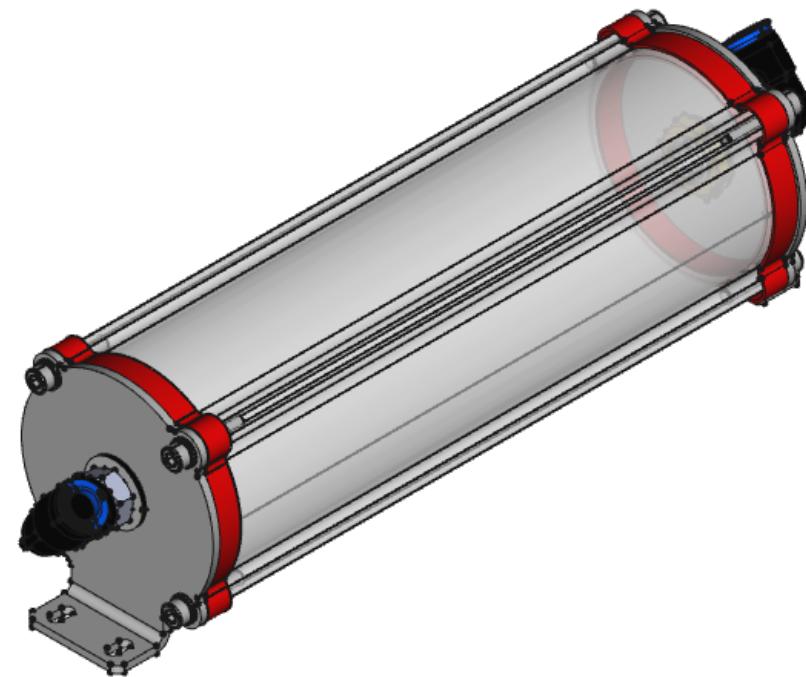
- As per BoM : <https://docs.google.com/spreadsheets/d/1hJWsOK6Ha9TGgY7TqO4Dt78tM5ed4X8MCPeQvz6Lhic/edit#gid=0&range=B29>

Tools Required

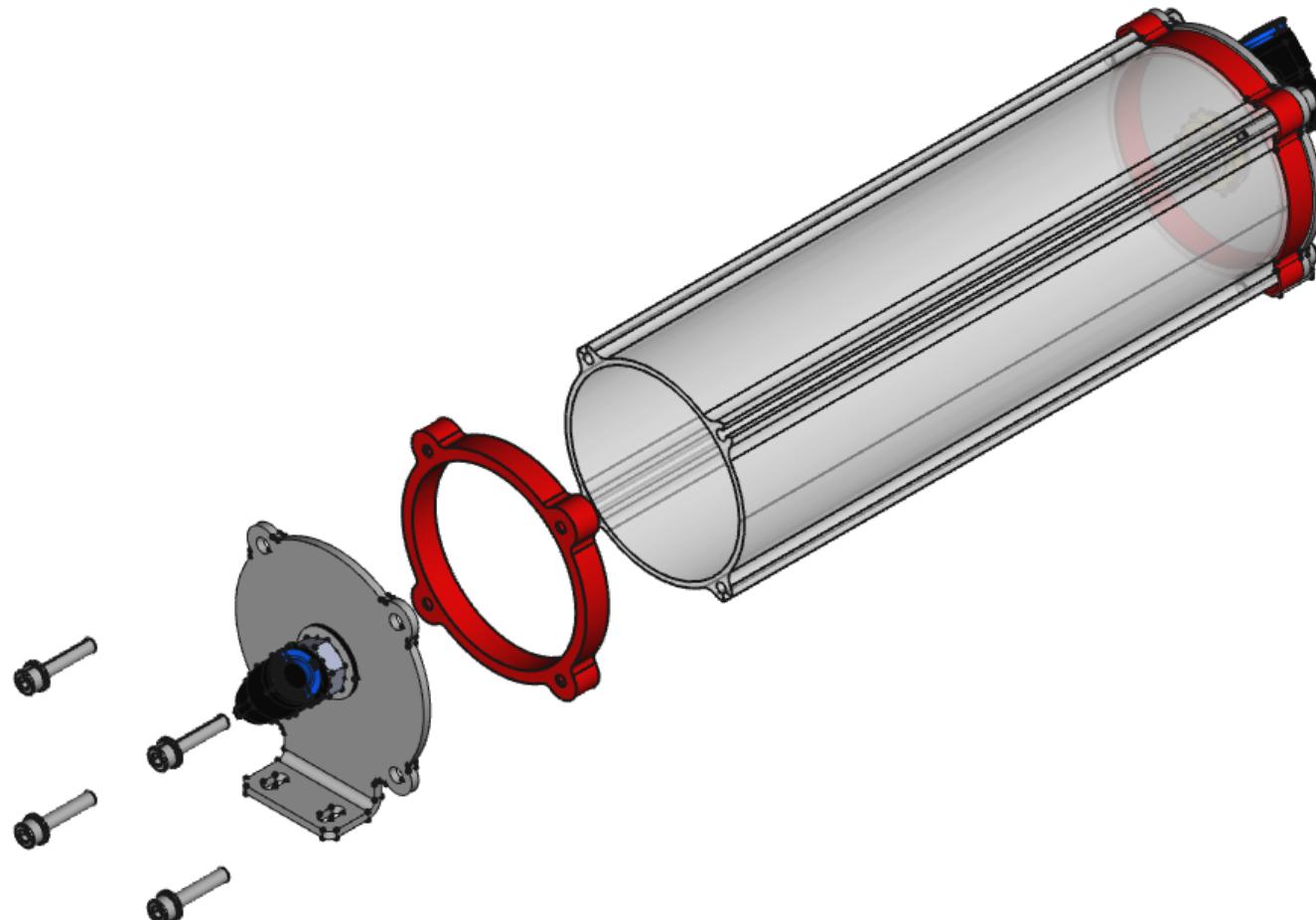
- Set of Allen Keys

Process

- Surge tank assembly is similar to Sieve assembly, but much simpler.
- Surge tank length is shorter compared to Sieves.
- Surge Tank does not contain coarse filter, fine filter, compression spring and zeolite.
- It is an empty, air tight chamber.



Surge Tank - assembled view



Surge Tank - exploded view.

6. COPPER COOLING COILS SUB-ASSEMBLY

Parts Required

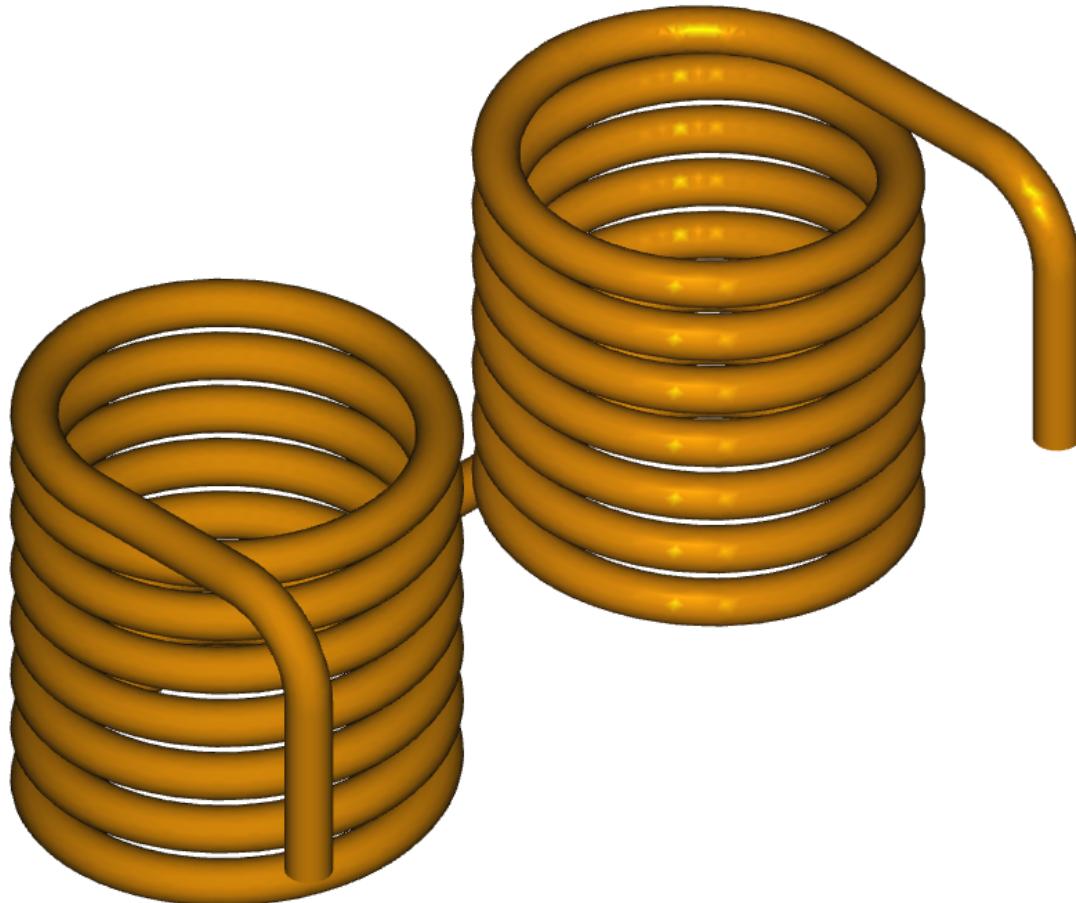
- As per BoM : <https://docs.google.com/spreadsheets/d/1hJWsOK6Ha9TGgY7TqO4Dt78tM5ed4X8MCPeQvz6Lhic/edit#gid=0&range=B50>

Tools Required

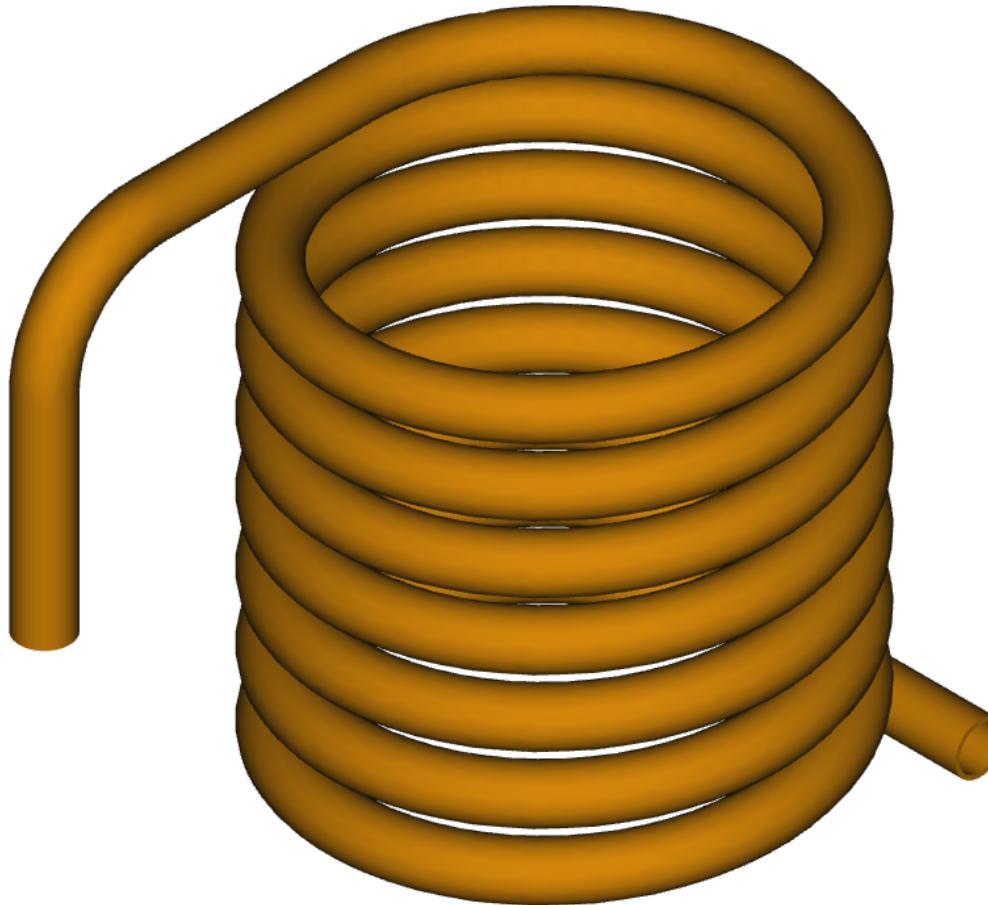
- Copper tube bending jig, or skill + elbow grease
- Butane gas flame burner (for soldering end cap termination to copper tube)

Process

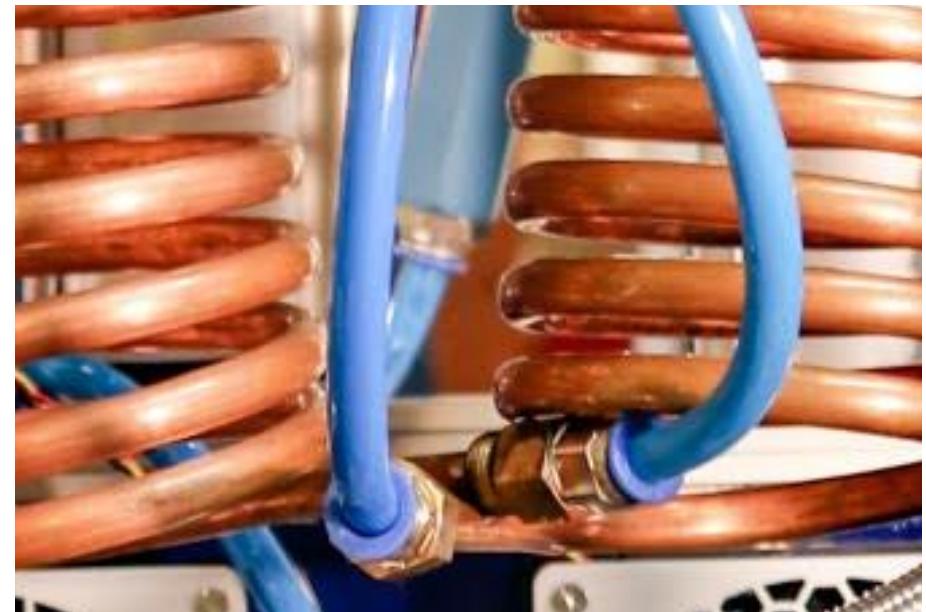
- Bending the copper coil, either using a bending jig or manually, requires some patience and skill. Do not rush it. Also, making very sharp bends will kink the copper tube.
- A 10 meter length can be used to make two copper coils (one pair)
- Construct the coils with about 10 to 12 full turns and a diameter between 100 mm to 120 mm
- The two coils are mirror images (Left and Right)



Cooling Copper Coils



Cooling copper coil - close up



Copper coils require male threaded brass fitting at the “hot” end (top of coil) and female threaded brass fitting at the “cold” (bottom of coil) end. These fittings can be brazed using a butane flame and solder.

7. COOLING COIL FAN SUB-ASSEMBLY

Parts Required

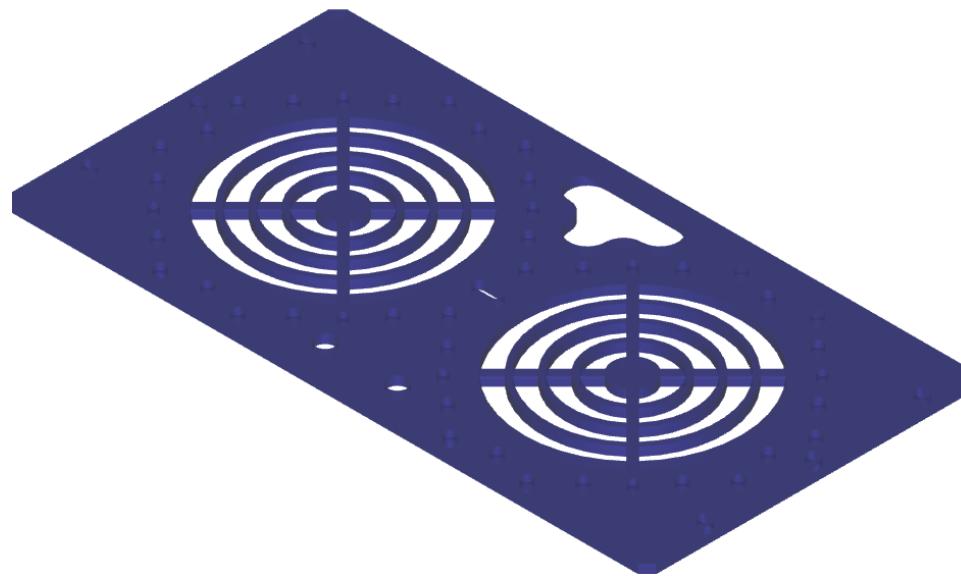
- Laser cut acrylic plate, 5 mm thick, for cooling coil assembly
- Cooling Fans, 24 V DC, 120 mm size, quantity 2 nos.
- Laser cut acrylic fan grilles (protective plate), 2 mm thick, quantity 2 nos.
- Mounting hardware - 4 mm x 50 mm bolts, 4 mm nuts, 4 mm plain washers - quantity 8 nos each
- Copper Cooling Coils
- Zip ties

Tools Required

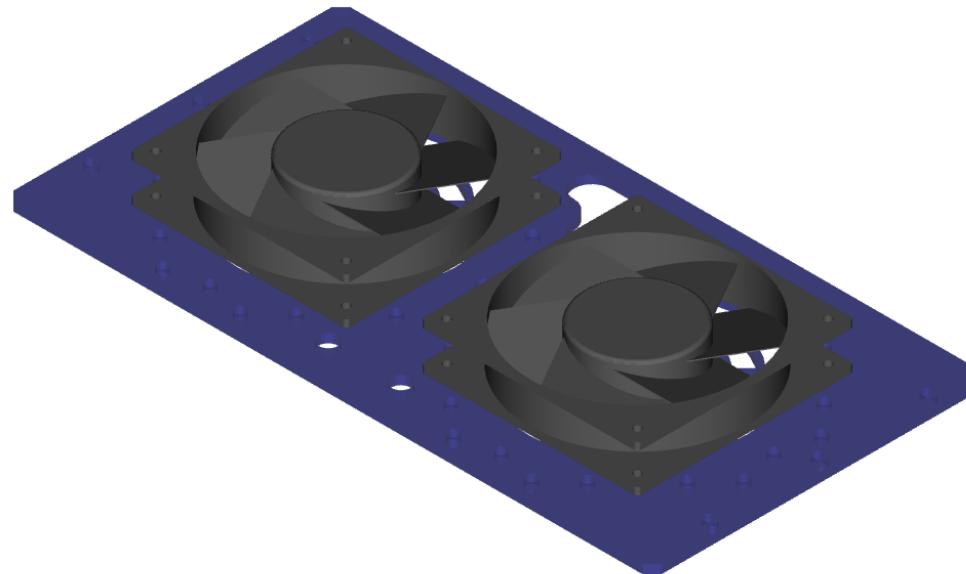
- Screwdriver
- Nut spanner, 4 mm
- Pliers / Cutter

Process

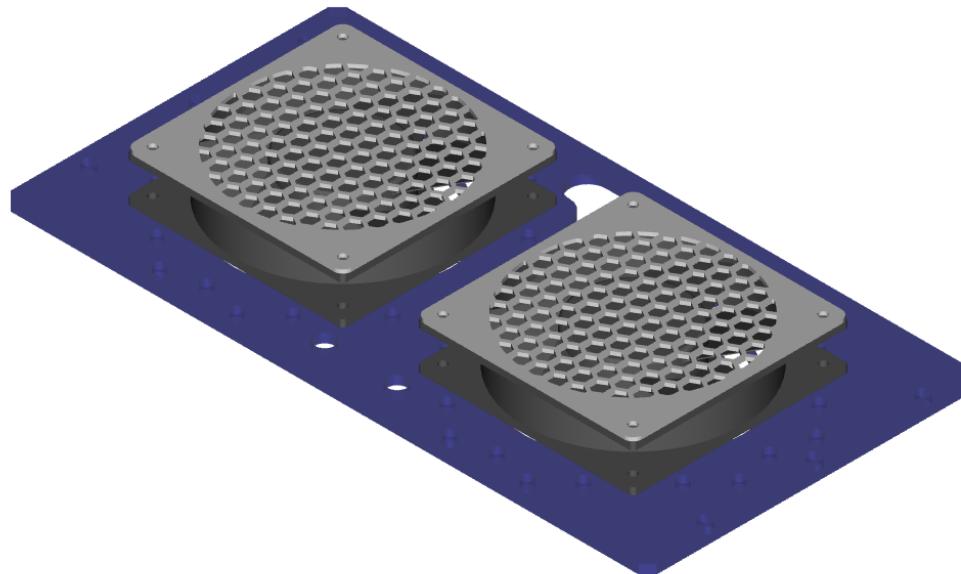
- Prepare the cooling coil fan assembly as per the accompanying drawings.
- Extend the length of the fan wires enough to reach the 24 V DC SMPS, and bunch them in a single harness.



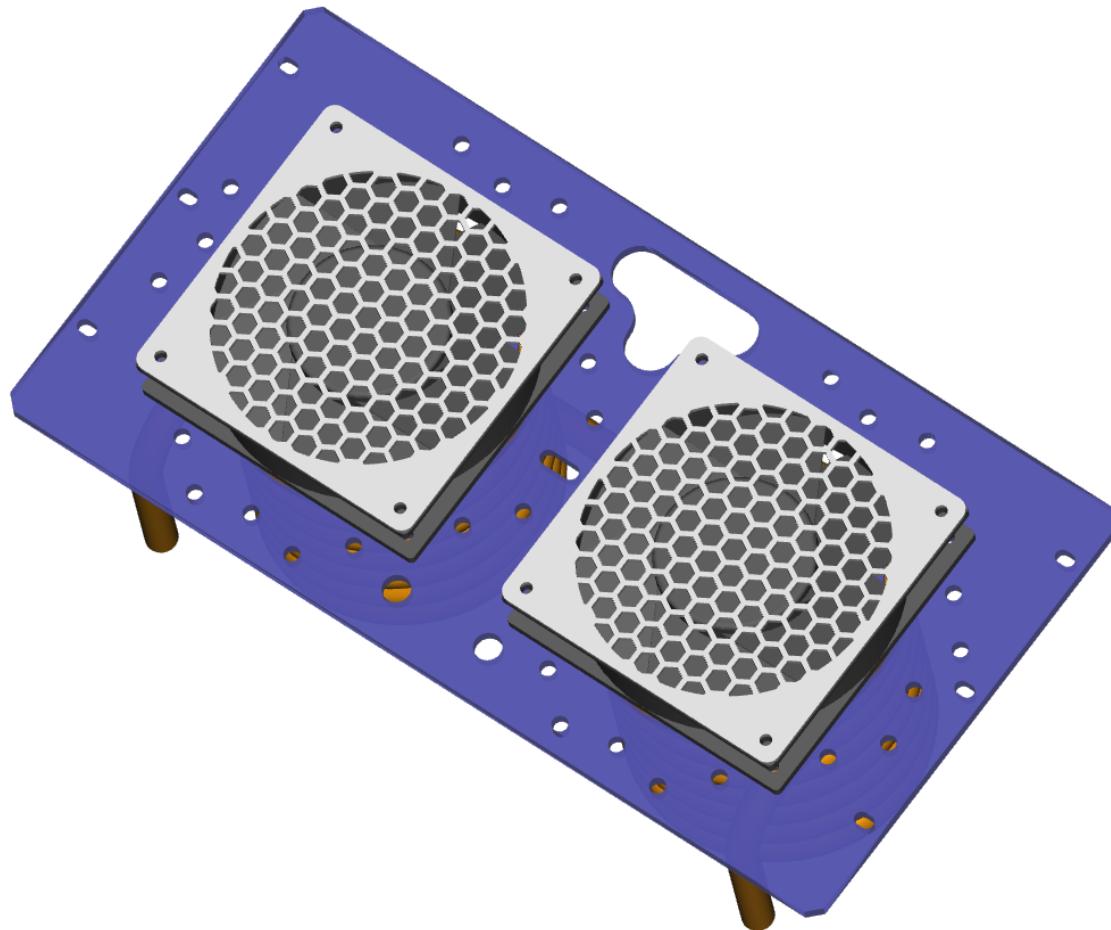
Cooling copper coil mounting plate



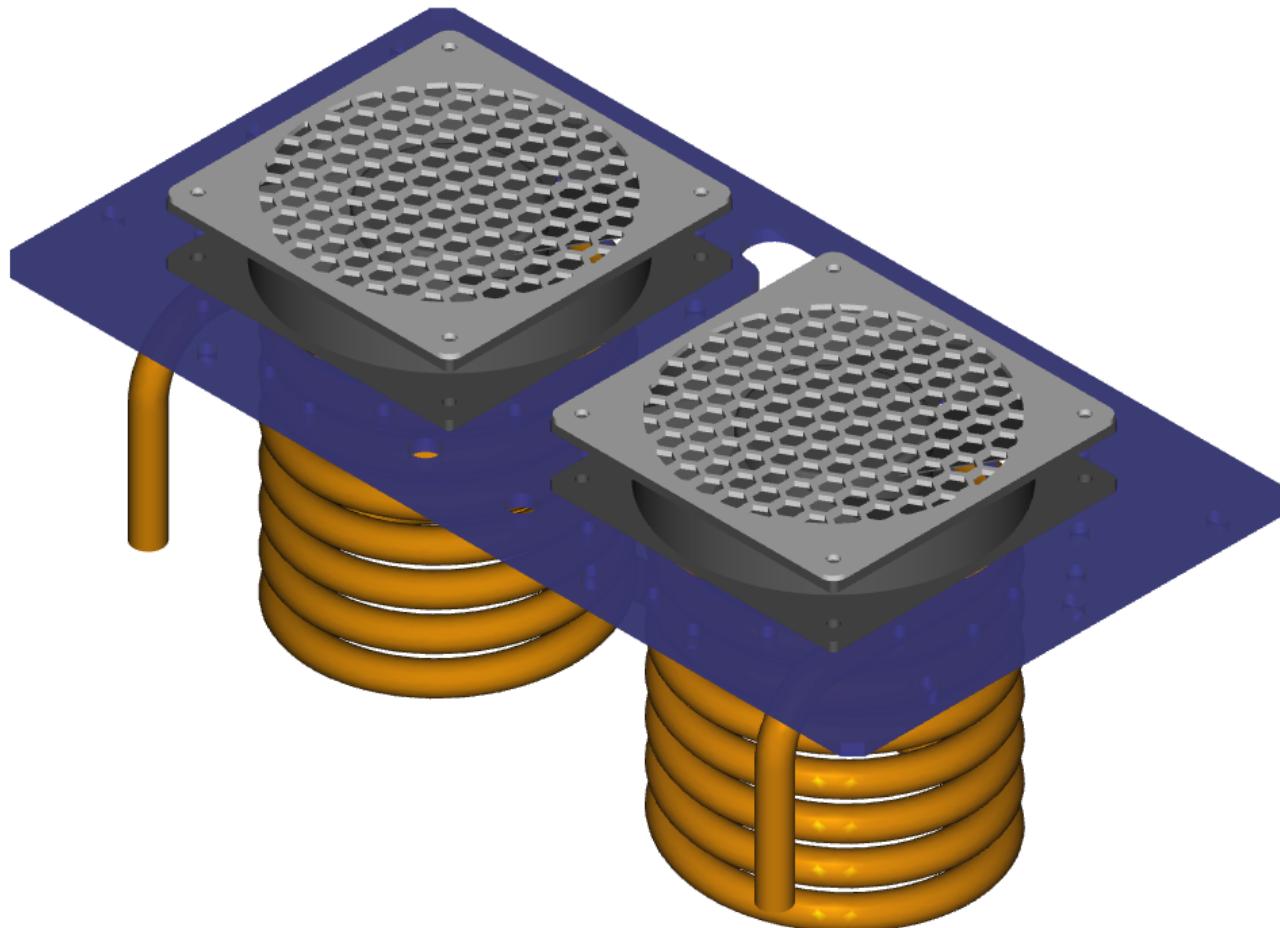
Add two fans such that the flow direction is in the upward direction



Add the protective grilles for each fan and fasten the whole assembly using 4 mm hardware



Attach the copper cooling coils under the fans, using zip ties via the multiple mounting holes provided around the fans



This completes the copper cooling coil and fan assembly

8. COMPRESSOR COOLING FAN SUB-ASSEMBLY

Parts Required

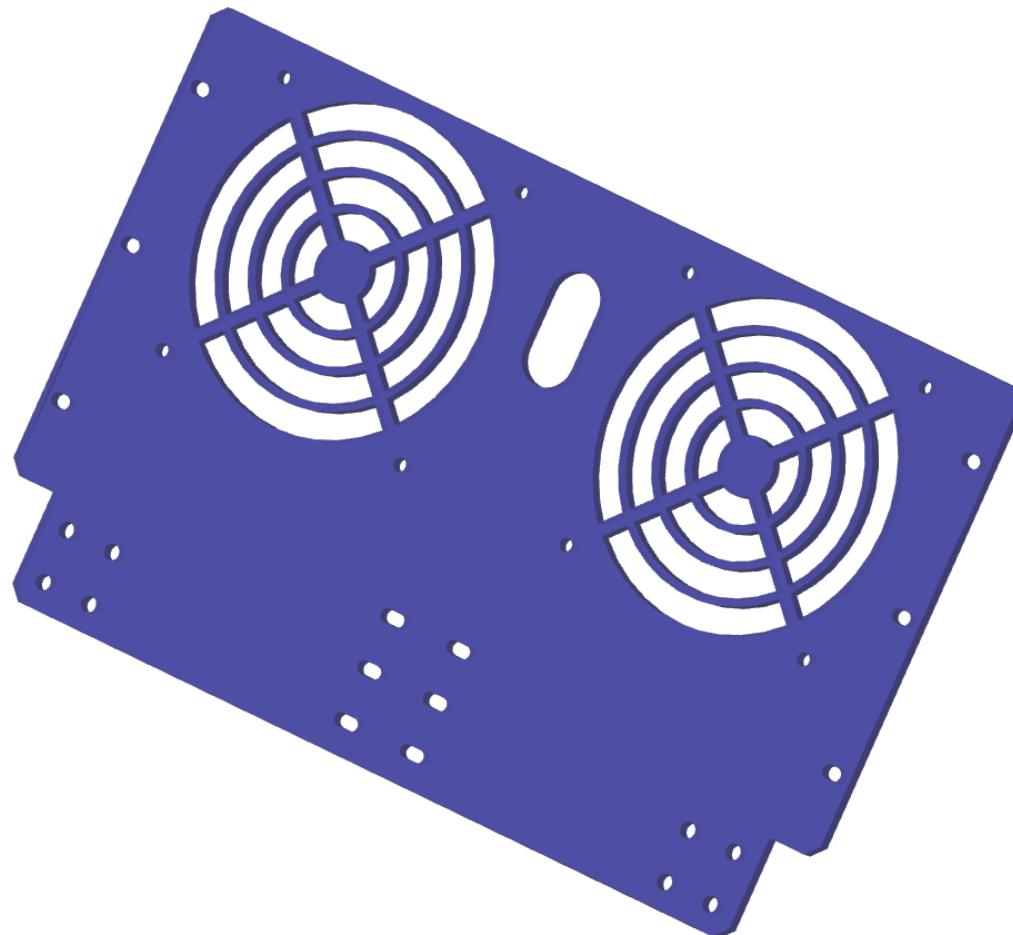
- [Laser cut acrylic plate, 5 mm thick, for cooling coil assembly](#)
- [Cooling Fans, 24 V DC, 120 mm size, quantity 2 nos.](#)
- [Laser cut acrylic fan grilles \(protective plate\), 2 mm thick, quantity 2 nos.](#)
- Mounting hardware - 4 mm x 50 mm bolts, 4 mm nuts, 4 mm plain washers - quantity 8 nos each
- [Solenoid Valve, 5/2, 24 V DC Coil](#)

Tools Required

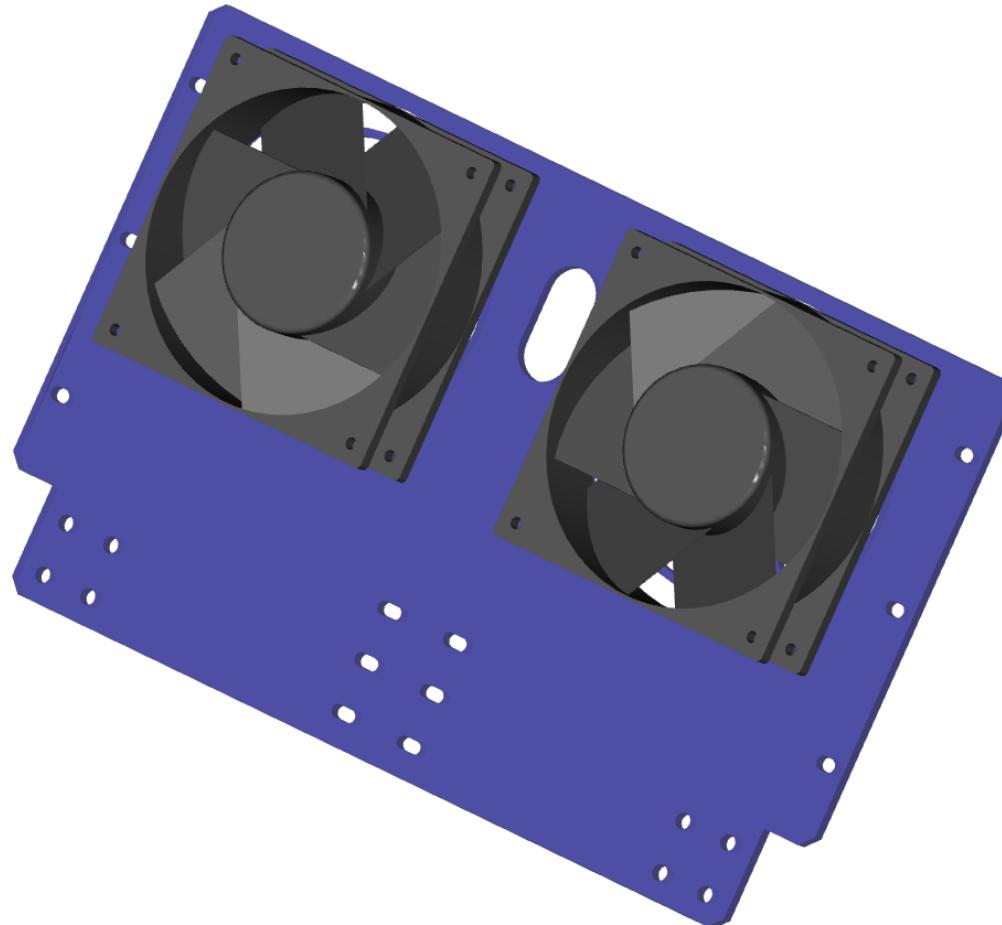
- Screwdriver
- Nut spanner, 4 mm
- Pliers / Cutter

Process

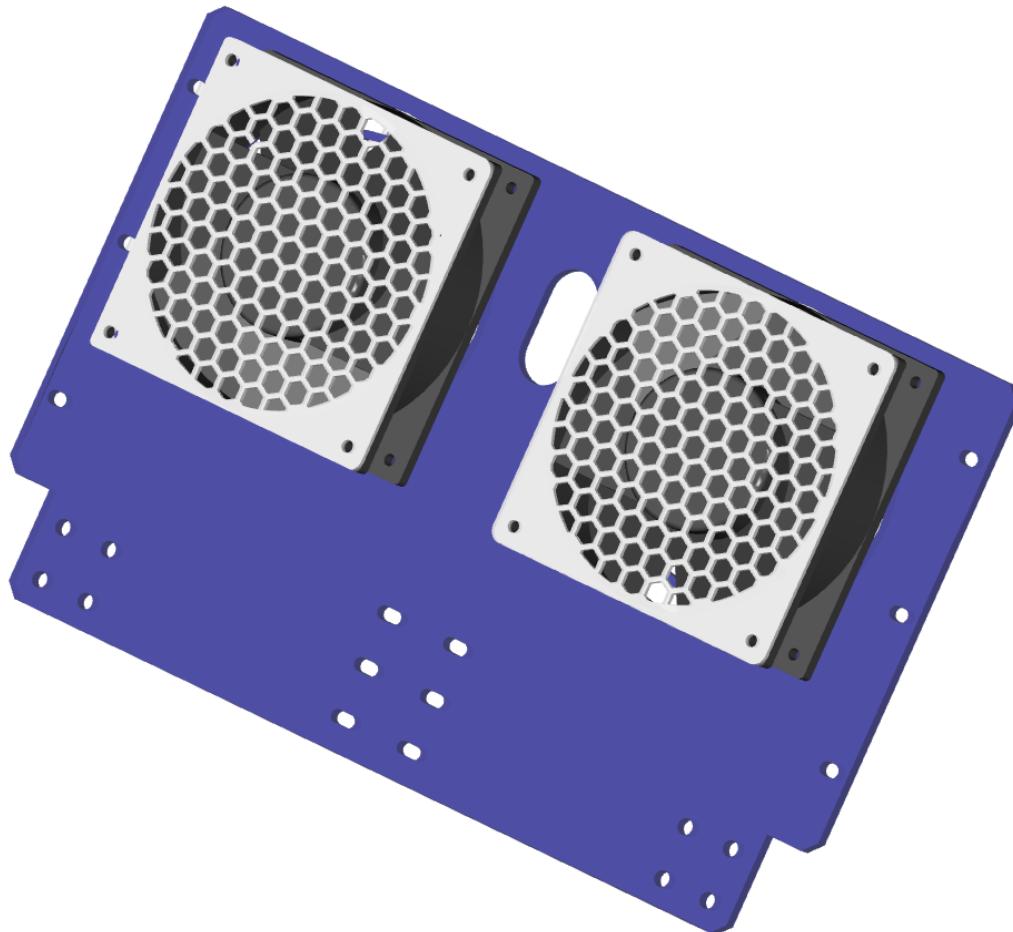
- Prepare the compressor cooling fan assembly as per the accompanying drawings.
- Extend the length of the fan wires enough to reach the 24 V DC SMPS, and bunch them in a single harness.
- Add connection wires to the solenoid coils of the 5/2 pneumatic valve enough to reach the Relay shield.



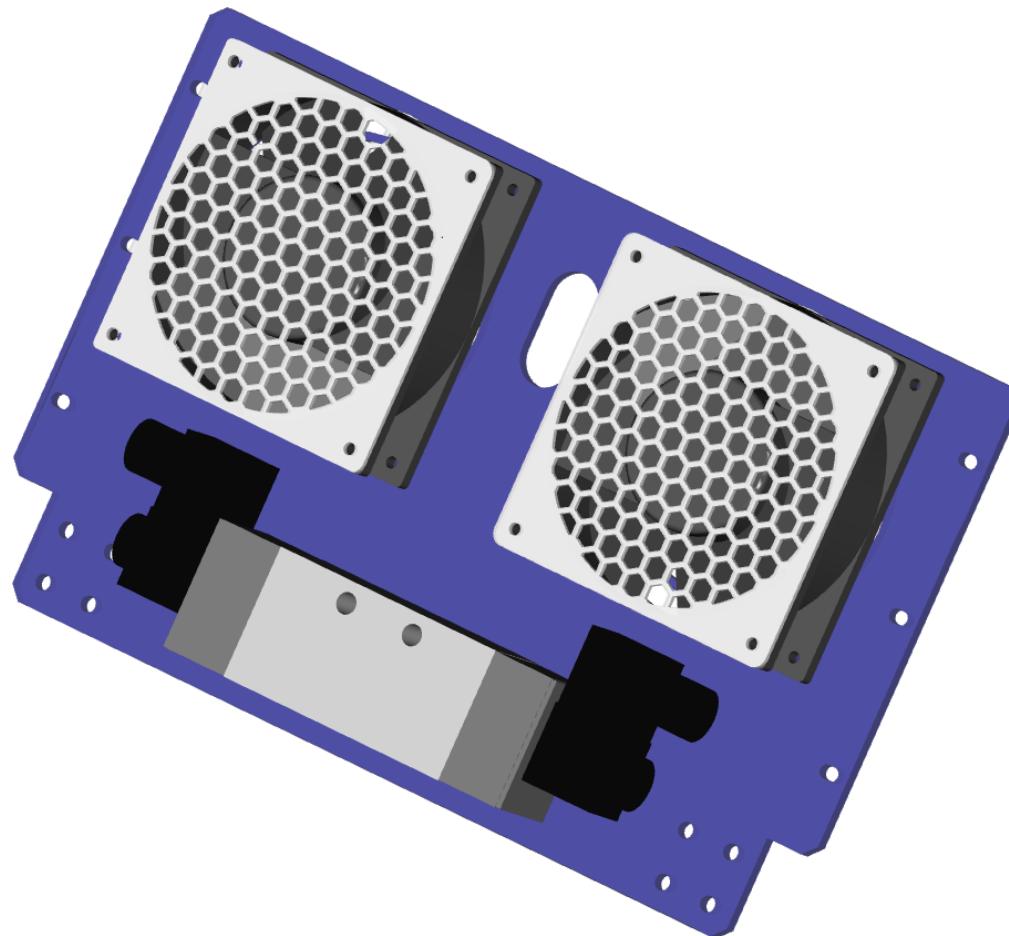
Compressor cooling fan mount plate



Add two fans such that the flow direction is towards the compressor



Add the protective grilles for each fan and fasten the whole assembly using 4 mm hardware



Fix the 5/2 solenoid valve, using 4 mm hardware. Solenoid outputs A/B are at the bottom, and inlets + exhaust are at the top

9. COMPRESSOR SUB-ASSEMBLY

Parts Required

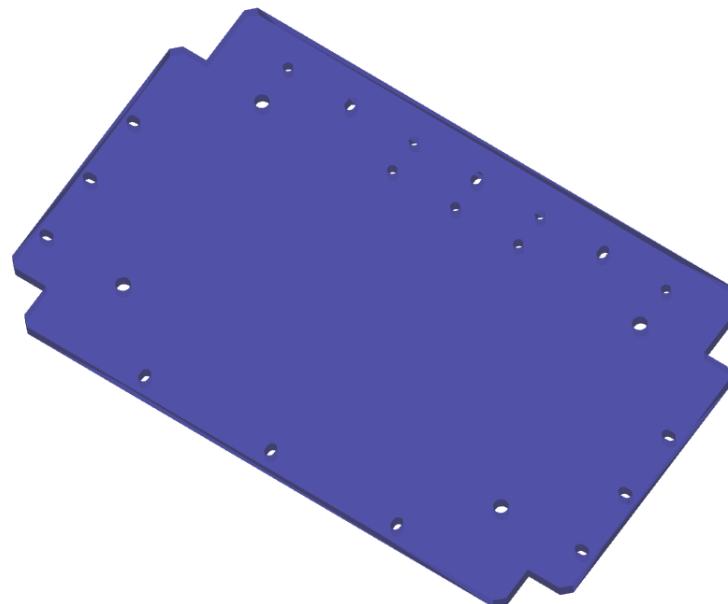
- [Laser cut acrylic plate, 5 mm thick, for compressor](#)
- [Compressor, 1800 W, high flow rate with matching capacitor](#)
- Compressor anti-vibration mounts (rubber)
- Mounting hardware
- Zip ties

Tools Required

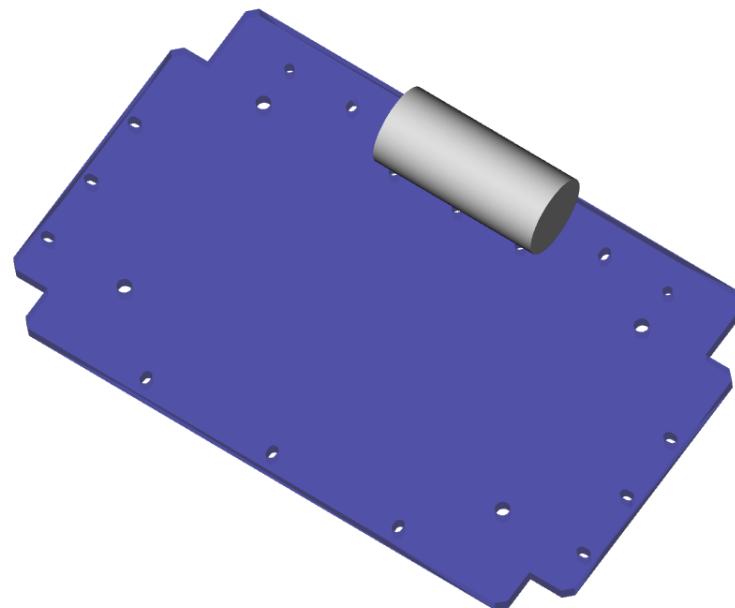
- Screwdriver
- Spanners
- Pliers / Cutter

Process

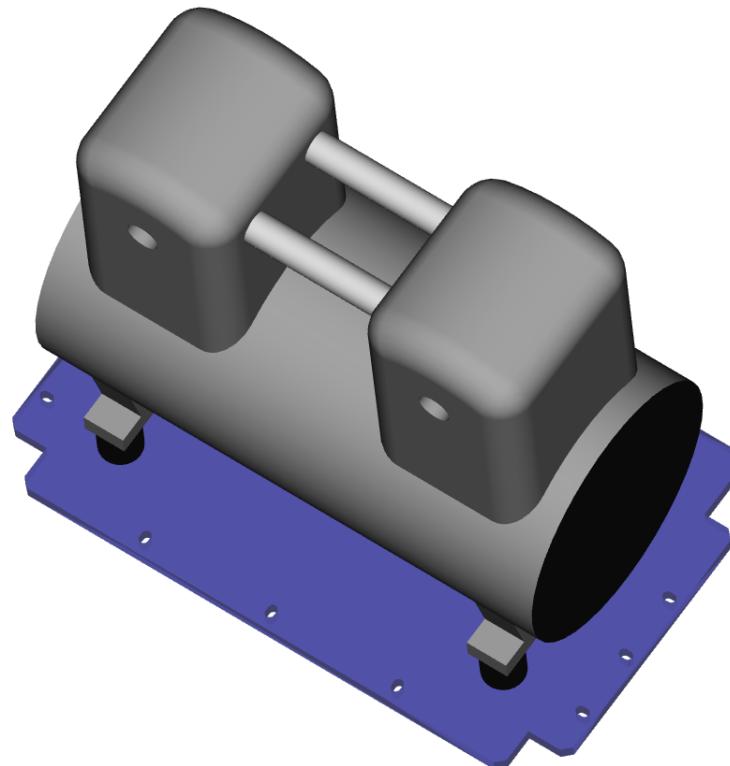
- Prepare the compressor assembly as per the accompanying drawings.
- Fix the compressor capacitor to the acrylic plate using zip ties
- Fix the compressor to the acrylic plate using the rubber anti-vibration mounts
- Connect the capacitor to the compressor, and make sure the joints are well insulated (use heat shrink tubing)
- Extend the length of the compressor wires enough to reach the compressor contactor on the electronics mount plate and bunch them in a single harness.
- Make sure that the GND wire of the compressor is connected to the metal aluminum frame.



Compressor mount plate - For greater stiffness, use 8 mm acrylic sheet instead of 5 mm



Attach the capacitor to the acrylic plate using zip ties



Fix the compressor to the mount plate using the rubber anti-vibration mounts.

10. ELECTRONICS SUB-ASSEMBLY

Parts Required

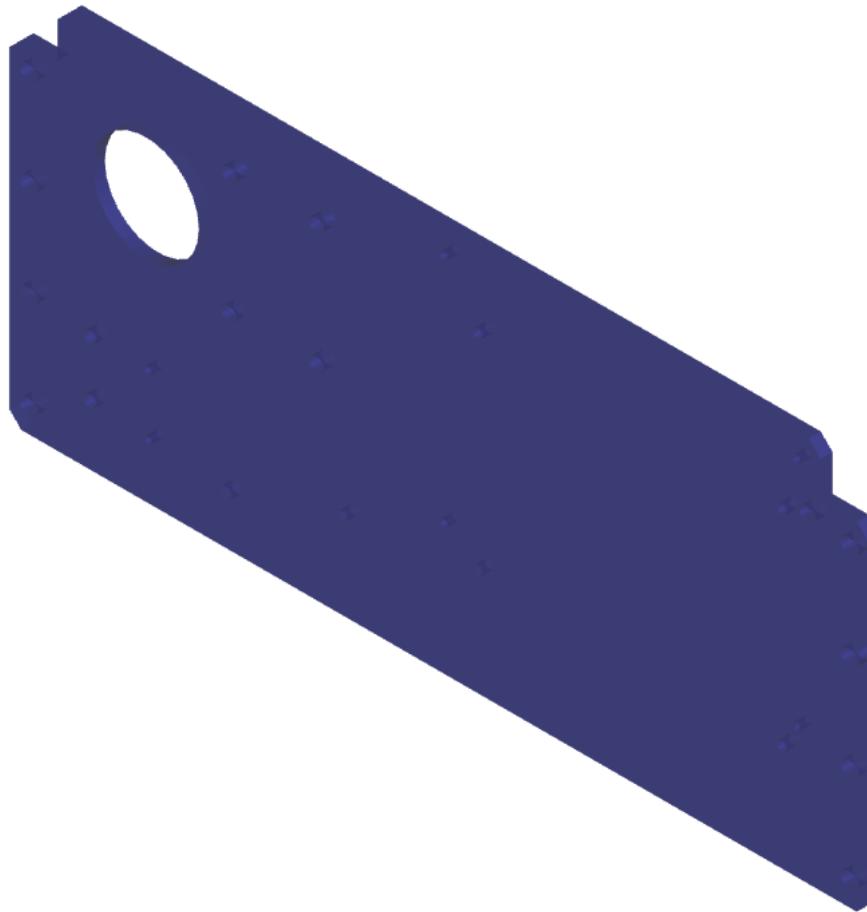
- [Laser cut acrylic plate, 5 mm thick, for electronics sub-assembly](#)
- Enclosed type SMPS, 230 V AC, 50 Hz input, 24 V DC, 100 W or greater
- Electronics PCB (consisting of microcontroller, Relay shield, 24 V DC to 5 V DC buck converter and DHT-22 ambient temperature / humidity sensor)
- Compressor Contactor, 24 V DC coil, 10 A or more contact rating at 230 V AC
- Over-pressure safety switch, Danfoss KP-35 or equivalent
- Low pressure regulator, pneumatic
- Mounting hardware
- Zip ties

Tools Required

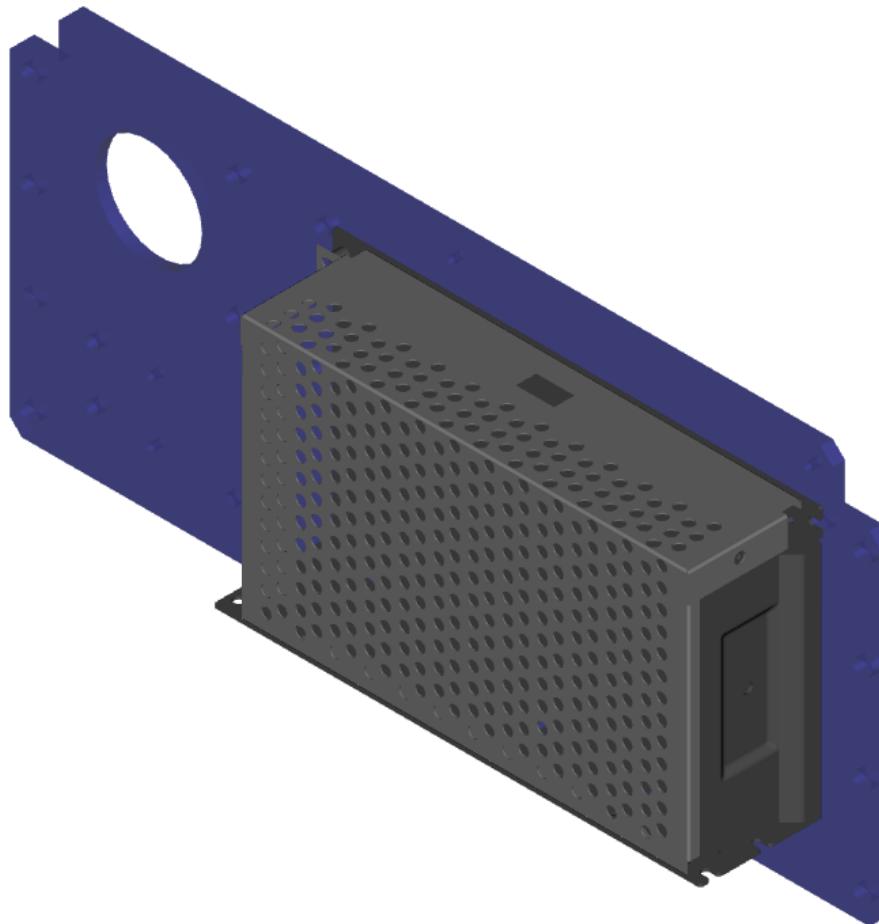
- Screwdriver
- Spanners
- Pliers / Cutter

Process

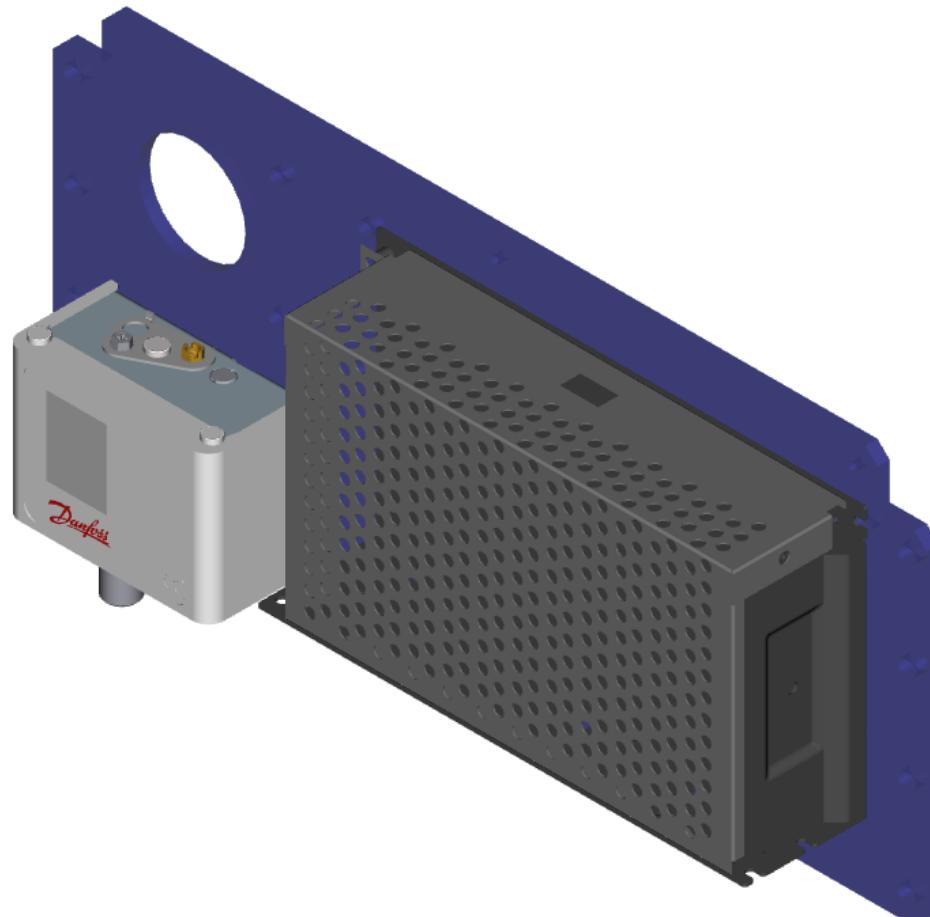
- Prepare the electronics sub-assembly as per the accompanying drawings.
- Fix the SMPS, the electronics PCB, compressor contactor, over-pressure safety switch and the low pressure regulator.



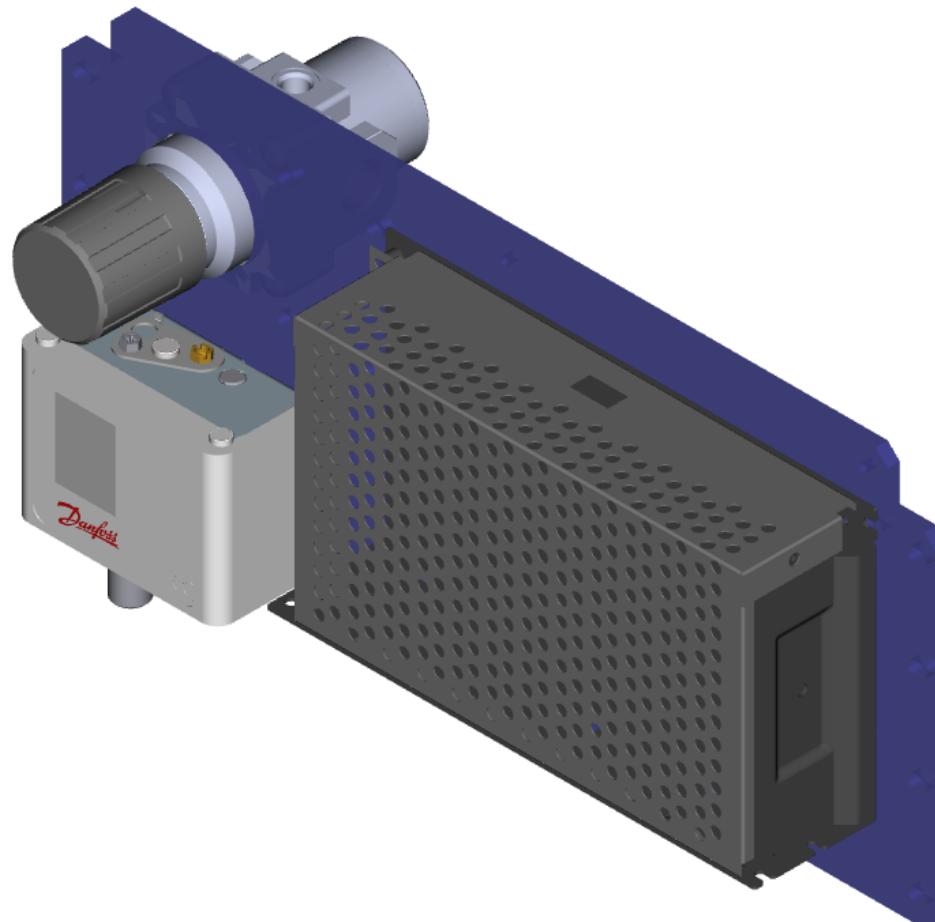
Start with the electronics sub-assembly acrylic plate



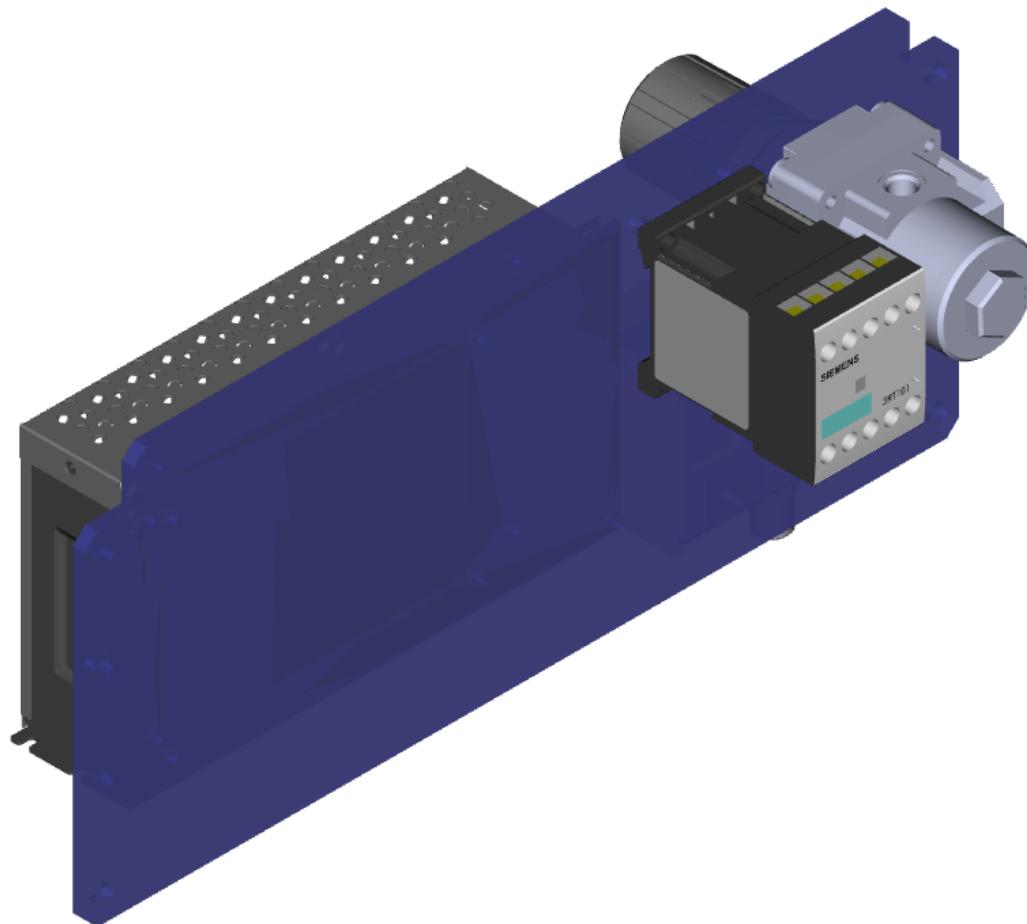
Fix the 24 V DC SMPS



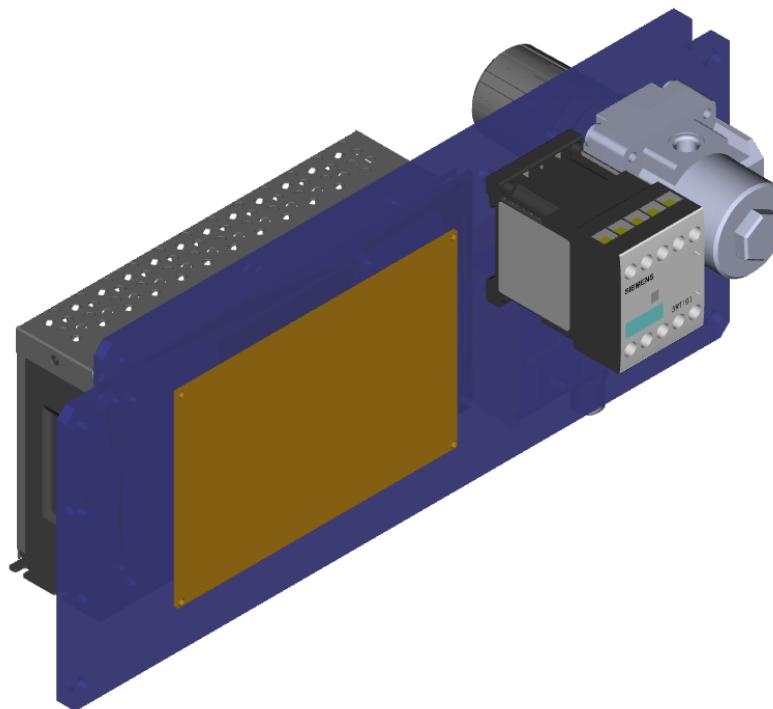
Fix the Danfoss KP35 (or equivalent) over-pressure safety switch



Fix the low pressure regulator



On the other side of the acrylic plate, fix the compressor contactor



As a last step, install the electronics PCB

11. FRONT PANEL SUB-ASSEMBLY

Parts Required

- [Laser cut acrylic plate, 5 mm thick, for front panel sub-assembly with laser engraved text and graphics](#)
- Emergency mushroom pushbutton, with two NC contacts
- Rocker switch, 2 pole, with integrated indicator lamp
- Fuse holder, for 20 x 5 mm cartridge fuse
- Front panel PCB
- 3D printed button cap (optional)
- Mounting hardware
- Zip ties

Tools Required

- Screwdriver
- Spanners
- Pliers / Cutter

Process

- Prepare the front panel sub-assembly as per the accompanying drawings.



Start with the front panel sub-assembly acrylic plate



Install the high voltage circuit parts - Emergency switch, rocker switch, fuse holder and hour counter (run time indicator)



Install the low voltage circuit parts - front PCB, Status LED, Buzzer/Speaker and Compressor switch

12. MOISTURE SEPARATOR SUB-ASSEMBLY

Parts Required

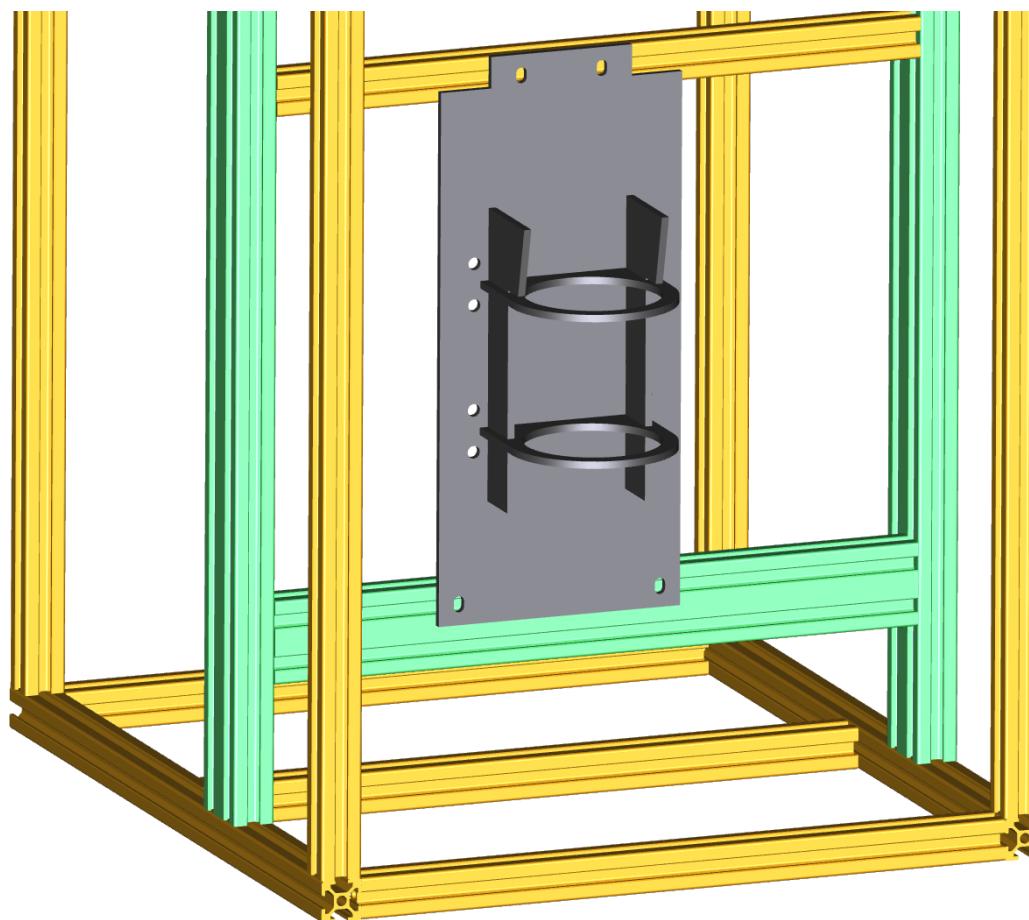
- [Laser cut ACP plates, 3 mm thick, set of 5 pieces as per BoM](#)
- Moisture Separator
- Auto-drain attachment
- Pneumatic hardware to extend drain outlet to the rear panel
- Mounting hardware
- Zip ties

Tools Required

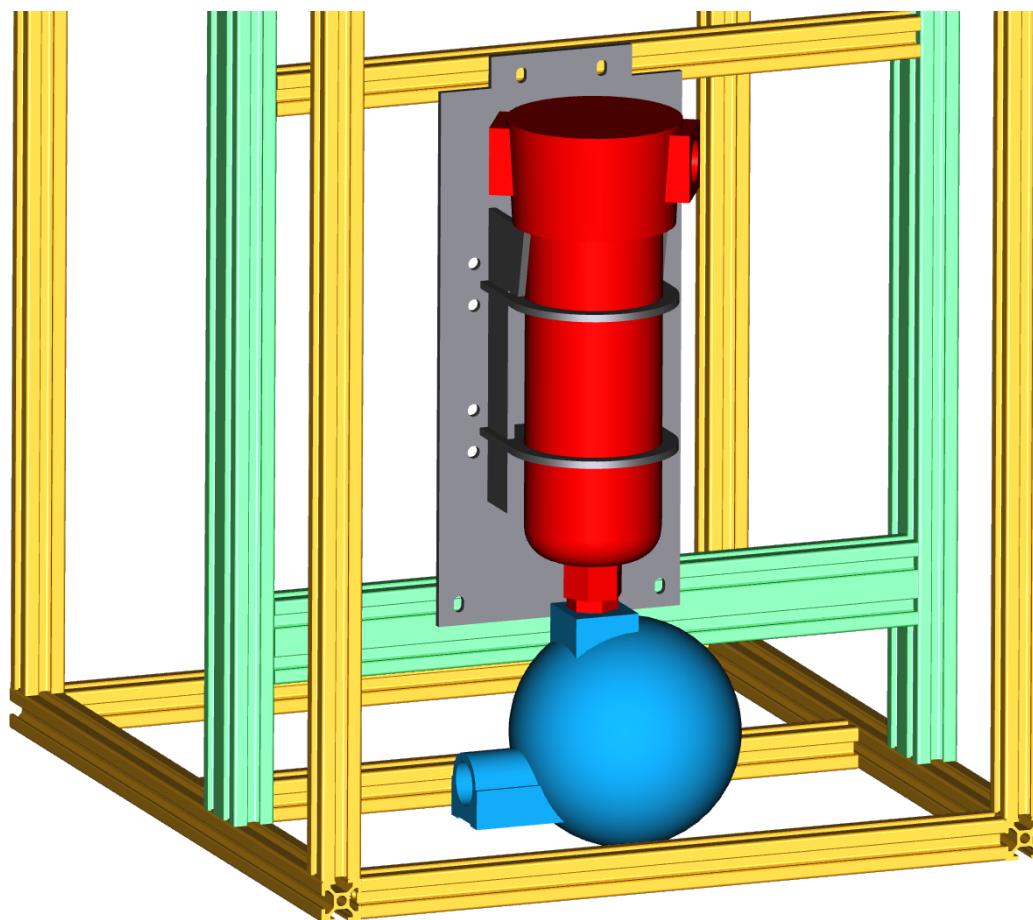
- Screwdriver
- Spanners
- Pliers / Cutter

Process

- Depending on the type and model of the moisture separator used, you can either use the provided drawing files for the mounting plates, or modify the design to suit any changes
- The moisture separator water outlet needs to be extended to the rear panel by adding suitable pneumatic hardware and tubing



The moisture separator mounting bracket consists of five interlocking pieces of 3 mm ACP panel



The moisture separator and auto drain assembly is fixed to the mounting plate using zip ties through the provided holes

13. OVERALL ASSEMBLY

Parts Required

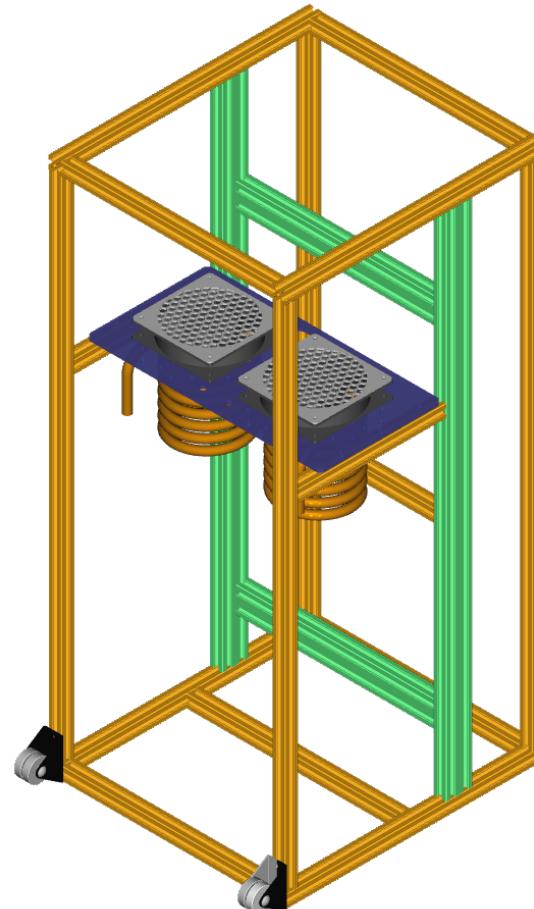
- All of the previously readied sub-assemblies
- Electrical hardware - heat shrink sleeving, PCV wires, etc
- Pneumatic hardware - 10 mm pneumatic tubing, push fit connectors, thread seal PTFE tape, etc
- Mounting hardware
- Zip ties

Tools Required

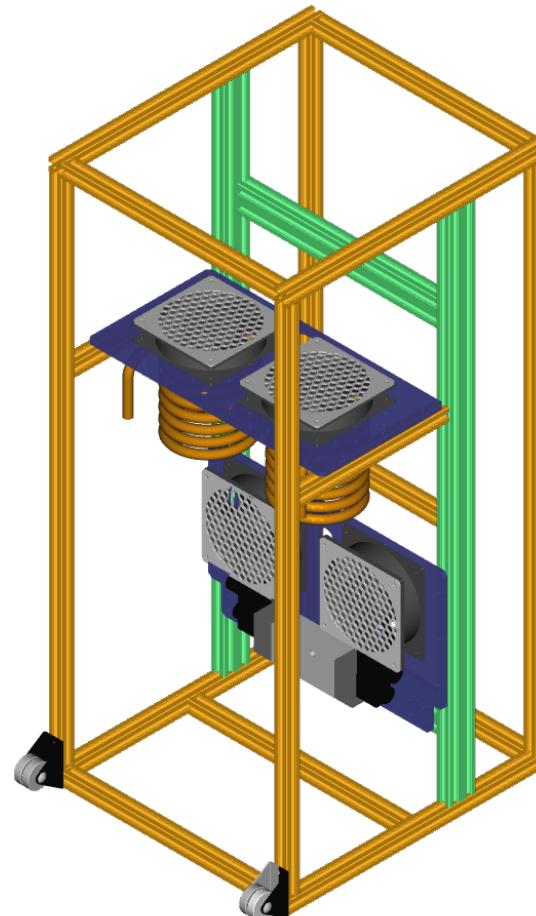
- Screwdriver
- Spanners
- Pliers / Cutter / Wire stripper
- Soldering iron, flux, solder wire

Process

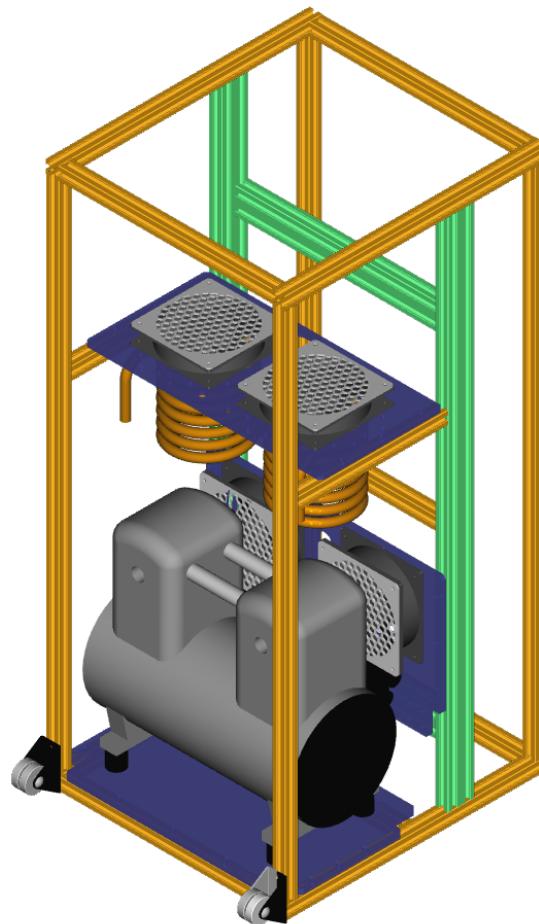
- Fix each of the sub-assemblies to the frame using the guide in the following pages
- After fixing all the sub-assemblies, you can do the pneumatic assembly. Use the pneumatic circuit diagram for reference.
- Some elements have no attachment locations. The orifices are inserted inside the 10 mm pneumatic tubing. The HEPA filter before the output humidifies is "in-line" in the pneumatic tubing.
- For connecting compressor outputs to the two cooling coils, use high-temperature rated tubing (at least 80 °C to 100 °C - preferable metal sheathed)
- Make sure you check for leakages at all joints, using the soap bubble test.
- After pneumatic piping is completed, proceed with the electrical wiring. Use the electrical schematic diagram for reference.



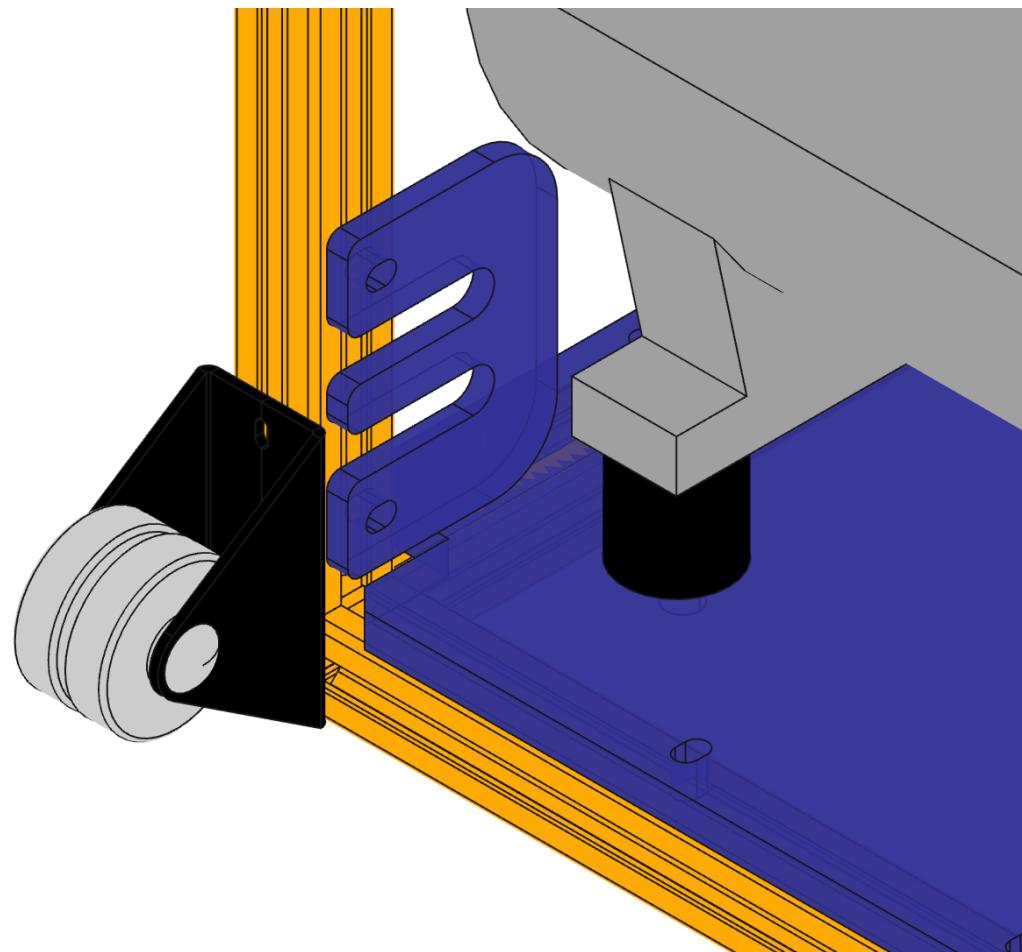
Start with the frame, and fix the copper cooling coil sub-assembly



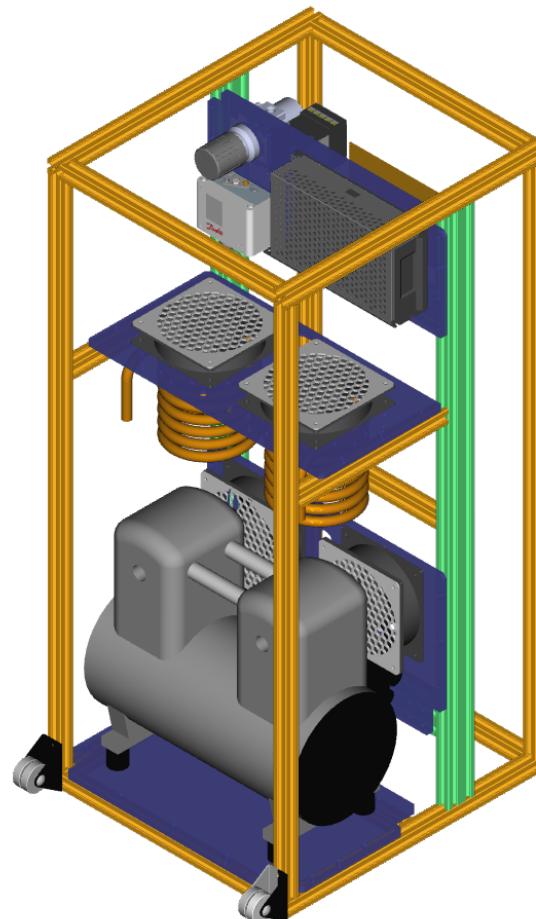
Fix the compressor cooling fans sub-assembly



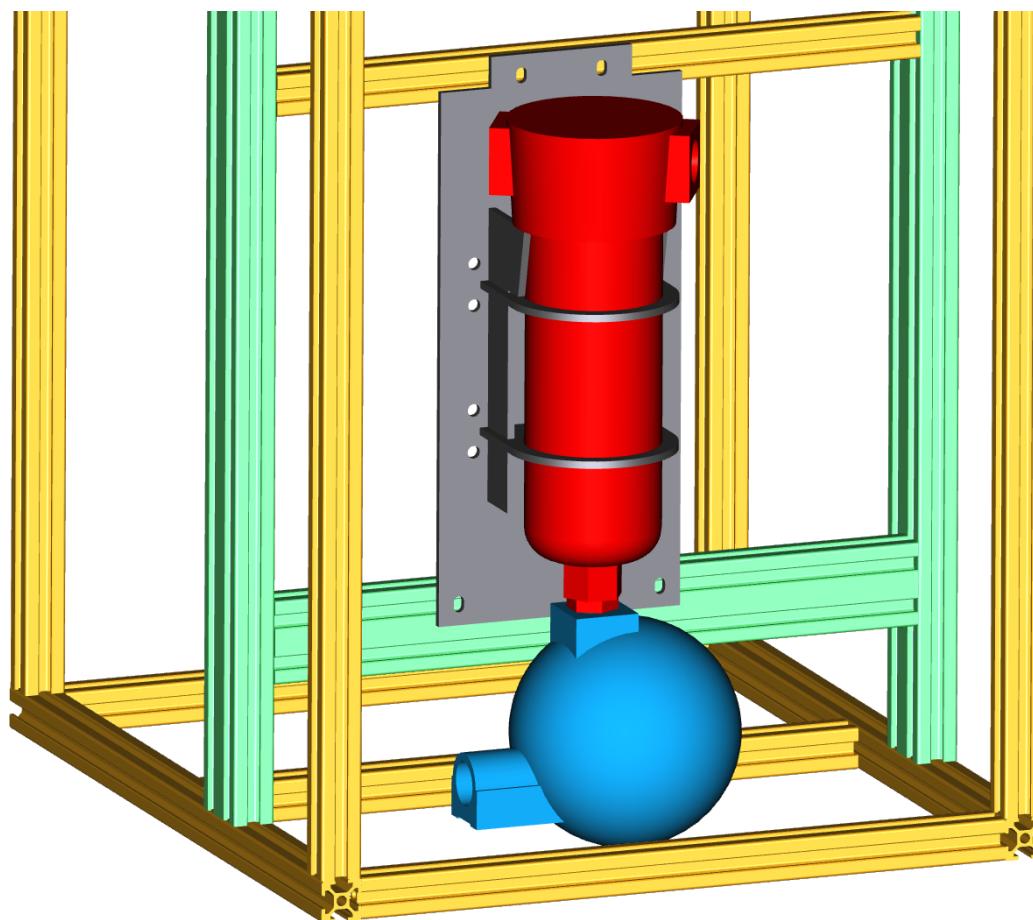
Fix the Compressor sub-assembly. Also, fix a 3 way screw terminal connector on the compressor cooling fan sub-assembly for compressor electrical connections



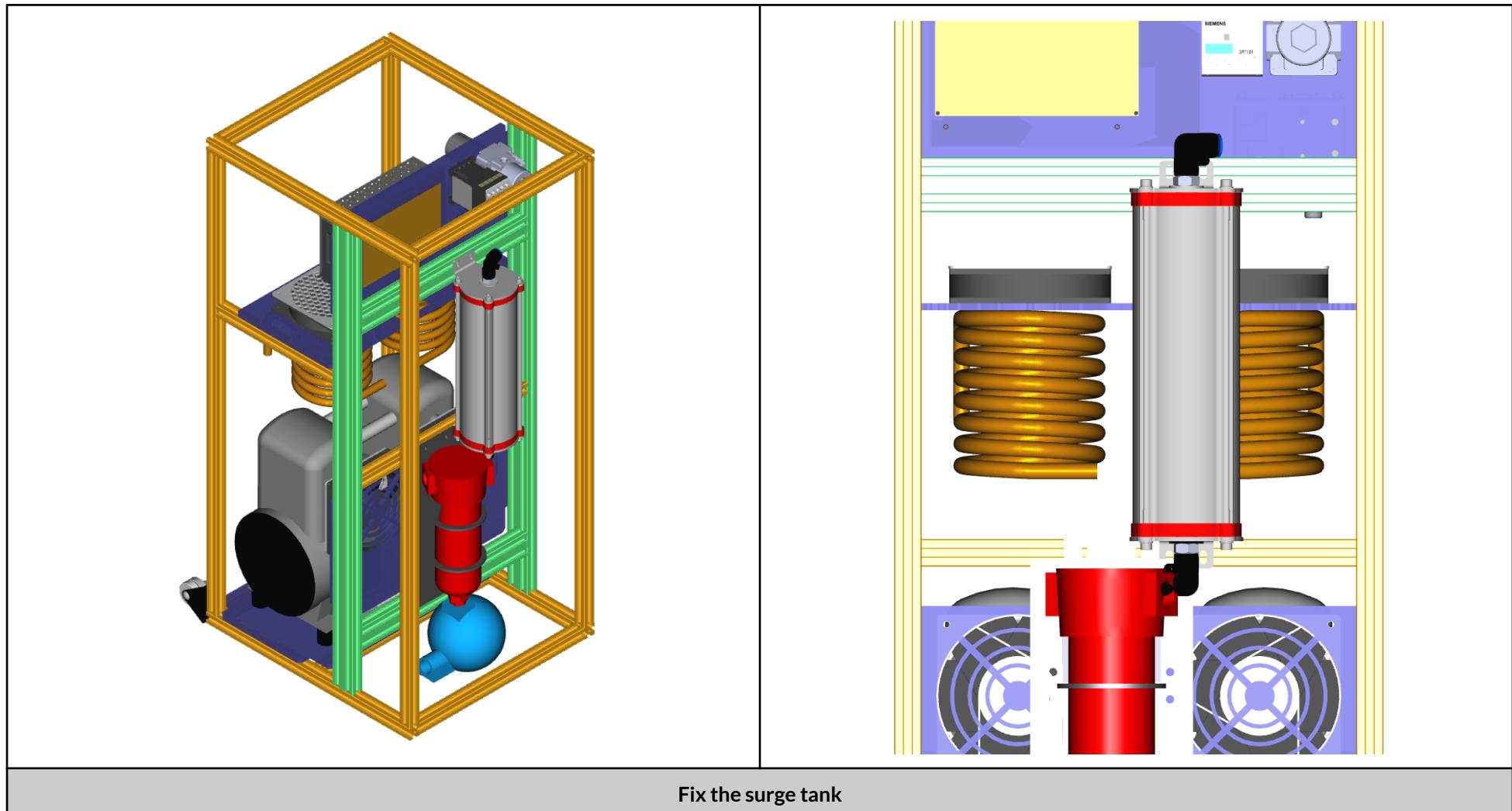
For incoming electrical cable strain relief, fix the strain relief acrylic plate as shown above

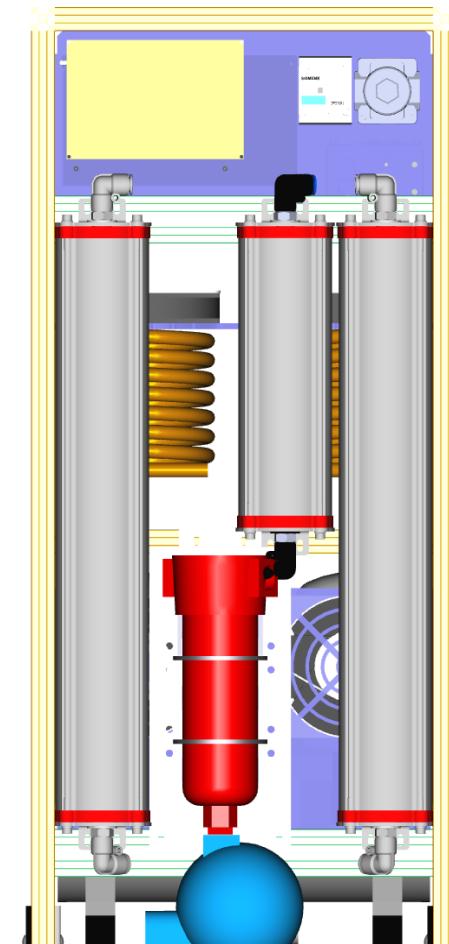
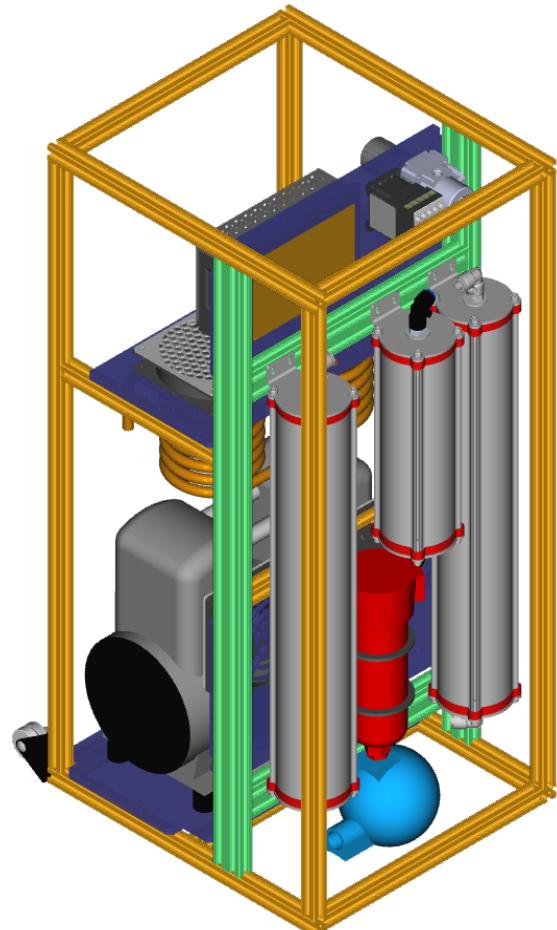


Fix the electronics sub-assembly

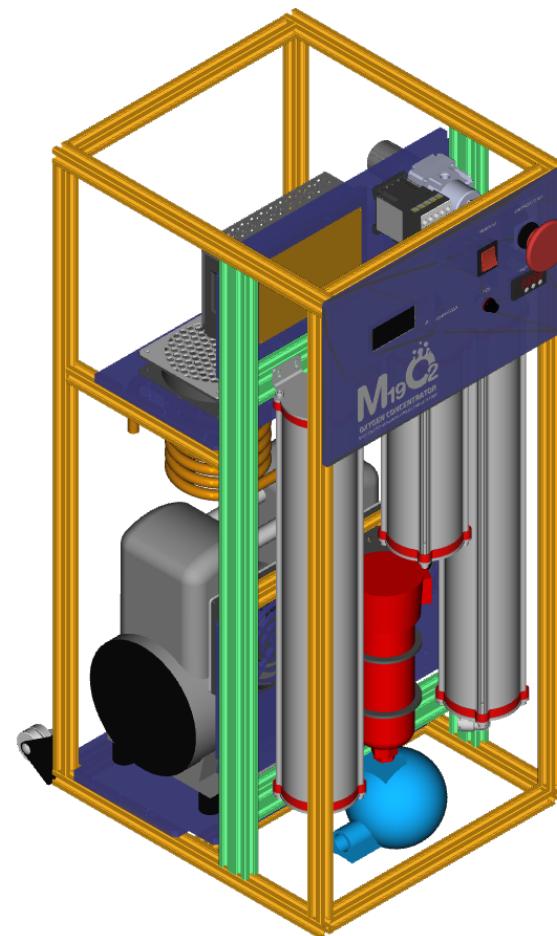


Fix the moisture separator sub-assembly

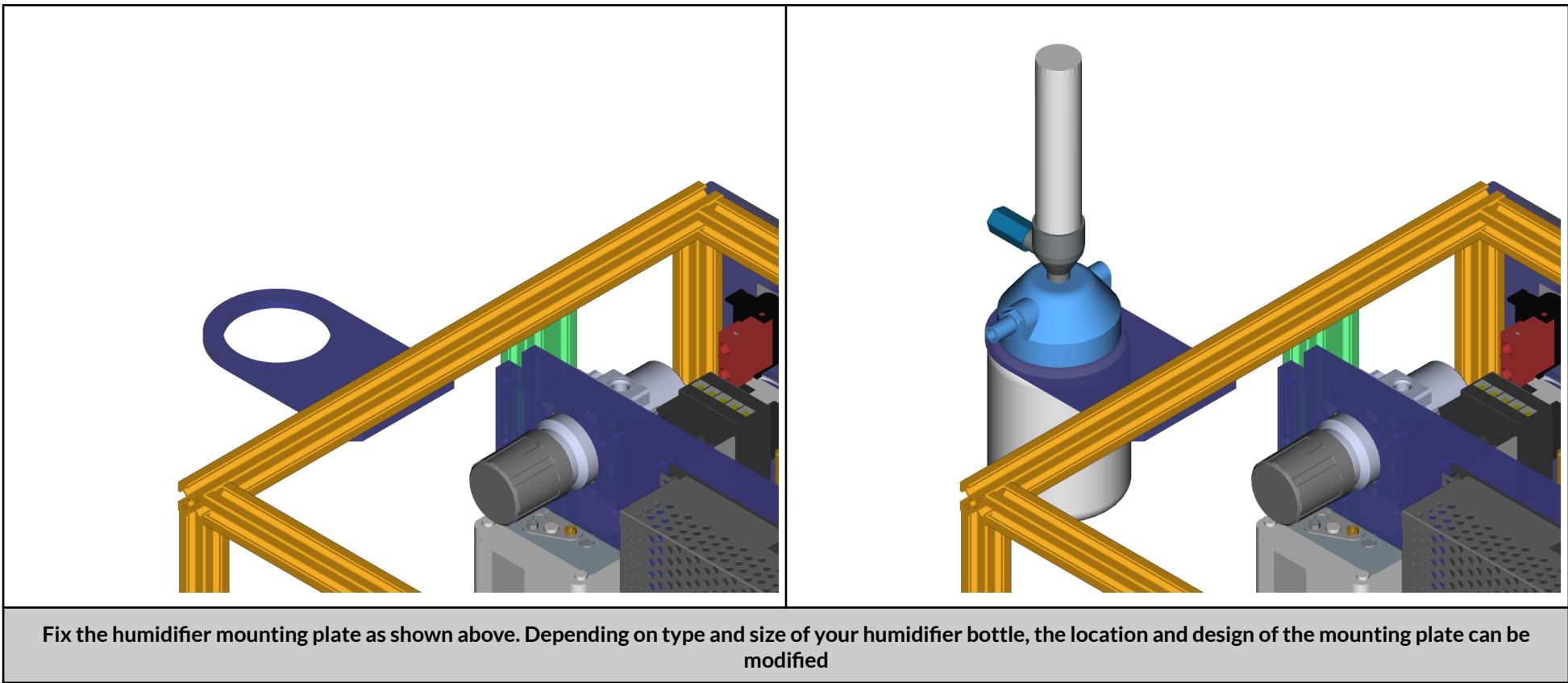


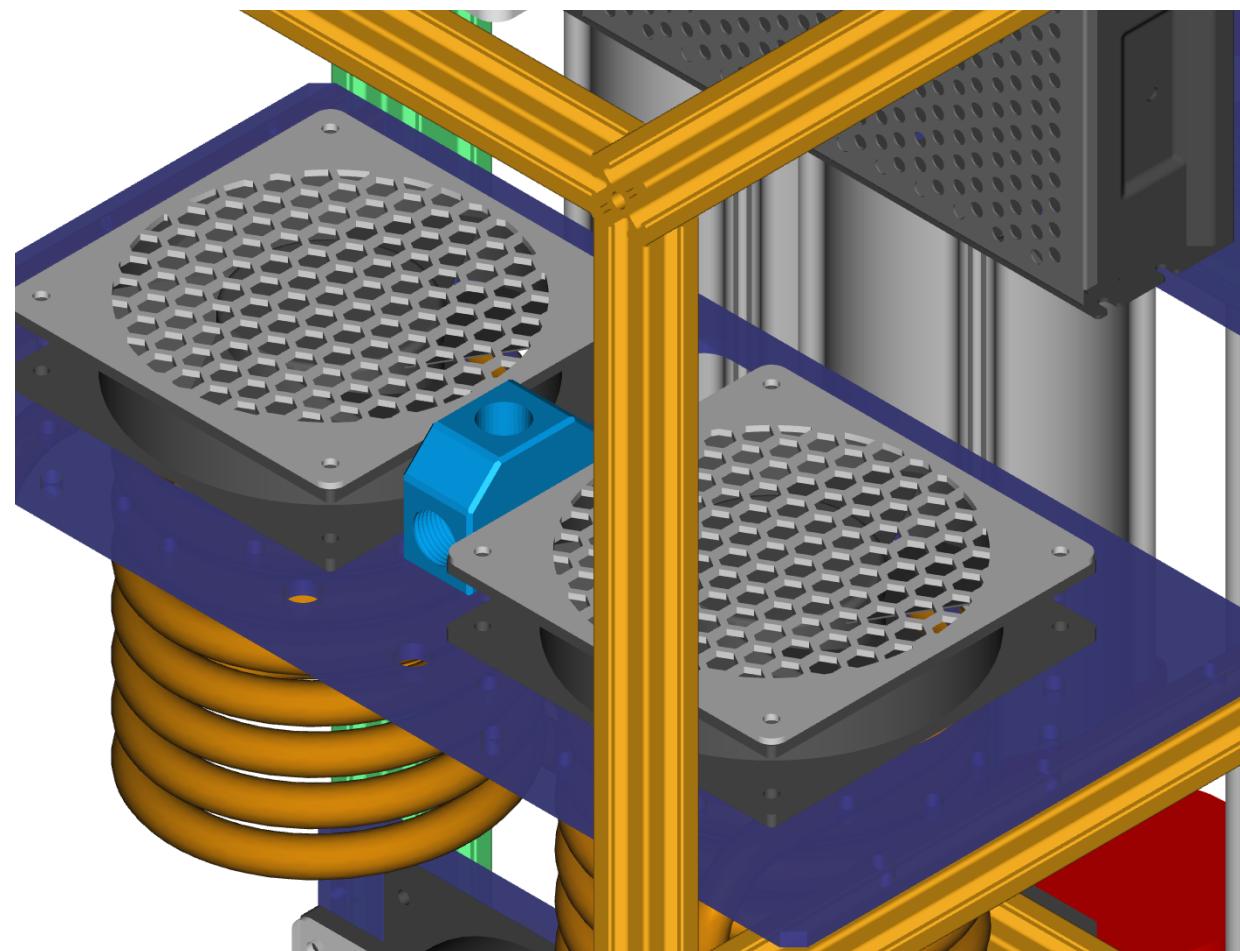


Fix the two molecular sieve canisters

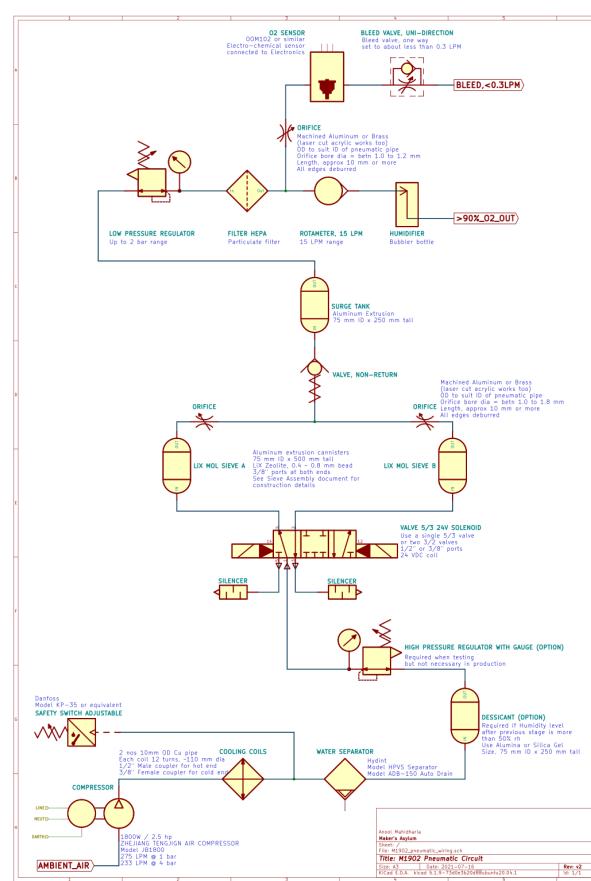


Fix the front panel sub-assembly

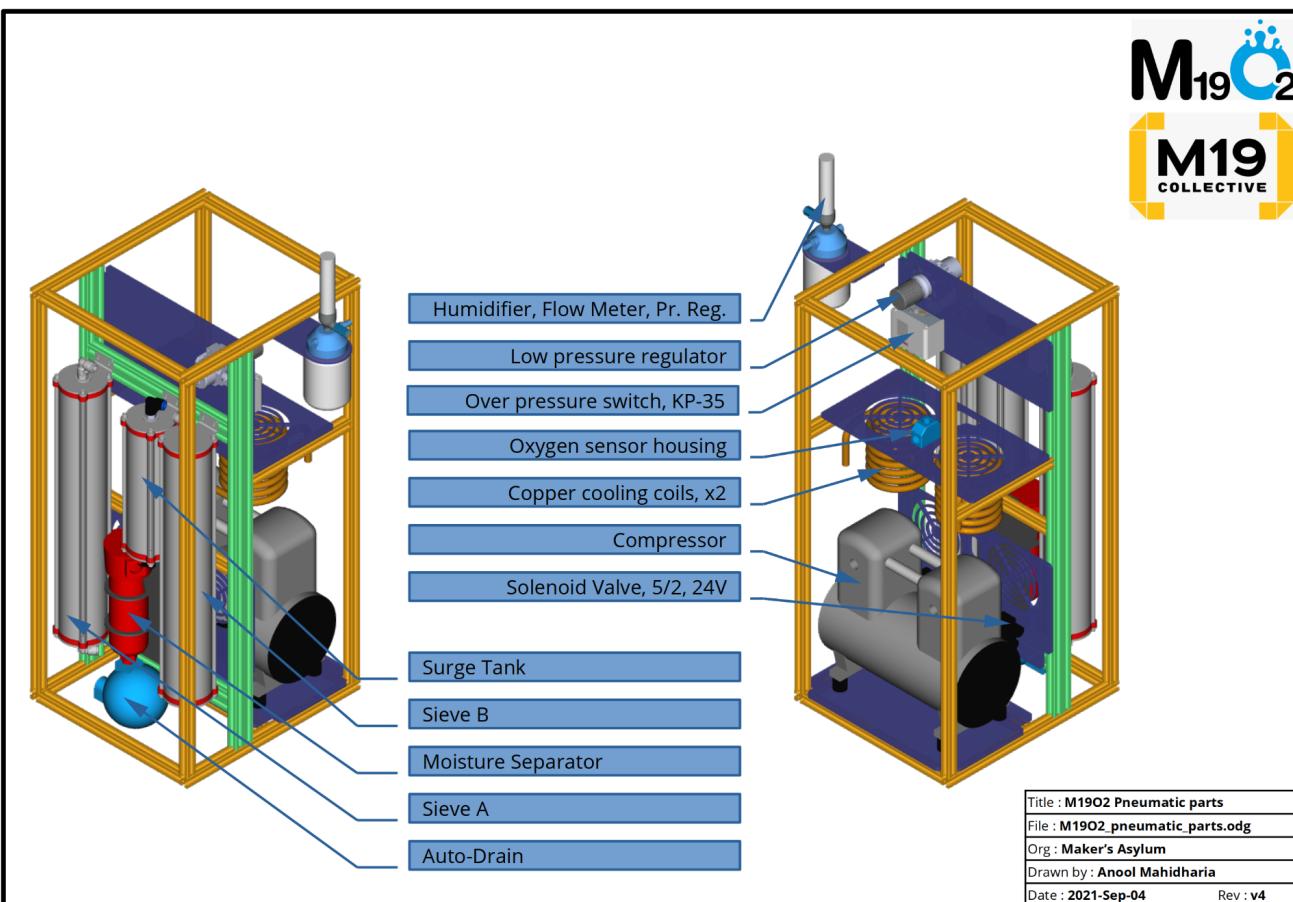




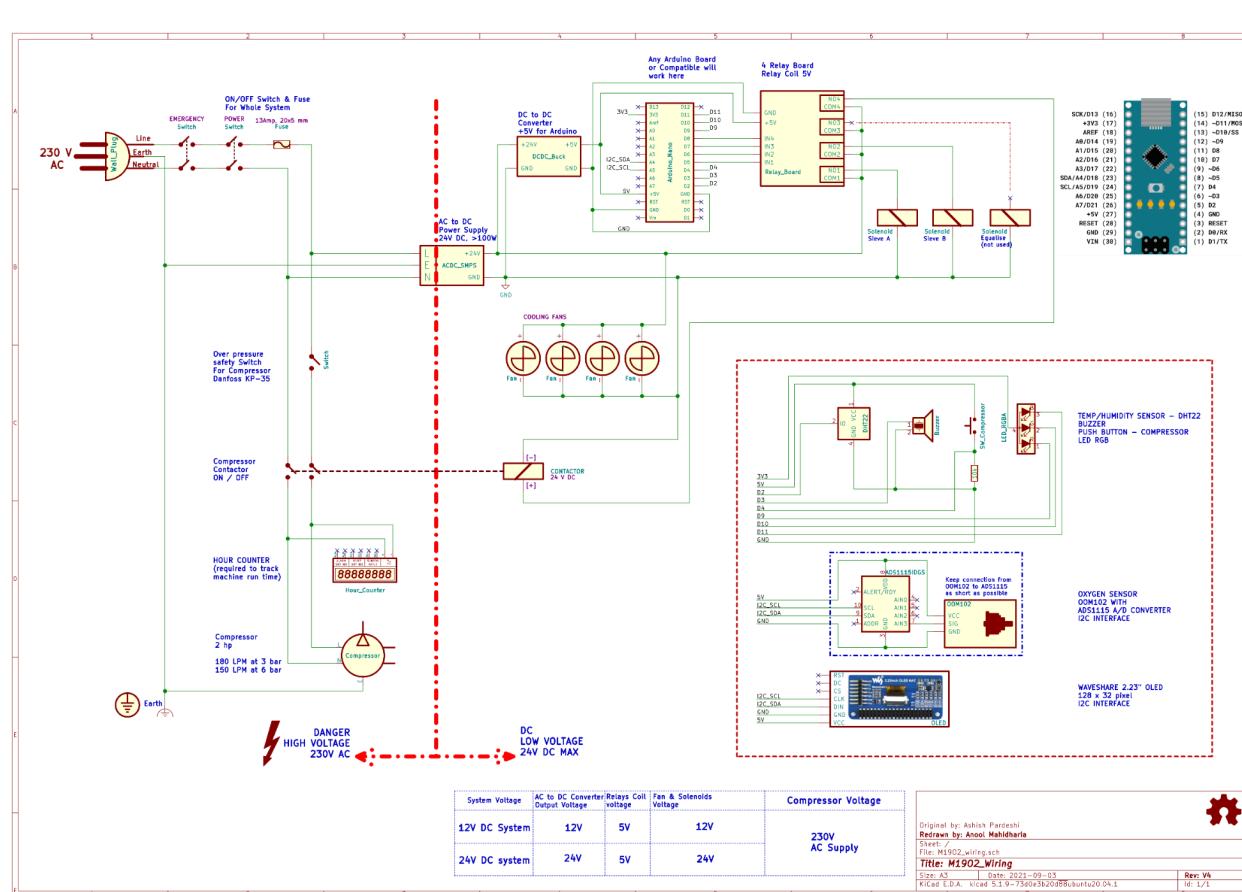
A 3D printed adapter for mounting the Oxygen sensor is fixed between the fans on the copper cooling coil sub-assembly



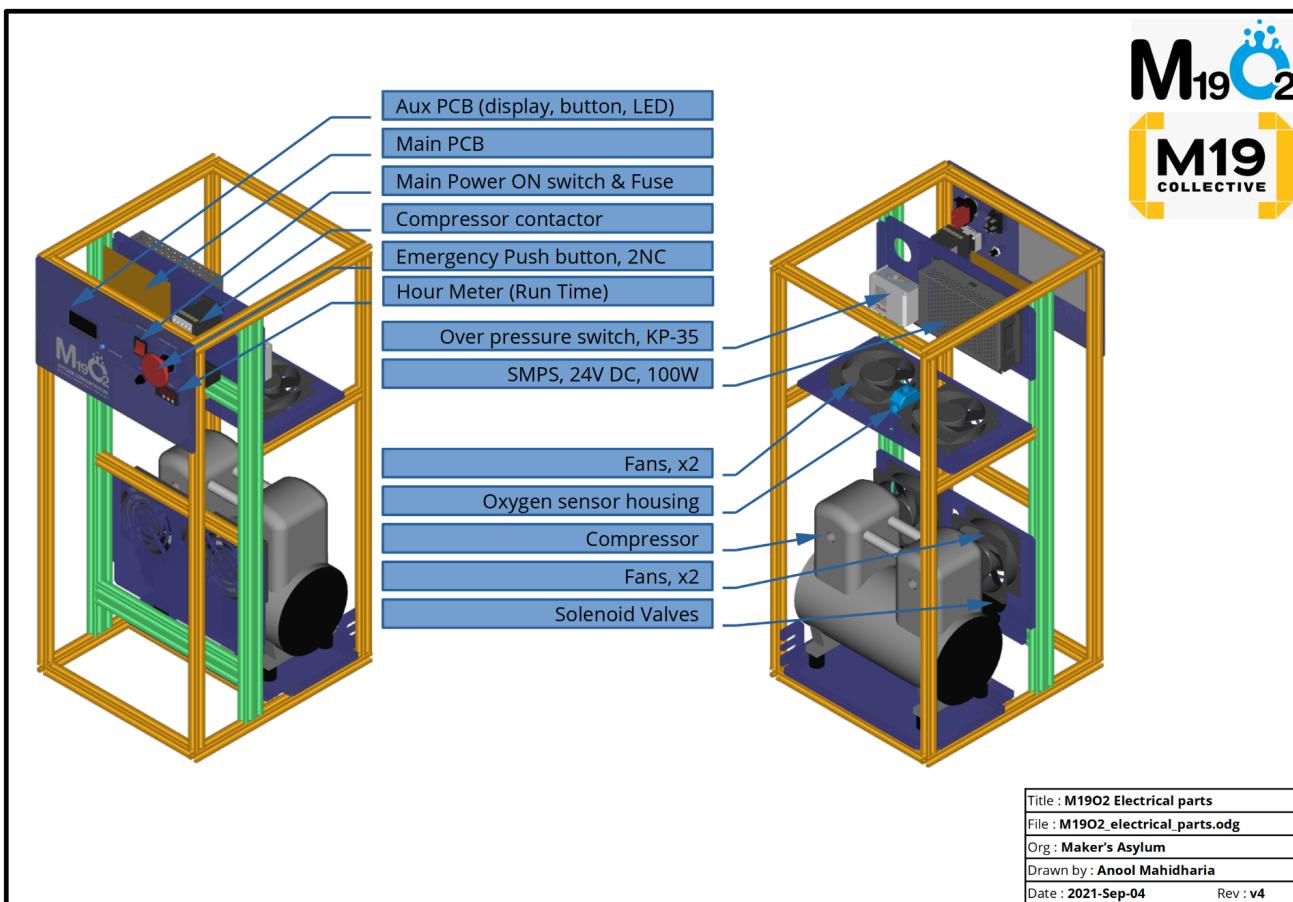
Pneumatic wiring schematic (high resolution PNG, PDF and source formats at this link :
https://github.com/MakersAsylumIndia/M19O2/tree/main/engineering/CAD/M19O2/M19O2_pneumatics



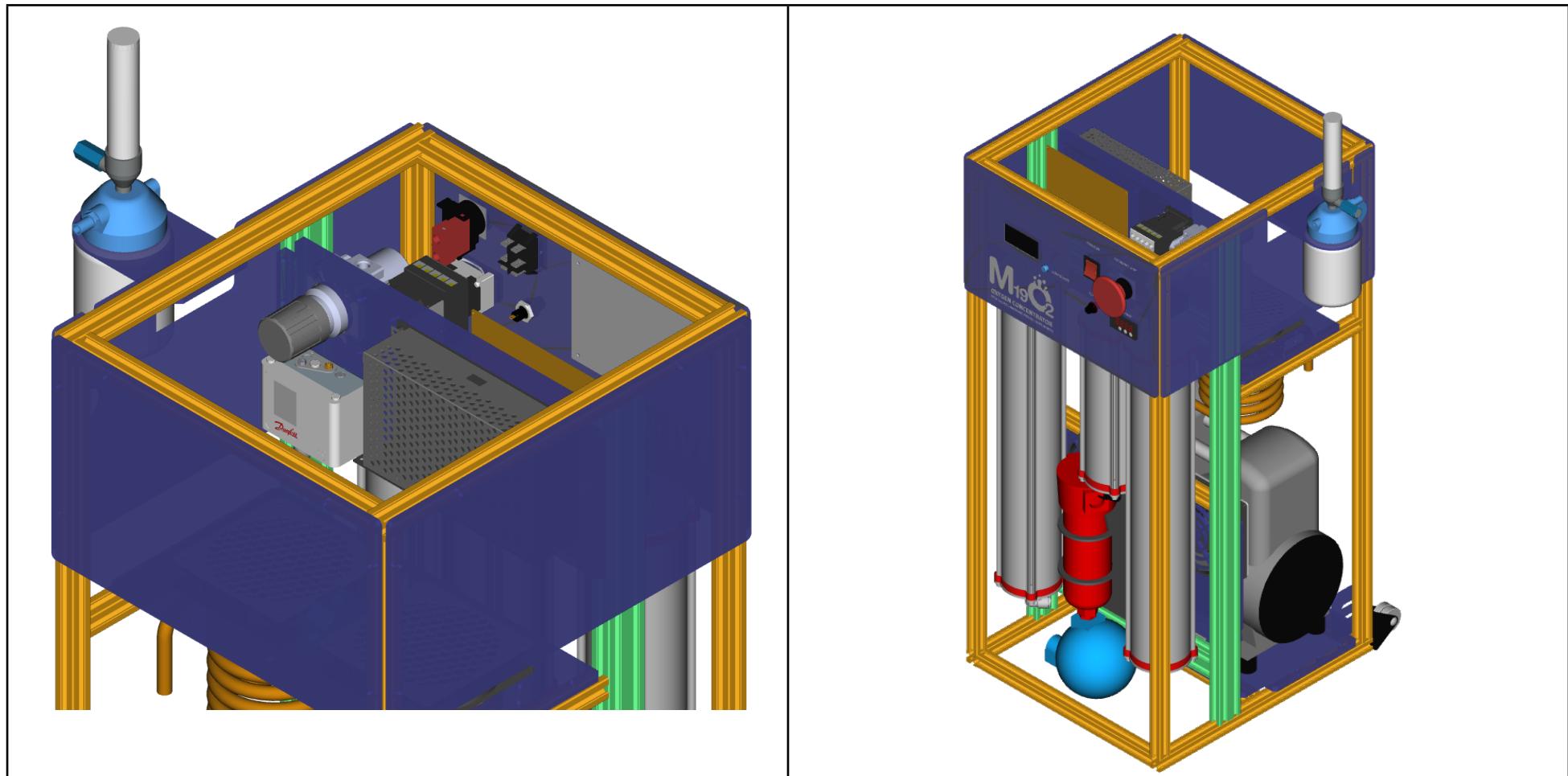
Pneumatic parts identification (high resolution PNG, PDF and source formats at this link :
https://github.com/MakersAsylumIndia/M19O2/tree/main/engineering/CAD/M19O2/M19O2_assembly/drawings



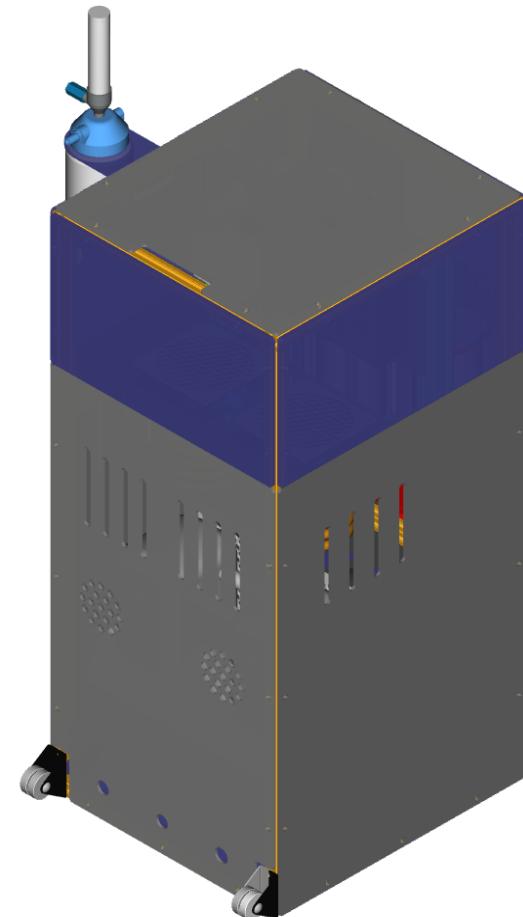
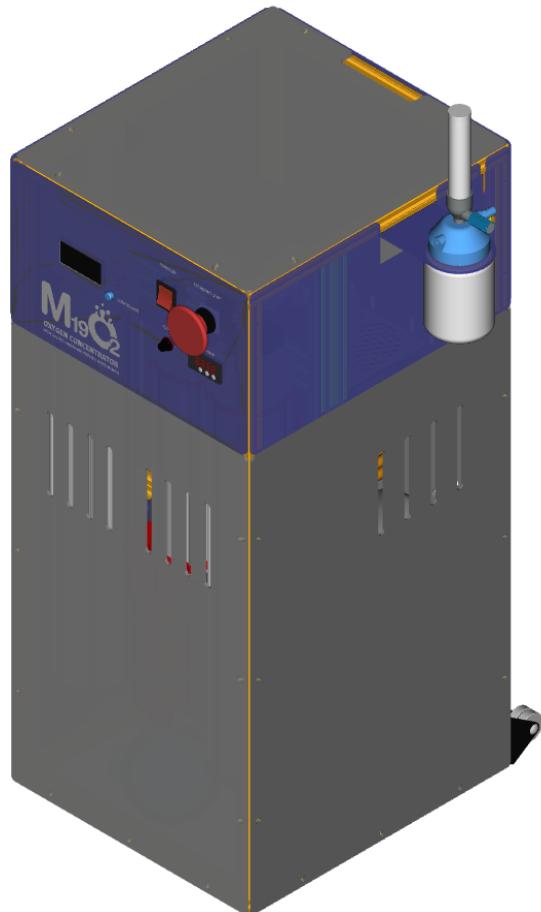
Electrical wiring schematic (high resolution PNG, PDF and source formats at this link :
https://github.com/MakersAsylumIndia/M19O2/tree/main/engineering/ELECTRONICS/M19O2_wiring



Electrical parts identification (high resolution PNG, PDF and source formats at this link :
https://github.com/MakersAsylumIndia/M19O2/tree/main/engineering/CAD/M19O2/M19O2_assembly/drawings



After completing pneumatic and electrical connections, fix the three upper acrylic panels (left, right and rear)



Finally, fix the four ACP lower panels and the top panel to complete assembly of the M19O₂ oxygen concentrator

14. REPRESENTATION & WARRANTIES

M19O2 is intended for use in COVID-19 like situations only. All reasonable care, prevention and precautions (including sanitisation) have been taken while designing and manufacturing **M19O2**.

M19O2 is suitable for usage in (inter-alia) only for the following:

Healthcare personnel refers to all paid and unpaid persons serving in healthcare settings who have the potential for direct or indirect exposure to patients or infectious materials, including body substances (e.g., blood, tissue, and specific body fluids); contaminated medical supplies, devices, and equipment; contaminated environmental surfaces; or contaminated air. These healthcare personnel include, but are not limited to, emergency medical service personnel, nurses, nursing assistants, physicians, technicians, therapists, phlebotomists, pharmacists, dentists and dental hygienists, students and trainees, contractual staff not employed by the healthcare facility, and persons not directly involved in patient care, but who could be exposed to infectious agents that can be transmitted in the healthcare setting (e.g., clerical, dietary, environmental services, laundry, security, engineering and facilities management, administrative, billing, and volunteer personnel).

Maker's Asylum (or any of its representatives) makes no warranties, expressed or implied, including, but not limited to, any implied warranty of fitness of **M19O2** except for usage for COVID 19 purposes and in accordance with the prescribed standards.

Users shall be solely responsible for determining whether **M19O2** is fit for a particular purpose and suitable for the user's method of use or application.

Maker's Asylum shall not be responsible for any inappropriate use and/ or misuse of the **M19O2** by the user and any resultant effect/ impact/ injury.

Governing law shall be the laws of India and the courts at New Delhi shall have exclusive jurisdiction.

M19O2, the **M19O2** logo, are either registered trademarks or trademarks of **Asylum Innovation Private Ltd**, registered company in India.

15. FAQ

What is Maker's Asylum ?

Maker's Asylum is a community space focussed on fostering innovation through hands-on learning. It also provides access to an ecosystem of stakeholders which includes Governments, Businesses, Incubators/Accelerators, Investors and subject matter experts. The space houses various labs that are co-located in order to facilitate prototyping of ideas that are interdisciplinary in nature.

What is M-19 INITIATIVE (MAKERS VS COVID19) ?

Makerspaces have traditionally been innovation hubs at the time of crisis for communities across the world. The reason - quick access to tools and equipment in order to prototype solutions "rapidly". Maker's Asylum is committed to the cause of contributing meaningfully to the COVID19 pandemic! The M-19 Initiative is aimed at bringing together maker spaces, communities, individuals and industry on a common "distributed intelligence" platform to rapidly iterate and devise designs to help fight against coronavirus while also creating a blueprint for a "distributed manufacturing" plan.

The M19 Collective is a collection of makerspaces, community organisations, foundations, industries, universities, researchers and individuals making a collaborative effort to foster open innovation and especially open hardware around the country using decentralised approach and knowledge sharing!

M-19 Projects

- [M-19O2 Oxygen Concentrator](#)
Activation of local communities to make M19 Oxygen Concentrator (with indigenously sourced parts) in cities, towns and villages in India and building capacity to manufacture & maintain locally and in a decentralised manner.
- [M-19 ReBreather](#)
M-19 ReBreather Smart Air Purifier with Replaceable Carbon activated HEPA Filters is an active respirator to help breathing comfortably inside an N-95 mask. Especially designed for senior citizens for comfortable breathing.
- [M-19 Face Shields](#)
The M-19 initiative started with a thought of giving 1000 M-19 shields to the frontline workers. However, in 49 days we were able to activate 42 cities, towns and villages through our open source design and give over 1 Million M-19 face shields through the M19 Collective.
- [M-19 MAPR](#)
A low cost powered-air purifying respirator (PAPR) for use in reducing exposure to airborne particles. This PAPR is designed to provide constant filtered airflow to healthcare workers in high risk environments during the COVID-19 pandemic.

16. CONTACT US

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