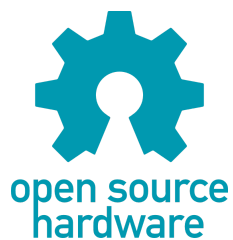


Instruction Manual

M1902 Oxygen Concentrator



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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

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. SAFETY NOTICES



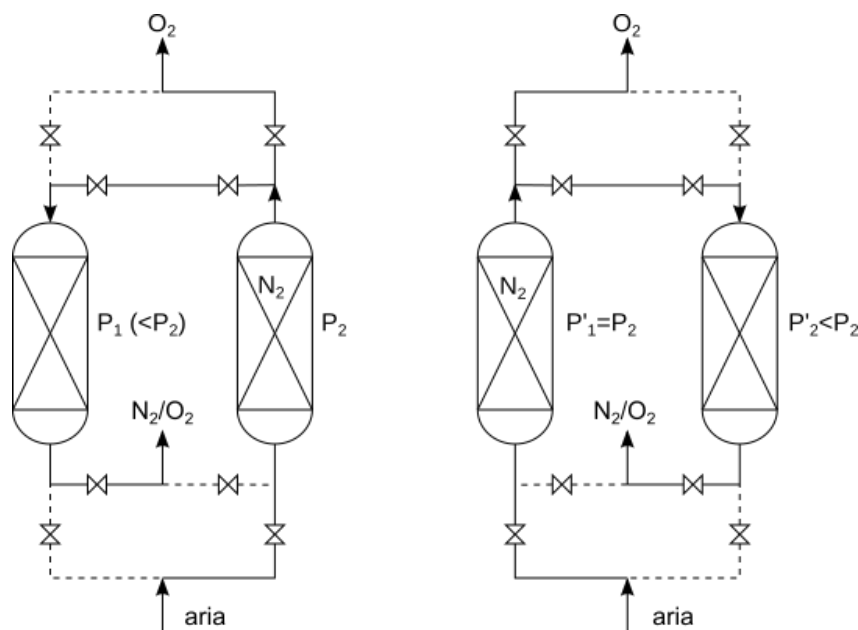
- This unit is not a life-support device, and oxygen therapy could potentially be hazardous for life. Always follow your health care providers directions and warnings while using this machine.
- Always allow the machine to stabilize to its operating parameters before using it on a patient. It takes between 2 to 5 minutes for the machine to reach its operating parameters.
- The machine requires 230 V, 50Hz single phase supply. Inverter backup power systems sometimes provide non-sinusoidal (stepped wave) outputs. In rare cases, this can affect compressor performance. In such situations, consider changing over to a genset based backup power supply.
- The machine produces high purity Oxygen at high volumes which can be a serious burning hazard. Please install the machine away from sources of open flame, sparks or high heat. Also, when being used in very dry environments that can cause static electricity build up in humans, please use anti-static mats, anti-static grounding straps or similar devices to safely discharge the static energy.
- Never close the output flow control valve completely since it can lead to higher pressure within the pneumatic system of the machine. Never obstruct the output flow.
- Never use any hydrocarbon or petroleum based products near or for cleaning the machine.
- If any of the machine cover panels need to be opened for any reason, please make sure the machine is switched off, and the electrical plug is disconnected from the wall socket outlet.
- Do not allow any liquid to spill over the machine, or use any liquids for cleaning it.
- While the machine incorporates dust filters at the air intake and the oxygen outlets, it is recommended to make sure the operating environment is dust free and as dry and cool as possible.
- Always install the machine on a flat level surface to prevent it from sliding while in use and to prevent tipping over.
- Do not place any items on the top panel of the machine.
- When moving the machine, always use the tilt handle to lean the machine backwards until the two caster wheels engage, and then roll it. Be careful while doing so since the machine is heavy.
- When the machine is in use, do not leave it unattended.
- Ensure that the air intake vents at the back panel of the machine do not have any obstruction or get blocked.
- **STORAGE** : If the machine is not to be used, please store it in a cool (less than 30 °C) and low humidity (less than 40 %RH) environment.

3. HOW IT WORKS

Ambient Air consists of 78.08% Nitrogen, 20.95% Oxygen, 0.93% Argon, and 0.04% other trace gases, most of which consists of CO_2 . The M19O2 Oxygen concentrator, removes Nitrogen from ambient air, resulting in enriched oxygen available at the output using a process called [Pressure Swing Adsorption](#). (PSA).

Pressure Swing Adsorption process for the generation of enriched oxygen gas from ambient air utilises the ability of a synthetic Zeolite Molecular Sieve to adsorb nitrogen. Nitrogen molecules get trapped within the crystalline structure of the Zeolite, while the Oxygen molecules pass through unrestricted.

A PSA concentrator consists of two canisters filled with Zeolite Molecular sieve as adsorbers. Compressed Air passes up through one of the canisters where the molecular sieve selectively adsorbs Nitrogen, allowing the remaining Oxygen to pass on up through the canister to the output. When the first canister gets saturated with Nitrogen, the inlet compressed air is diverted to the second canister. While the second canister is getting pressurised and saturated, the first canister is regenerated by desorbing nitrogen through depressurisation and purging it with some of the oxygen from the second canister. This cycle is repeated, swinging between pressurisation for oxygen production (adsorption), and regeneration by purging/venting for removal of nitrogen (desorption).



PSA Process Schematic

Credit

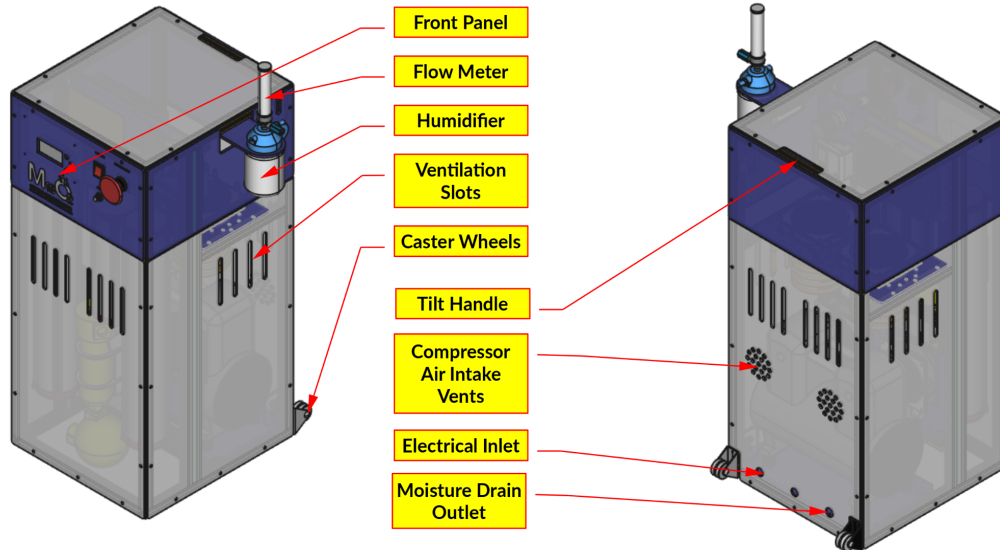
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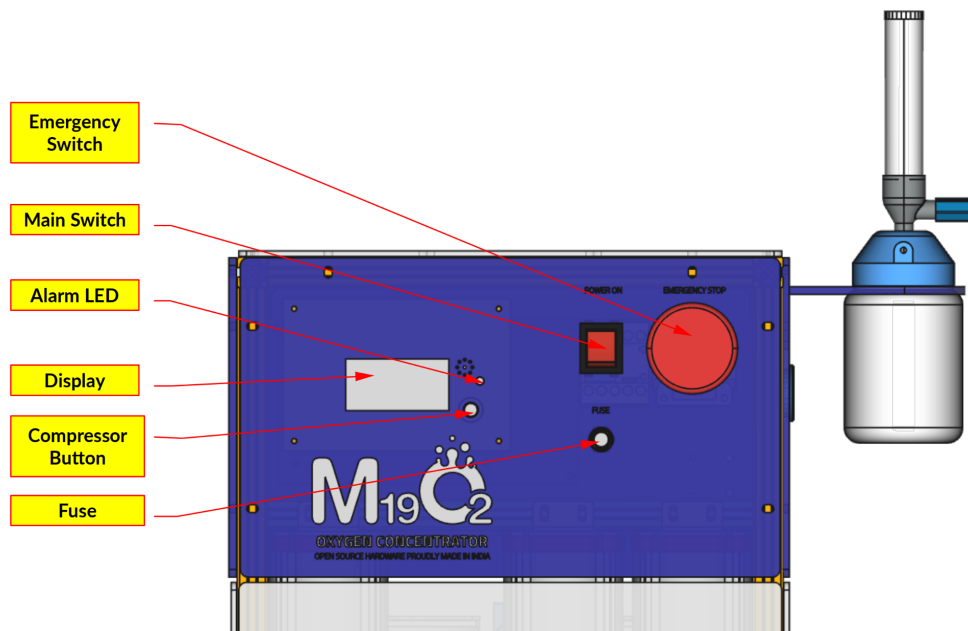
conversion from JPEG to SVG: User: Personification of plenty,

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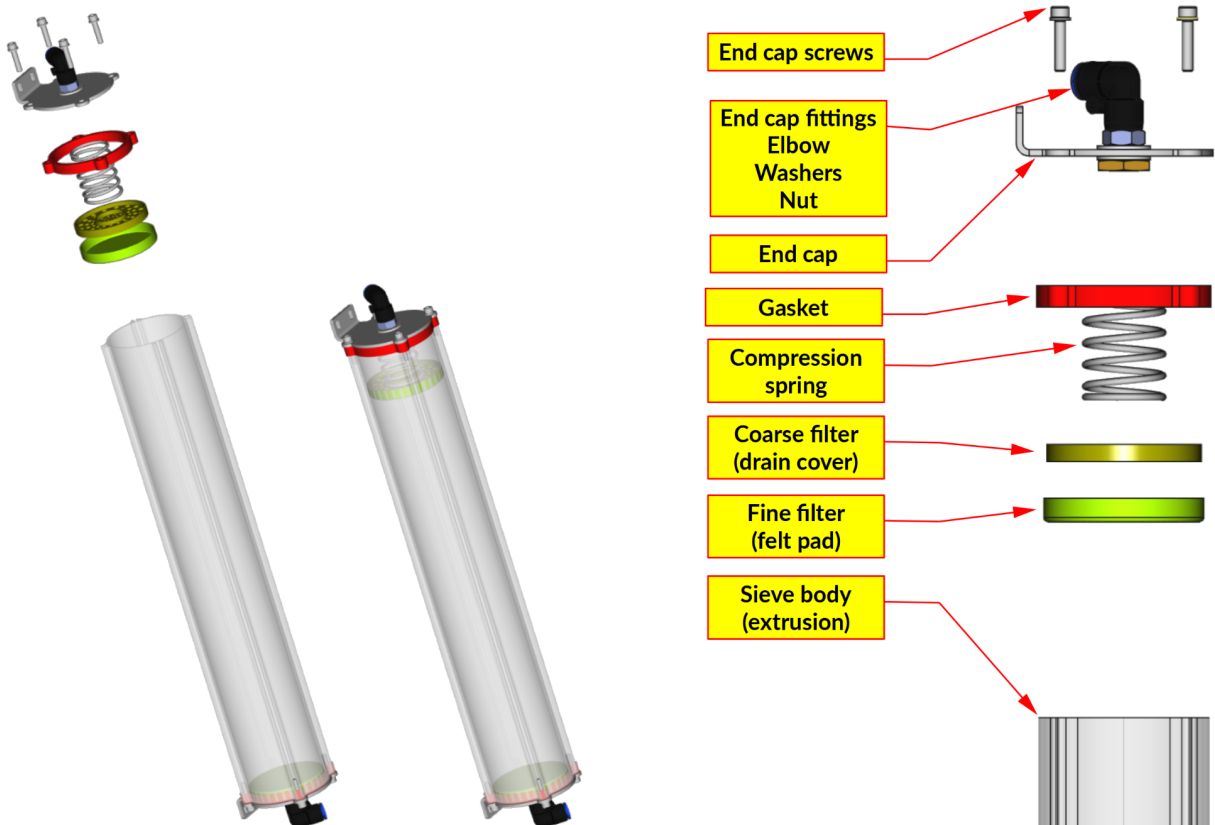
4. M1902 PARTS IDENTIFICATION



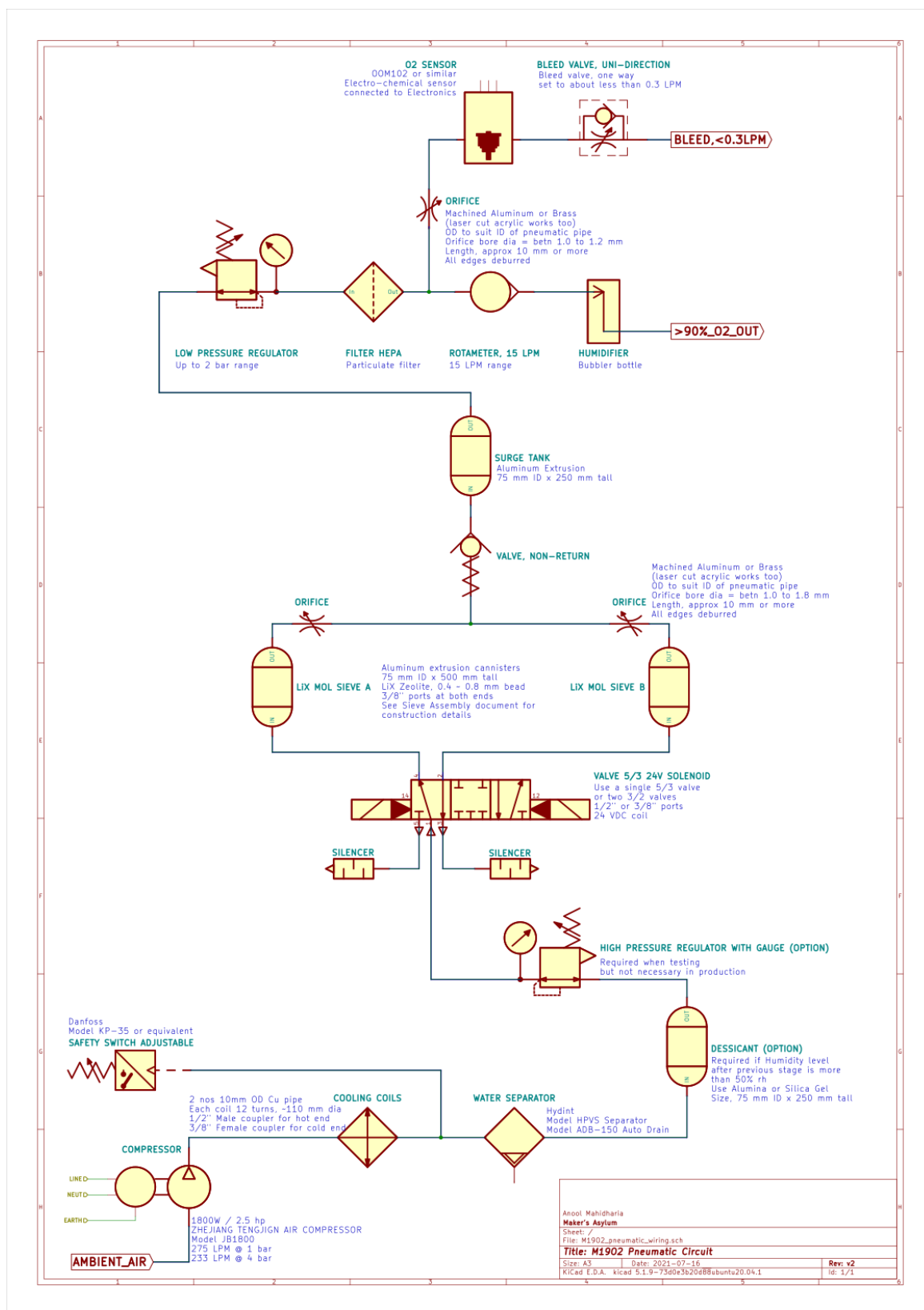
5. FRONT PANEL



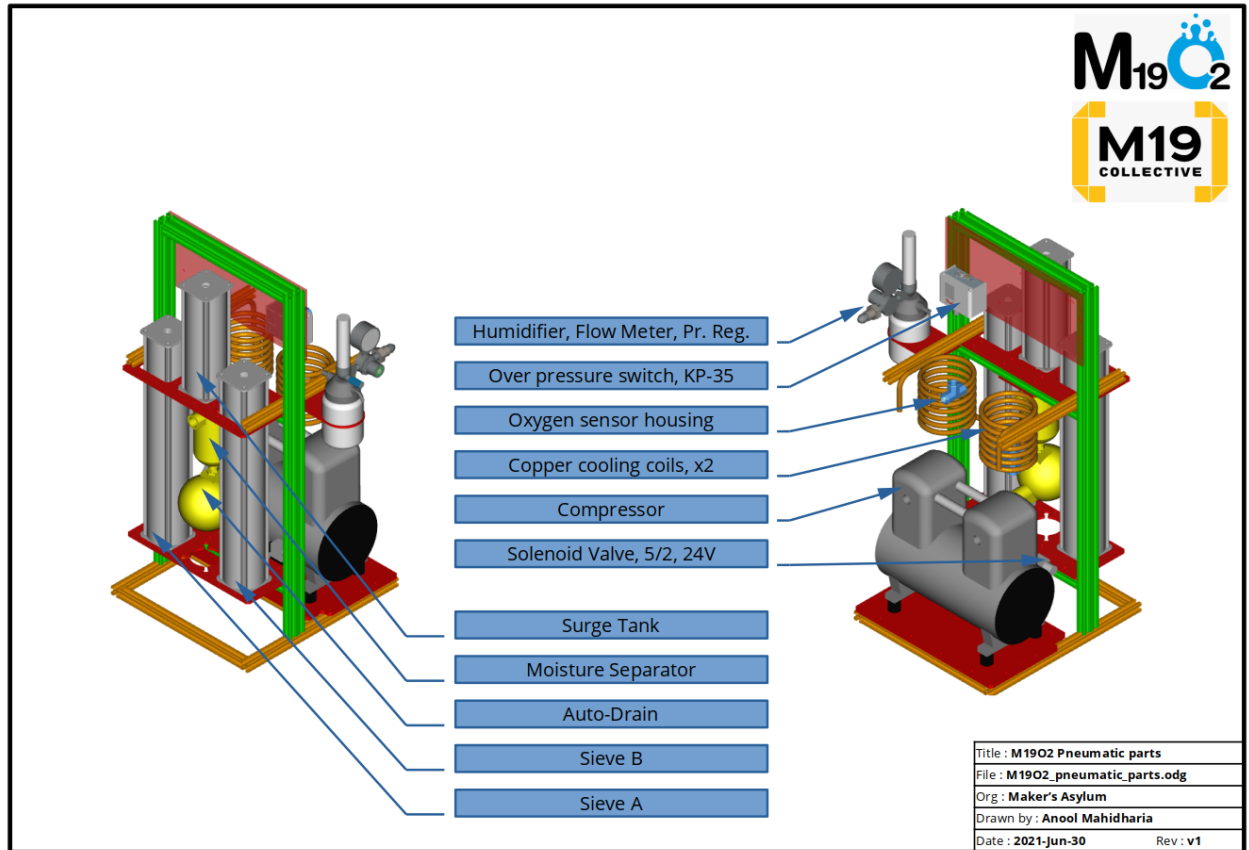
6. SIEVE ASSEMBLY



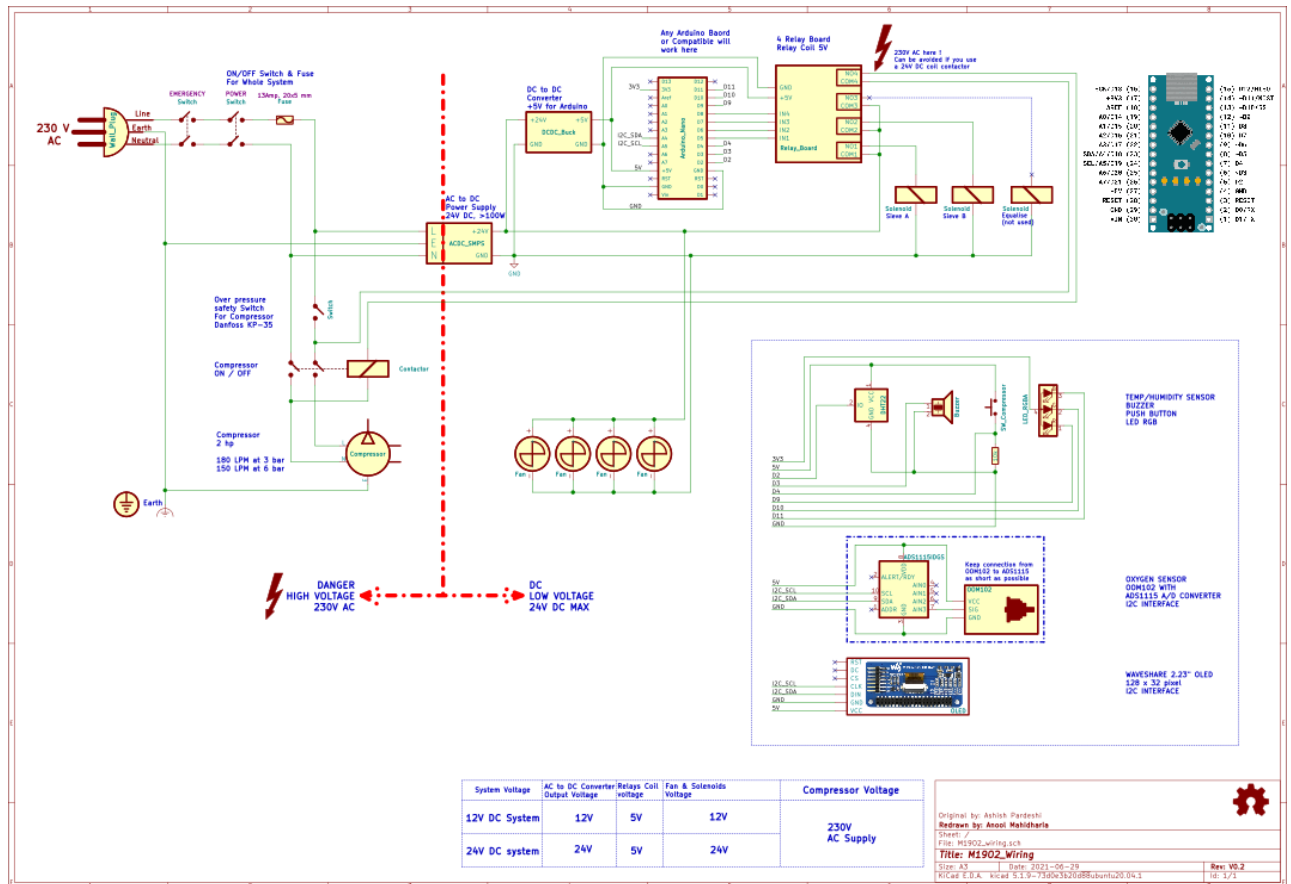
7. PNEUMATIC SCHEMATIC



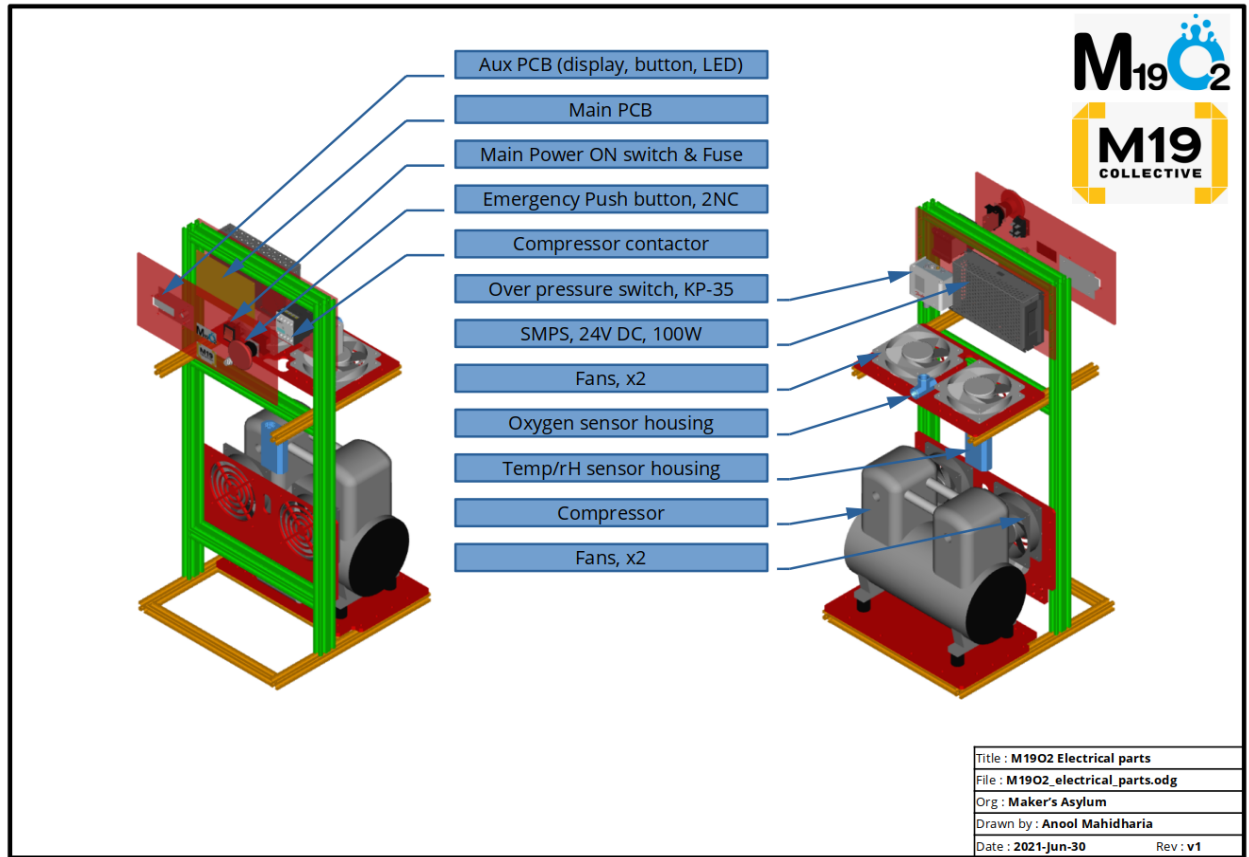
8. PNEUMATIC PARTS IDENTIFICATION



9. ELECTRICAL SCHEMATIC



10. ELECTRICAL PARTS IDENTIFICATION



11. INSTALLATION

- Place the machine on a level surface and make sure there are no obstructions on the rear and sides.
- The moisture trap auto-drain outlet is at the back of the machine. At regular intervals, the moisture collected in the separator drains out. Make sure to connect this to a drain.
- The machine requires electrical power from a 230 V AC, 50 Hz, 16 A switched socket outlet. The electrical connection **MUST** have proper grounding.
- Connect the plug of the machine to the wall socket.
- Turn on the Power Switch on the front panel. If the indicator light does not turn on, make sure the Emergency Switch is disengaged by rotating its knob.
- Check Troubleshooting if the indicator still does not light up.
- In a few seconds, the timing cycle controlled via the embedded microcontroller will start actuating the electrical solenoid coils.
- Make sure the flow control adjustment knob is set to the fully open position.
- Turn on the compressor by pressing the pushbutton on the front panel.
- The PSA process will be initiated, and the flow meter will indicate the output flow in lpm.
- Adjust the flow control adjustment knob for the desired flow rate between 10 to 15 lpm.
- The front panel digital display shows the output oxygen concentration level, ambient temperature, ambient humidity and the status of the compressor.
- It can take between 2 to 5 minutes for the oxygen concentration level to reach >90%. Below 80% concentration, the LED on the front panel lights up Red, for 80% to 90% concentration, it lights up Blue, and once the concentration exceeds 90%, it lights green.
- At this point, it is safe to connect the output of the machine as desired.
- To stop the machine, first turn off the compressor using the pushbutton on the front panel, and wait for a few minutes to allow the fans to cool down the compressor, the pressure inside the system to dissipate, and for the oxygen sensor value to reach back to ambient value of approximately 21%. After that, the main switch can be turned off.

12. MAINTENANCE

- Clean the outside of the oxygen concentrator
 - Begin by unplugging the oxygen concentrator from its power source
 - Dip a soft cloth in a solution of mild dishwashing soap and warm water
 - Squeeze cloth until damp and wipe down the concentrator
 - Rinse cloth clean and remove any excess soap on concentrator
 - Let concentrator air-dry or dry with a lint-free cloth
- Change the particle filter
 - Replacing the HEPA air filter inside the machine is recommended once a year. If the machine is used for long durations, then replacement is recommended at shorter intervals.
 - A set of allen keys will be required for this operation.
 - Begin by removing the acrylic panel on the left side of the machine near the humidifier / flowmeter.
 - Remove the HEPA filter connected just before the flow meter. Detaching the two tubes connected to the HEPA filter may take some effort.
 - Replace the HEPA filter with a fresh one. Contact the manufacturer for replacement filters.
 - Destroy and discard the old, used filter.
 - Replace the side acrylic panel.
- Additional tips
 - Avoid using an oxygen concentrator in a dusty environment
 - Use a voltage stabilizer to offset voltage fluctuation (see Safety Notice for additional information)
 - Rest the concentrator for 20 – 30 minutes after continuous usage for 4 -- 6 hours
 - Do not submerge the concentrator in water
 - Cleaning the outside of the concentrator is recommended on a weekly basis.
 - Recommended service intervals for the concentrator should be at least once annually, or more depending on usage time.
 - Place the concentrator at least 300 to 600 mm (1 to 2 feet) away from surrounding walls.

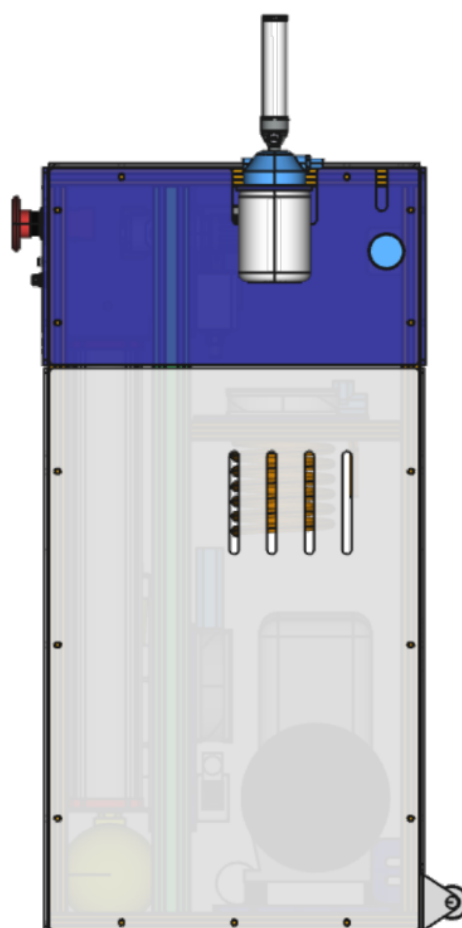
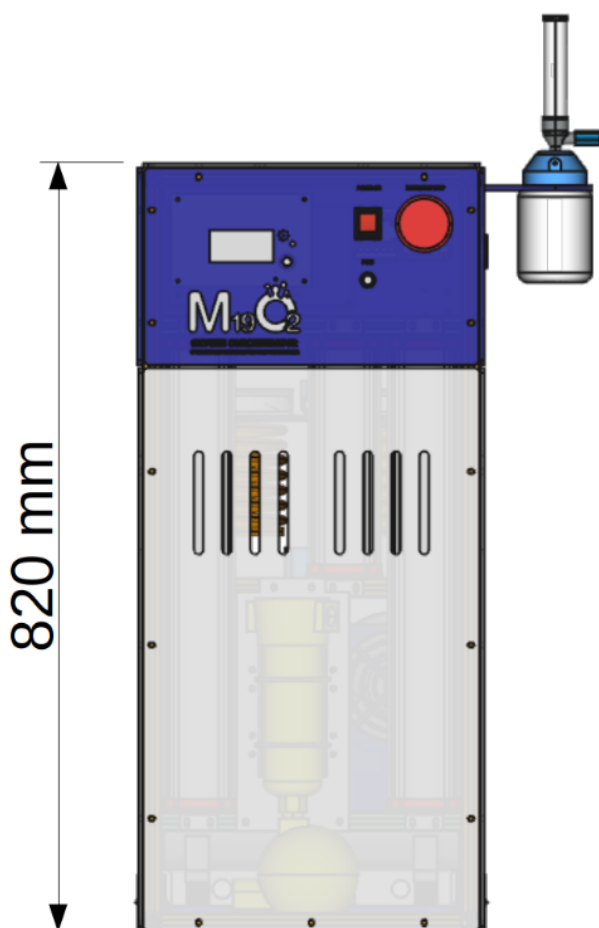
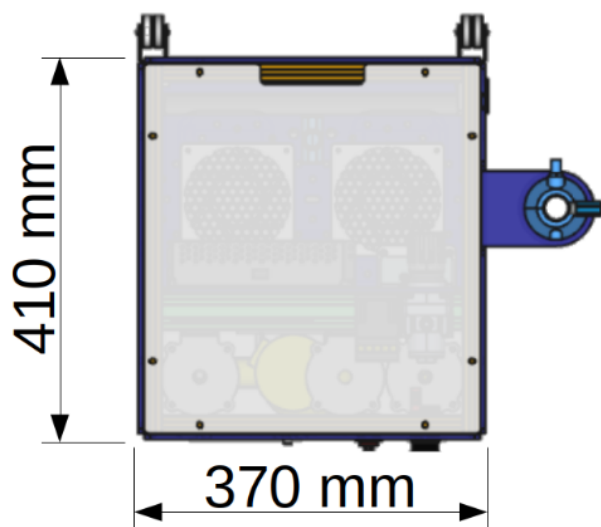
13. TROUBLESHOOTING

ISSUE	POSSIBLE CAUSE	WHAT TO DO
No display and no indicators light up when machine is connected to electrical outlet	No power to the concentrator	<p>Disconnect plug from electrical socket.</p> <p>Check electrical socket for presence of 230 V AC. If the fuse is blown or MCB has tripped, contact the manufacturer.</p> <p>Check the condition of the plug for broken or disconnected wires.</p> <p>Check and replace the fuse on the front panel. Fuse rating is 10A slo-blo or time delay type, 20x5 mm glass cartridge. If the fuse blows repeatedly, contact the manufacturer.</p> <p>Make sure the outlet and switch are rated for 16 Amps.</p> <p>Rotate and release the EMERGENCY button.</p> <p>If problem continues, contact the manufacturer.</p>
No oxygen flow (Put the end of the cannula in a cup of water to make sure there is no flow; a steady flow of bubbles should be seen when oxygen flow is present)	Tubing is disconnected or kinked	Reconnect, straighten, or replace tubing.
	Flow rate not set properly	Check the flow meter on the concentrator unit – make sure that flow rate is set to your prescription level.
	Humidifier cross-threaded	Disconnect humidifier from concentrator outlet, and reconnect without cross-threading.
	Concentrator power is off	Turn concentrator power switch to ON position.
	Machine malfunction	Switch to your back-up system and contact the manufacturer.
Flowmeter won't adjust	Tubing is disconnected or kinked	Reconnect, straighten, or replace tubing.
Machine turns off by itself	Machine malfunction	Switch to your back-up system and contact the manufacturer.
RED or BLUE LED indicator lights up on front panel	<p>RED = Oxygen concentration is below 80%</p> <p>BLUE = Oxygen concentration is between 80% to 90%</p>	<p>It takes about 2 --3 minutes for the machine to reach >90% concentration levels.</p> <p>If the concentration level does not increase, contact the manufacturer.</p>
Water in supply tubing	Some condensation is normal, but may block flow of oxygen	If necessary, replace the supply tubing. Try using less water in the humidifier. Keep tubing elevated off the floor.

14. SPECIFICATIONS

- O₂ concentration >92 %, ⁻²/₊₃ %
- Output flow rate Between 10 to 15 lpm
- Altitude limits -10 % reduction in output flow at 1000 m elevation gain
- Electrical Input 230 V AC, 50 Hz, 10 Amps, single phase, 2000 VA
- Ambient Temperature 20 °C to 35 °C
- Ambient Humidity 0 %RH to 70 %RH
- Noise Emission < 75 dB(A)
- Dimensions 820 H x 410 D x 370 W, in mm
(excluding caster wheels, tilt handle, external flow meter/humidifier)
- Weight 30 kgs, approx
- Safety Features
 - Emergency Switch
 - Fuse, overcurrent protection (5x20 mm, glass cartridge, slo-blo)
 - Visual Indicator for concentration level
 - <70% = Red
 - >70%, <90% = Blue
 - >90% = Green
 - Over pressure cutoff (set to trip at 5 bar, reset at 1 bar)

15. DIMENSIONS



16. 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.

17. 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.

18. CONTACT US

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