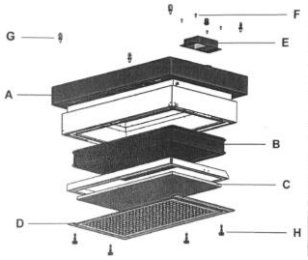
HALO-P AND COVID-19

Halo-P is a smart air purifier unit which dramatically improves indoor air quality. The system is being introduced by Erlab, as a commercial product that impacts room filtration continuously removing air particulates and replacing with clean filtered air. This product could provide an innovative approach to today's COVID-19 environment. Just think that when you are in a room or enclosed indoor space with a Halo-P, which is removing 99.99% of air droplets and small particles continuously and then providing filtered clean air back into the room, how much safer do you feel. This is what the Halo-P system can do.

Technically, the Halo-P is a smart air purifier but a bit of a misnomer with all the functions it can do. The Halo-P is ductless meaning it works independently of existing complex centralized rigid HVAC systems. This independency gives the Halo-P flexibility as to where it can be used such as offices, conference rooms, hospitals, clinics, stores, theaters, gyms, etc. The Halo-P uses active air movement to directly push air upward to the ceiling where it is then filtered by an H14 **H**igh **E**fficiency **P**articulate **A**ir (HEPA) filter. The HEPA filters are the ultimate contamination removal filters and are used in pharmaceutical, implantable medical devices, hospital operating rooms, semiconductor and aerospace industries. These filters developed for *The Manhattan Project,* are used primarily in clean rooms for removal and control of airborne particulates as well as microbes such as bacteria, mold and viruses. HEPA and clean room technology is solid and has stood the test of time.

The Halo-P units operate continuously, 24/7 and redeliver clean air back into the enclosed space. The units also have state of the art sensors to indicate filter changeout, pressure sensors to ensure HEPA efficiency and fan speed adjustments for increasing active air movement when a room may have a number of increased participants. Halo is equipped with smart technology enabling operation, adjustments, maintenance and alarm notification directly from your phone or laptop.



A	Fan module
B	Filter
C	Prefilter
D	Grid
E	Power supply carter
F	4 Screws
G	4 eye bolts
H	4 quarter turn screws

Halo specifications are provided below. The unit is roughly 24in wide x 36in long x 10in high and can easily fit into a suspended ceiling or directly hung from a true ceiling. Other specifications are listed in the following table. It is a stylish unit and includes lighting to enhance its appearance but also functional to blink when the filter needs replacement. Filters roughly last between 1-3 years depending on use. Erlab is very customer service oriented and can provide replacement items when needed.

Specifications		
Processed air flow	220 m3/h	
Operating modes	24/24h - 7/7, Night/Day	
Fan monitoring	Halo unit monitors the air flow and informs the user through light pulsation communication	
Prefiltration	Particulate prefilter	
Particulate filtration for powders	HEPA	ULPA
	HEPA H14 filtration efficiency: 99.995 % according to MPPS method, EN1822 standard	ULPA U16 filtration efficiency: 99.99995 % according to MPPS method, EN1822 standard
Smart-light	Simple communication by LED pulsation system	
e-Guard Communication	Remote control and monitoring App	
Ethernet Port	1 x RJ45 (included)	
Installation	Hung via 4 eye bolts (included) must hold 31 Kg / 68,34 lb	
Weight	31 kg (including filter)	
Voltage / frequency	80-240V 50/60hz	
Amperage	0.5 A (220 V) - 1 A (110 V)	
Energy consumption	50 W	

Since the *Coronavirus* outbreak in 2019, public health warnings have been issued worldwide. COVID-19 is a disease caused by a new strain of Coronavirus called SARS-COV-2. This virus is highly related to SARS-COV-1 which infected people with acute respiratory syndrome (SARS), a contagious and sometimes fatal respiratory disease which first appeared in China in 2002.

Coronavirus 2 causes Severe Acute Respiratory Syndrome 2 or COVID-19. In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak as a pandemic. Symptoms include fever cough and tiredness and may also encompass a loss of taste or smell. Symptoms can range from mild to severe. People who are older have a higher risk of serious illness as well as folks with pre-existing chronic medical conditions (heart disease, cancer, diabetes, COPD and obesity). The virus appears to spread easily among people especially close contact (within six feet) and transmits via respiratory droplets especially when coughing, sneezing or talking. There currently is no vaccine available. Coronavirus statistics from 9/24/2020 are below.

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www.coronvirus.jhu.edu

Total Cases: 31,673,086

Total Deaths: 972,372

Countries: 188

SARS-COV-2 is the causative virus. It is a Ribo Nucleic Acid (RNA) single stranded virus with a size between 60 nanometers (nm) to 140 nm diameter and has the appearance of a solar corona. The size of the COV-2 virus is a much smaller particle compared to bacteria which range from 400nm to 3000nm. Knowing the size of a single virus particle can help identify the effectivity of items such as Personal Protective Equipment, face masks and air filters. Air filters, specifically, HEPA units have been shown to be very effective in capturing particles. Particles as small as the Coronavirus are retained by HEPA filters utilizing diffusion mechanics. When used alone, **HEPA-rated media provides superior performance for removing virtually 100% of particulates according to NASA[1].** HEPA designation has a strict set of requirements and they must be able to remove $\geq$ 99.97% in the US per MIL-STD 202 and in Europe $\geq$ 99.95% removal of particles per ISO 29643 and EN 1822.

The Halo-P unit is designed with a H14HEPA filter. H14 designation is within the highest tier of HEPA and considered medical grade. The web of fibers that make up these filters traps the smallest particles at a higher rate. For the cleanest air, the H14 HEPA is optimal especially when comparing air purifier performance.

During the COVID-19 pandemic, EPA recommends usage of air purifiers indoors which may be particularly helpful when additional ventilation with outdoor air is not possible. When used properly air cleaners can reduce airborne contaminants including viruses in a building or small space. **When used along with other best practices recommended by the CDC, filtration can be part of a plan to protect people indoors,** says the EPA[2]. Even the World Health Organization (WHO) acknowledged that airborne transmission of the Coronavirus may be a threat in indoor spaces[3] and the CDC is still vacillating on airborne transmission but did publish, and then quickly withdrew, the guidance document that the virus is spread through respiratory droplets or small particles, such as those in aerosols, produced when an infected person coughs, sneezes, sings, talks or breathes[4].

Halo-P air purifier is made to reduce the number of particles in the air to help mitigate airborne transmission. Halo-P also provides HEPA filtered clean air and increases the number of air change per hour (ACH) in an enclosed indoor space. This increase in ACH provides a dilution of existing airborne particulates. Particle size is the most important determinant of aerosol behavior. Particles that are 5 micron or smaller can remain airborne indefinitely under most indoor conditions unless there is removal due to air currents or dilution ventilation[5] according to Lancet, a respected British respiratory medicine journal.

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[1]sub-micron and nanoparticulate matter removal by HEPA media filters document No. 20170005166 NASA Scientific and Technical Information Program, May 2016

[2]EPA.gov, Air cleaners, HVAC filters and Coronavirus

[3]WHO Transmission of SARS-COV-2 Scientific Brief, July 9, 2020

[4]CDC Website, Friday, September 18, 2020

[5]The Lancet Respiratory Medicine *Particle Size of Infectious Aerosol*, July 24 2020

Physical distancing has been successful as a public health tool in reducing viral contamination. CDC recommends a distance of ≥ 6 ft. It has also been demonstrated that violent emissions from people including coughing, sneezing and singing can reach up to twenty-four (24) feet.

These forcible emissions emit more particles especially <5 micron size which are more prevalent in the lower respiratory tract of humans. These smaller particles are more highly concentrated in the plumes created by coughs and sneezes. In cough aerosol studies, pathogens have been isolated in the plume clouds generated by coughing[6]. Again, the Halo-P with ductless capability can forcibly direct aerosols toward the ceiling and away from breathing height (standing at 5ft). The Halo-P plays a large role in air quality improvement and personnel safety by

(1) Retaining small particles;
(2) Returning filtered clean air; and
(3) Reducing aerosols and potential viral load.

It would seem prudent during the pandemic that mask wearing, social distancing, handwashing and disinfectant usage would be more robust in an enclosed area with the presence of a functioning Halo-P air purifier.

SARS-COV-2 affects individuals differently especially within age groups and due to the presence of pre-existing health conditions. Affected patients can be symptomatic as asymptomatic. A few patients can also be classified as super spreaders relating back to *Typhoid Mary* who was first person identified as an asymptomatic carrier, infecting 53 people with Typhoid Fever in the NYC area outbreak in the early 1900's. In a recent study by *Thorax*, one of the world's leading respiratory journals, found that asymptomatic individuals with SARS-COV-2 infections have viable viral loads and have been linked to several transmission cases. These viral loads were comparable to those in symptomatic patients and showed persistent positive upper respiratory test results at follow-up medical check-ups[7]. This type of hidden infection may account for many of the college and school closing soon after their formal reopening. Given this situation, people should be wary and utilize both CDC guidelines and available cutting edge technologies that can potentially reduce transmission vectors especially from asymptomatic individuals.

One last thought that impacts COVID-19 infectivity is the duration of exposure. The potential to transmit disease begins prior to the development of symptoms and is highest early in the course of the illness. The risk of transmission decreases thereafter. The longer you stay in an environment that may contain the virus, the higher the risk of getting sick. A rule of thumb states[8]:

Successful Infection = Exposure to Virus x Time

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[6]The Lancet Respiratory Medicine Journal *Particle Size Infections Aerosol" July 24, 2020*
[7]Thorax British Medical Journal *Upper Respiratory Viral Load in Asymptomatic Individuals* Sept. 22, 2020
[8]CNN Eric Levenson "Staying safe isn't just about hygiene and distance. It's about time too" May 19, 2020

This equation is the underlying theory behind contact tracing, which tries to locate and contact anyone who has spent a prolonged time near an infected person. This seems to be the scenario in the Washington State choir practice where 50 people developed COVID-19 out of 61 attendees or 87% after a 2½ hr choir practice. But infectious disease experts say that the issue of exposure to the virus also varies on the actions within closed space. Louder spaces are riskier because infected people emit more virus when they talk, sing or shout. Quieter places with fewer airborne particles may be lower risk. Erlab, the makers of the Halo-P, recently, commissioned 3 Flow Inc, a company specializing in ventilation, to test the Halo-P while simulating loud talking situations where the Halo-P reduction in particles averaged 70%[9].

Halo-P has continuous clean filtered air that is delivered to the enclosed space and may lessen the impact of exposure duration by a combination of HEPA filtration and continuous clean air delivery to that area. HEPA filtration, also, reduces moisture levels in enclosed space by desiccation, especially in particles emanating from the respiratory tract. These liquid formed particles become aerosolized carrying and transporting potential virions. Desiccation is an effective physical treatment that can comprise the COV-2 virus envelope and capsid proteins to render them less harmless[10]. This is another potential advantage of the Halo-P.

In conclusion, discussions have centered on COVID-19, specifically how the virus functions from transmission via personal contact and airborne droplets, to the degree of infectivity, duration of exposure, age and pre-existing conditions of hosts, and the amount of activity levels in an enclosed space. This has provided a better insight into COVID-19 transmission and a clearer viewpoint into the mechanisms on how the virus can infect individuals. Throughout the discussion, informative information from expert organizations like CDC, WHO, EPA and NASA along with up-to-date briefings from leadership respiratory medicine publications, such as Lancet and Thorax, have provided scientific analysis into COVID-19 infection and spread. Along with this wide range of technical acumen on COVID-19, the technology of the Halo-P was presented to demonstrate its potential utilization in providing safeguards via filtration and ventilation to better insure indoor air quality in regard to reducing the risk of COVID-19 transmission. It seems that Halo-P can enhance personal indoor safety in conjunction with social distancing, face mask wearing, hand washing and disinfection use, providing a safe and practical approach to the future new normal way of life.

[9]3 Flow Inc *Halo-P Filtration Test Report* Sept. 10, 2020
[10]American Chemical Society *COVID-19: A Call for Physical Scientists and Engineers* April 8, 2020