HALO AIR FILTRATION PREVENTATIVE RESPONSE TO AEROSOLIZED TRANSMISSION

Executive Summary

Erlab, Inc. provides filtered solutions to help enhance our lives by purifying the air we breathe. For over 50 years, we have focused on developing products to increase the level of safety within laboratories by reducing the risks of chemical inhalation and particulate exposure. In early 2020, due to the response to the pandemic and our scientific understanding of how viruses are spread, we launched the HALO air filtration system to the commercial sector to deliver HEPA-filtered air while increasing ventilation effectiveness and increasing equivalent air change rates (eACH). Very early on we knew that addressing the air we breathe would help reduce exposure and super spreader events. We started by educating the public on the value of filtration and ventilation and exposed some of the companies that were making fraudulent marketing claims of 'killing or deactivating 99% of viruses' with unproven and untested technologies, many of whom added particulate load and/or off-gassing of other harmful contaminates among their product's benefits. In spite of being fully aware of inherently promoting false claims, this dangerous misinformation was still pursued and bogus products were sold putting the health of an unsuspecting public at risk.
After several years of litigation and lacking direction from legislation and other governing bodies, ASHRAE launched the 241-2023 standard for the Control of Infection Aerosols to protect consumers and provide desperately needed guidance.

Dissecting ASHRAE 241-2023

The purpose of this standard is to establish minimum requirements for the control of infectious aerosols to reduce the risk of disease transmission on occupied spaces in new buildings, and established buildings. The standard also defines the equivalent airflow or air change rate (eACH). Methods of design for HVAC systems are provided to ensure proper mixed-mode operation, and natural ventilation. Added air cleaning systems should not inhibit the development of the intended flow regimen of the ventilation system (HVAC) meaning that depending on the zone air distribution category (Table 1.1) will determine the best placement for an air cleaning system.

Table 1.1 – Air distribution categories

Zone air distribution category	Permitted Air Cleaning System Category
Well-mixed	Ceiling, Wall, Floor
Natural	Ceiling, Wall, Floor
Crossflow	Ceiling, Wall, Floor
Downflow	Ceiling, Wall, Floor
Upflow	Floor, Wall

Testing requirements

Testing of the air cleaning system must be performed by a third party to ensure effectiveness and safety under the requirement of the ASHRAE 241 standard. See Table 1.2 for types of air cleaners.

Table 1.2 – Types of Air Cleaners

Types of air cleaners to be tested
Commercial-grade in-room air cleaners using mechanical fibrous filters
Electronic In-Duct air cleaners
In-duct ultraviolet germicidal radiation
In-room air cleaners that utilize mechanisms other than mechanical fibrous filters
Upper room UV

Testing of the variation of air cleaners seen in Table 1.2 is to be performed by a testing laboratory that complies with ISO/IEC 17025. The test chamber must have a volume of 800 ft^3 (22.7 m^3). The test chamber must have smooth, nonporous walls, ceilings, and surfaces and shall maintain proper temperature and humidity levels. The chamber must also be airtight and capable of flushing the air between tests. A mixing fan must also be installed to ensure proper mixing of contaminates during the tests. For any in-duct air cleaning device for occupied zones, the same conditions apply with a means to test single-pass removal efficiency. All testing for the effectiveness of each air cleaning device must be performed with the nonenveloped bacteriophage, MS2, aerosolized in the chamber by nebulizing a microbial suspension to produce discrete particles.

The intention of testing requirements

For all air cleaners, the intent is to show a reduction of aerosolized particles, the time to achieve a log reduction (% of virus reduced over time) or decay rate with the unit powered on, versus that of the natural decay rate of the aerosolized particles (MS2). Further studies.

Clean Air Flow Rate or Clean Air Delivery Rate which is the volume of air that has been purified of the specific particles of interest (MS2)

Assessment of any chemical analytes released by the Air Cleaning system or result thereof from chemical reactions in the air. Exempt air cleaners are those that do not add an active agent to react either on surfaces or in the air.

Any UV device must be tested to ensure compliance with the threshold limit values for the wavelength emitted by the system.

The HALO test data and full compliance with ASHRAE 241

As the HALO is an air filtration system using mechanical fibrous and activated carbon filtration, testing for analytes or for UV emittance is not applicable. The results achieved are that of overall particulate reduction of the source aerosolized agent MS2 and the clean air flow rate or clean air delivery rate (CADR). As per the ASHRAE requirements, the HALO is certified as an ASHRAE 241 air cleaning device, achieving a 99.94% reduction with an average aerodynamic particle size distribution of 0.7 µm see Figure 1. The net log reduction of the HALO was 3.06 +/- 0.15 within 60 minutes of operation, which is an equivalent of 99.94% reduction in MS2 aerosolized particles see Figure 2 and Figure 3. Air As for the Clean Air Flow Rate (CADR), the HALO achieved an equivalent air change rate (eACH) of 7.18 see Figure 4.

ASHRAE Testing - ARE Labs

Figure 1

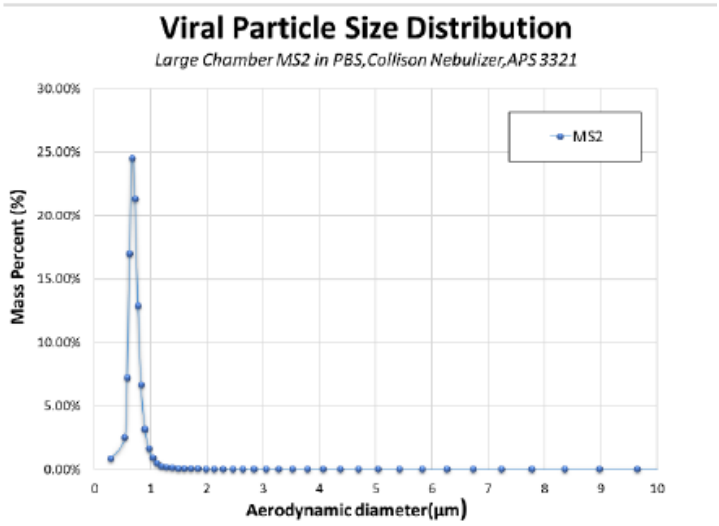


Figure 2

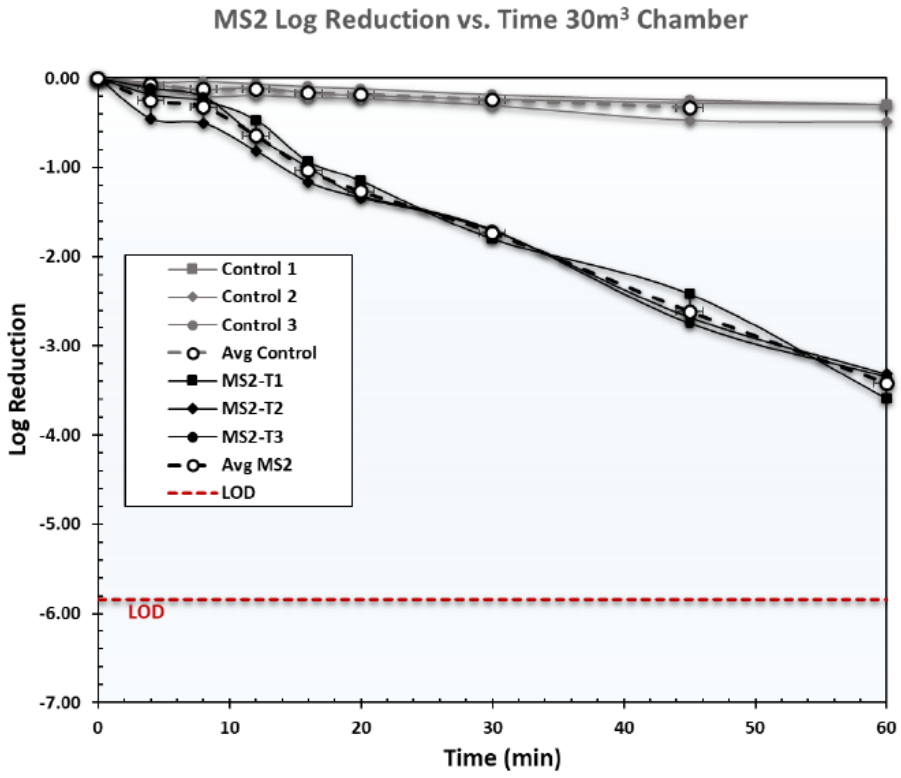
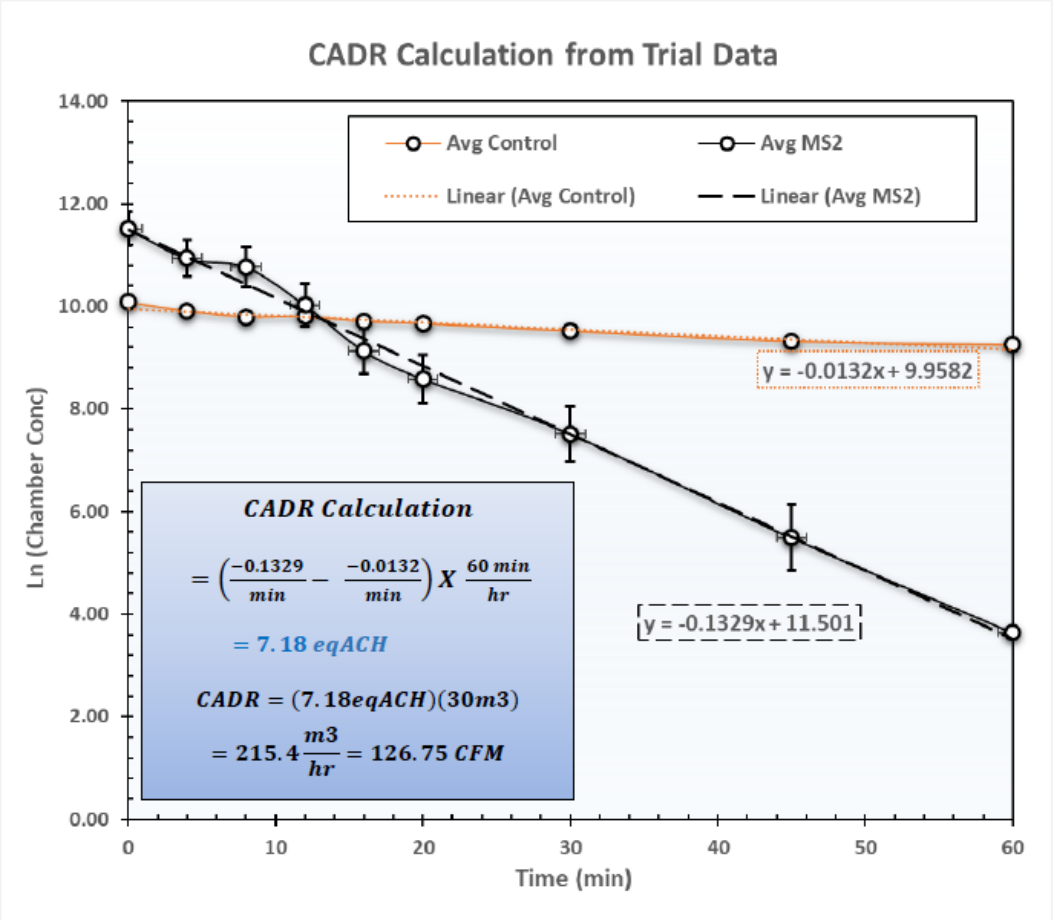


Figure 3

Figure 4

Bioaerosol Type	Species (description)	Reduction Type	Trial Time (minutes) 4	8	12	16	20	30	45	60
Virus	*MS2* (RNA Virus)	*Net Log Reduction*	-0.11	-0.13	-0.35	-0.78	-0.97	-1.56	-2.09	-3.23
		Net % Reduction	22.1176%	26.2480%	55.2152%	83.2712%	89.3310%	97.2395%	99.1858%	99.9408%
Virus	*MS2* (RNA Virus)	*Net Log Reduction*	-0.38	-0.38	-0.69	-1.00	-1.16	-1.46	-2.35	-2.95
		Net % Reduction	58.0540%	58.3897%	79.7601%	90.0695%	93.0811%	96.5647%	99.5496%	99.8886%
Virus	*MS2* (RNA Virus)	*Net Log Reduction*	-0.04	-0.09	-0.53	-0.84	-1.13	-1.46	-2.41	-2.99
		Net % Reduction	8.1912%	17.9184%	70.3308%	85.4539%	92.6668%	96.4969%	99.6148%	99.8968%
All Trial Averages +/- St. Dev.		***Net Log Reduction***	***-0.17 +/- 0.18***	***-0.2 +/- 0.16***	***-0.52 +/- 0.17***	***-0.87 +/- 0.12***	***-1.09 +/- 0.1***	***-1.49 +/- 0.06***	***-2.28 +/- 0.17***	***-3.06 +/- 0.15***
		Net % Reduction	*29.45% +/- 25.73%*	*34.19% +/- 21.37%*	*68.44% +/- 12.38%*	*86.26% +/- 3.47%*	*91.69% +/- 2.06%*	*96.77% +/- 0.41%*	*99.45% +/- 0.23%*	*99.91% +/- 0.03%*

Bioaerosol Type	Species (description)	Reduction Type	Trial Time (minutes) 4	8	12	16	20	30	45	60
Virus	MS2 (RNA Virus)	*Net Log Reduction*	-0.07	-0.13	-0.11	-0.17	-0.19	-0.24	-0.28	-0.30
		Net % Reduction	15.2542%	25.4237%	22.0339%	32.2034%	36.1017%	42.3729%	47.6271%	50.1695%
Virus	MS2 (RNA Virus)	*Net Log Reduction*	-0.11	-0.21	-0.19	-0.22	-0.23	-0.31	-0.47	-0.49
		Net % Reduction	21.5054%	37.6344%	35.4839%	39.7849%	41.3978%	50.8602%	66.1290%	67.4194%
Virus	MS2 (RNA Virus)	*Net Log Reduction*	-0.05	-0.04	-0.07	-0.10	-0.12	-0.18	-0.25	-0.30
		Net % Reduction	10.4762%	8.5714%	14.2857%	20.0000%	23.8095%	34.2857%	43.1429%	49.5238%
All Control Average +/- St. Dev.		***Net Log Reduction***	***-0.08 +/- 0.03***	***-0.12 +/- 0.08***	***-0.12 +/- 0.06***	***-0.16 +/- 0.06***	***-0.18 +/- 0.06***	***-0.24 +/- 0.06***	***-0.33 +/- 0.12***	***-0.36 +/- 0.11***
		Net % Reduction	*15.75% +/- 5.53%*	*23.88% +/- 14.59%*	*23.93% +/- 10.73%*	*30.66% +/- 9.98%*	*33.77% +/- 9.02%*	*42.51% +/- 8.29%*	*52.3% +/- 12.18%*	*55.7% +/- 10.15%*



Understanding Aerosolized Virus Transmission

There are many ways a virus is transmitted, but airborne aerosolized droplets are the primary form of spread. When these micro-sized droplets are released, they remain suspended in the air for several hours (or longer). Even worse, they are recirculated through a building's ventilation via the return and supply vents.

Unfortunately, these tiny droplets wreak havoc on our bodies—particularly our respiratory systems—as they are inhaled deep into our lungs. Our bodies cannot filter these tiny particles out, leading to lower respiratory tract infections and increasing the severity of the disease. However, because these droplets are so small, there must be a high "viral load," or concentration, of droplets for transmission to occur. This will affect every individual differently, meaning we can never truly know what a safe environment is. Therefore, the best course of action is to put proper air treatment solutions in place to ensure cleaner, safer air for everyone.

Mitigating Risk - Improving the Indoor Air Quality (IAQ) in Your Commercial Space

The American Society of Refrigeration and Air-Conditioning's (ASHRAE) positioning document on infectious aerosols states that the design and operation of HVAC systems can influence infectious aerosol transport. Still, they are only one part of infection control. Their positioning document on Indoor Air Quality (IAQ) and the CDC's recommendation for ventilation in buildings outline the criteria facilities should follow to improve IAQ and decrease the risk of viral transmission.

1. Increase air change rates (ACH) and minimum outdoor airflow rates.
2. Ensure proper air distribution or dirty-to-clean directional airflow patterns.
3. Increase air filtration within the ventilation without reducing design airflow or decreasing the air change rates.
4. Add HEPA-filtered systems to enhance air cleaning.

Independent HEPA Filtration System: HALO HEPA

The ceiling-mounted HALO filtration system was originally designed to protect laboratory personnel from laboratory pollution exposure. The design was based on a delicate equation of the right airflow, carbon bed depth, and air distribution.

Developing the HALO with this unique approach was made possible through over 50 years of experience in providing air filtering solutions to laboratories across the globe. Our flexible and adaptable designs allow us to integrate HEPA H14 filters into the HALO, providing us with the ability to adapt to the necessary demands of HEPA-filtered air purifiers, even outside of the laboratory. Because of the strict standards within laboratories, the HALO was designed with more than just filtration in mind. It also considers the impact the HALO would have on the facility's ventilation effectiveness (VEFF) and increases in air change rate (ACH). The HALO's proven efficiency in a lab setting is transferable to the commercial world and has provided us the ability to ensure we meet all necessary criteria, such as:

1. Airflow pattern distribution
2. Increased ACH
3. Optimal H14 HEPA filtration
4. Effectiveness at reducing particulate load concentrations

Each HALO will provide one (1) additional ACH per every 10,000 Cu' of volume. The placement of the HALO is critical to achieving such phenomenal results. Its position on the ceiling creates a vertical airflow pattern that drives polluted air up and away from the breathing zone and returns clean air back into the very same room horizontally across the ceiling, creating what is known as the Coanda effect.

Data derived from several different third-party tests prove HALO's performance against aerosolized viruses. Tests were conducted in controlled and real-world dynamic conditions to understand the efficacy of HALO's performance. The consistency of results has been staggering, with an average particulate load reduction of >80% for the most harmful particles between 5micron – 0.3 microns in size. The reduction of particles directly impacts the effectiveness of reducing the chances of airborne viral transmission. The reduced exposure to viral concentration loads is the successful equation for proper mitigation. Below are results from both third-party controlled testing and real-world peered reviewed data on the HALO performance:

APPENDIX

ASHRAE 241 Test Data and Compliance

WSS installation validation - ABC Testing

The ARK Installation Validation Report

Christ The King Video Testimonial

NEXT Charter School Case Story

Off The Vine Case Story

Community Chapel Case Story

Avamere Healthcare performance validation report
ARE labs MS2 performance validation report

3 Flow VEFF test data

With other virus mitigation options, there are serious risks to consider. Simply put, a lot of snake oil is available on the market. Everywhere you look, someone seems to have the best possible solution. They promise 99.99% decontamination or effectiveness. In reality, many unethical companies are taking advantage of the current anxiety-ridden air purification market. The HALO data is unmatched, third-party certified, and not full of "fluff" data. Expectations are set according to the product's actual performance in a real-world setting. There is simply no false data or misleading performance criteria. The HALO will perform as advertised and mitigate the risk of airborne spread while improving your IAQ.

HALO is a long-term solution; the HALO is a permanent infrastructure improvement without the infrastructure development costs or complexities. A solution for today's challenges and tomorrow's well-being.