

Efficacy of the Violett M Standalone Indoor Air Purifier Against Aerosolized MS2 Bacteriophage

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FDA Compliance:

This study was conducted in compliance with FDA Good Laboratory Practices (GLP) as defined in 21 CFR, Part 58.

Testing Lab:

Aerosol Research and Engineering Laboratories, Inc. Project #: 10938.10

Conflict of Interest:

Aerosol Research and Engineering Laboratories, Inc. have no affiliations with, or involvement in any capacity, with Violett's financial interests such as; membership, employment, stock ownership, or other equity interest.

ABSTRACT

Purpose:

This study was done to test a prototype version of the Violett M for its efficacy at reducing a single microorganism, the bacteriophage MS2, from indoor room air.

Background:

This in-vitro study characterized the efficacy of Violett M, indoor air purifier, to reduce respirable bioaerosol levels for a single viral bioaerosol from the air in a 16m³ stainless steel bioaerosol test chamber. The species selected for this study was the virus MS2, a bacteriophage, which is a recognized surrogate for more dangerous pathogenic organisms. MS2 is a non-enveloped ssRNA virus that is a common surrogate for influenza viruses and is a tentative surrogate for SARS-CoV-2.

Methods:

MS2 bacteriophage was aerosolized into a sealed $16m^3$ environmental bioaerosol chamber, containing the Violett M, using a Collison 24-Jet Nebulizer. The MS2 bioaerosols had a mass median aerodynamic diameter (MMAD) averaging at 0.7μ m (700nm). Bioaerosol samples were taken, with impingers, at multiple time points throughout each trial, to quantify the reduction rate capability of the air purification device over time. The impinger samples were serially diluted, plated, incubated, and enumerated in triplicate to yield viable bioaerosol concentrations for each of the sampling time points. Chamber control trial data, or the natural loss rate, was subtracted from the device trial data to yield the net log reduction for each of the bioaerosol challenges.

Results:

The device achieved an average log reduction of -6.77 + -0.09 in 60 minutes. This equates to a net log reduction of 6.42 + -0.09 (> 99.999961%) when accounting for control losses. These results show that the Violett M device is extremely effective at the rapid removal of viral bioaerosols from room air, achieving a 4-net log (99.99%) reduction within thirty-five (35) minutes.

Conclusions:

In conclusion, the Violett M device achieved >4 net log reduction of MS2 bacteriophage bioaerosols within about thirty-five minutes and a 6.42 net log (>99.9999%) reduction within sixty (60) minutes of operation. It is anticipated that such a reduction should reduce the likelihood of individuals being exposed to and contracting airborne infectious diseases in any enclosed environment, medical or otherwise.

Introduction

This study was conducted to evaluate the efficacy of the Violett M indoor air purifier, manufactured by Violett, at reducing aerosolized MS2 bacteriophage. The Violett M device is a free-standing air purifier that is equipped with a HEPA filter and UV-C emitters in a vortex reactor chamber. It is designed to reduce a broad range of gram-positive and gram-negative bacteria, RNA and DNA viruses, bacterial and fungal spores, and other airborne contaminants in indoor air. The Violett M is

designed for use in medical facilities, dental offices, classrooms, eldercare facilities, offices, and other indoor spaces.

The test plan incorporated challenging the Violett M, in a closed environmental chamber, to determine the reduction rate of a single (1) viral bioaerosol, the MS2 bacteriophage. A picture of the Violett M device is shown in Figure 1.



Study Overview

Testing was conducted to characterize the reduction efficacy of a single Violett M unit against a single (1) aerosolized micro-organism; the MS2 bacteriophage which is an RNA virus. This will allow for a reasonable demonstration of the capability of the Violett M device to reduce viable bioaerosol concentrations and therefore, theoretically reducing the chances of exposure to airborne pathogens.

Previous R&D testing

Previous testing of Violett prototype devices have been conducted by ARE labs over the course of several months. Initial testing concluded that the devices had a high efficiency of bioaerosol removal from a 16m³ bioaerosol chamber. Once this testing was complete, the testing proceeded to the Violett M device.

Test Device Description

The Violett M device is a standalone air purification system equipped with HEPA filtration and a photocatalytic vortex chamber equipped with UV-C emitters. The photocatalytic chamber amplifies the exposure wattage of the UV-C emitters by using a highly reflective material to coat the inside of the vortex. Air is channeled into this vortex through a filter and is exposed to this reflecting UV-C light. The Violett M has multiple UV-C emitters which increases the decontamination efficacy.

An integrated High Efficiency Particulate Air (HEPA) filter removes respirable particles from the air inlet. The UV-C technology is intended to degrade any biological organisms that may have passed through the filters using high intensity UV-C emitters within the unit. The device is equipped with a 5speed fan and is designed for large spaces. The device was placed in the center of the testing chamber for the duration of all the testing and was tested at the highest fan speed (speed 5).

Bioaerosol Testing Chamber

A 16m³ sealed aerosol test chamber was used to replicate a contaminated room environment and to contain any potential release of aerosols into the surrounding environment.

The aerosol test chamber is constructed with 304 stainless steel and is equipped with three viewing windows and an airtight lockable chamber door for system setup and general ingress and egress. The test chamber internal dimensions are 9.1ft x 9.1ft x 7ft, with a displacement volume of 580 cubic feet, or 16,000 liters. Figure 2 shows the bioaerosol chamber used for all testing in this study.



Figure 1: Violett M Device: The device is a standalone air purification system equipped with HEPA filtration and a photocatalytic vortex chamber that uses UV-C emitters. The pictured device has a prototype enclosure with production working components.



Figure 2: Stainless Steel Bioaerosol Test Chamber used for all Violett M Testing. The chamber is equipped with HEPA filtered air (in/out), multiple bio aerosol sampling ports, decontamination, and pressure balance. Exterior picture.

The chamber is equipped with filtered HEPA inlets, digital internal temperature and humidity monitor, a heater and humidifier, lighting system, multiple sampling ports, aerosol mixing fans, and a HEPA filtered exhaust system that are operated with wireless remote control. For testing, the chamber is equipped with four 3/8-inch diameter stainless steel probes for aerosol sampling, a 1-inch diameter port for bio aerosol dissemination into the chamber. A Collison 24-jet nebulizer was used for the aerosolization of the microorganism tested.



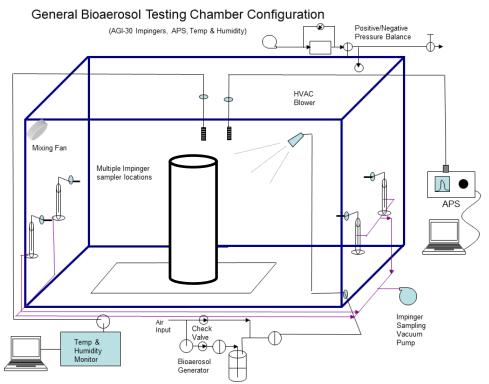


Figure 3: Bio-Aerosol Test Chamber Flow Diagram. Chamber includes bioaerosol induction, multiple bioaerosol sampling ports, particle size monitoring, internal mixing fans, and temperature and humidity controls. Main system HEPA evacuation system not pictured.

To avoid wall effects, all sample and dissemination ports were inserted approximately 18 inches in from the interior walls of the chamber and at a height of approximately 40 inches from the floor. The aerosol sampling and aerosol dissemination probes are stainless steel and bulk headed through the chamber walls to provide external remote access to the aerosol generator and samplers during testing.

The test chamber is equipped with two high-flow HEPA filters for the introduction of filtered room air into the test chamber during aerosol evacuation/purging of the system between test trials. A HEPA filtered exhaust blower, with a 500 ft³/min rated flow capability, is used for rapid evacuation of remaining bioaerosols.

A Magnehelic gauge (Dwyer instruments, Michigan City IN), with a range of -0.5 to 0.5 inches of H_2O , is used to monitor and balance the system pressure during aerosol generation, aerosol purge, and testing cycles. A general flow diagram of the aerosol test system is shown in Figure 3.

Environmental Controls

For increased stability of bioaerosols, the relative humidity inside the chamber was kept at 65% +/- 5% using a PID humidity controller in combination with an ultra-sonic humidifier to nebulize filtered DI water. Temperature

controls maintain chamber trial conditions at typical ambient conditions of 74°F +/- 2°F

Bioaerosol Generation System

All test bioaerosols were disseminated using a Collison 24-jet nebulizer (BGI Inc. Waltham MA), like the one shown in **Figure 4**. The aerosolization of bioaerosols was driven by dry, filtered house air supply. A pressure regulator allows for control of disseminated particle size, use rate, and sheer force generated within the Collison nebulizer. Prior to testing, the Collison nebulizer flow rate and use rate were characterized using an air supply pressure of approximately 40-60 psi, which produced an output volumetric flow rate of 50-80 L/min with a fluid dissemination rate of approximately 1.25 mL/min. The Collison nebulizer was flow characterized using a calibrated TSI model 4040 mass flow meter (TSI Inc., St Paul MN).

Bioaerosol Sampling and Monitoring System

Two AGI-30 impingers (Ace Glass Inc. Vineland NJ) were used for bioaerosol collection to determine chamber concentrations. The two AGI-30 Impingers were placed at opposite corners of the chamber in order to represent an entire room sample. The mixing fans inside the chamber worked to ensure a homogenous air mixture inside the chamber.





Figure 4. 6-Jet Collison nebulizer. Glass and 304 stainless steel construction, BGI Industries.

The AGI-30 impinger vacuum source was maintained at a negative pressure of 18 inches of Hg during all characterization and test sampling to assure critical flow conditions. The AGI-30 impingers sample at a rate of 12.5 LPM impinger flows were characterized using a calibrated TSI model 4040 mass flow meter.



Figure 5. TSI Aerodynamic Particle Sizer (APS) model 3321 used to measure total particle concentration and particle size distribution of the challenge bioaerosol. Range 0.54-20.0 µm aerodynamic diameter, with 1 particle/L detection limits.

TSI Aerodynamic Particle Sizer

A TSI model 3321 Aerodynamic Particle Sizer (APS) (TSI Inc., Shoreview, MN) was used to measure aerosol concentrations and particle size during the test trials. The APS provided real-time aerodynamic particle characterization with a size range from 0.54-20.0 μ m with 52 size bins of resolution. Sampling is continuous with a data export interval of 1 second. The APS has a continuous flow rate of 5 liters per minute (LPM). A picture of the APS is shown in Figure 5.

Species Selection

Due to safety concerns for bioaerosol testing, organism selection was based on Biological Safety Level 1 (BSL1) species which served as surrogates for more dangerous pathogenic (BSL2 & BSL3) organisms.

Viral Challenges:

MS2 bacteriophage is a viral single-stranded, nonenveloped RNA bacteriophage that has historically been used as a surrogate for influenza viruses. MS2 has also recently been used as a tentative surrogate for SARS-CoV-2 in numerous published bioaerosol studies.

The US FDA guidance document, *Enforcement Policy for Sterilizers, Disinfectant Devices, and Air Purifiers During the Coronavirus Disease 2019 (COVID-19) Public Health Emergency,* states that lipid enveloped viruses, such as coronaviruses, are the least resistant microorganisms to germicidal chemicals. It is presumed that this susceptibility is similar for other chemical, physical, and catalytic methods of destruction.

MS2 is a non-enveloped virus, which makes it more resistant to disinfection than lipid viruses, and therefore, should represent a "worst case scenario" when compared to actual lipid-enveloped RNA viruses like SARS-CoV-2. Figure 6 is a graphic from the FDA document, COVID Sterilizers, Disinfectant Devices, and Air Purifiers Guidance, demonstrating resistance to disinfection.

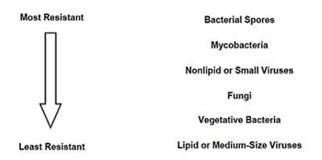


Figure 6: FDA graphic demonstrating general resistance to disinfection for various microorganisms. FDA, Guidance Enforcement Policy for Sterilizers, Disinfectant Devices, and Air Purifiers during the Coronavirus Disease 2019 (COVID-19). Pg. 7. March 2009. SAR-CoV-2 (lipid or medium-Sized Virus), MS2 (non-lipid small virus).

For UV-C deactivation, MS2 is also a much more resilient organism than SARS-CoV-2. To achieve a 1 log deactivation of MS2 it takes 15.9 mJ/cm² of UV irradiation (Wilson et al 1992), coronaviruses such as SARS-CoV-2 takes 3.7mJ/cm² (Heßling et al 2020).

These results were obtained by investigations on many different coronaviruses, including SARS-CoV and MERS-CoV, but not SARS-CoV-2. Nevertheless, it can be assumed that they are also applicable for SARS-CoV-2 and all future mutations. RNA mutations might have a strong influence on the pathogenicity of a virus, but they do not result in larger structural differences, especially concerning the UV absorption properties of the RNA, which are the main cause for the antiviral effect of ultraviolet radiation.



Viral Particle Size Distribution Im³ Chamber, MS2 in PBS, Collison Nebulizer, APS 3321 30.00% 25.00% 15.00% 5.00% 0 2 4 6 8 10 Aerodynamic diameter(µm)

Figure 7: Aerodynamic Particle Size Distribution of RNA virus MS2 in the test chamber. MMAD for viral species averaged approximately $0.7 \mu m$.

Bioaerosol Challenge Particle Size Testing

Bioaerosol challenge particle size distributions were measured with a TSI Aerodynamic Particle Sizer model 3321 (APS) for all challenge species. The particle size distribution was taken shortly after aerosolization for each species via sampling through a sample probe into the test chamber. The APS has a dynamic measurement range of 0.54 to 20.0 μ m and was programmed to take consecutive real-time oneminute aerosol samples. Data was logged in real-time to an Acer laptop computer, regressed, and plotted.

The aerodynamic particle size distribution for all challenge bioaerosols is shown to be within the respirable range for regional alveolar tract deposition and show a low geometric standard deviation (GSD), indicating that a monodispersed aerosol was generated in the chamber for each of the challenge species. The aerodynamic particle size distribution for MS2 can be found in Figure 7.

While there may be variation in the particle size of a single virus to the dispersal size, shown in the previously mentioned graph, any virus that is encountered in nature is most likely suspended in a matrix solution. While viruses may

be smaller than the particle size shown these aerosolized particles are far more representative of a real-life situation where the device would encounter these organisms.

Viral Culture & Preparation

Pure strain viral seed stock and host bacterium were obtained from ATCC. Host bacterium was grown in a similar fashion to vegetative cells in an appropriate liquid media. The liquid media was infected during the logarithmic growth cycle with the specific bacteriophage.

After an appropriate incubation time, the cells were lysed, and the cellular debris separated by centrifugation. MS2 stock yields were greater than 1×10^{11} plaque forming units per milliliter (pfu/mL) with a single amplification procedure. This stock MS2 viral solution was then diluted with PBS to approximately 1×10^{10} plaque forming units per milliliter (pfu/mL) for use in the Collision nebulizer.

Plating and Enumeration

Impinger and stock biological cultures were serially diluted and plated in triplicate. (Multiple serial dilutions) using a standard spread plate assay technique onto tryptic soy agar plates. The plated cultures were incubated for 24-48 hours, depending on the species, then enumerated and recorded.

Post-Testing Decontamination and Prep

Following each test, the chamber was air flow evacuated/purged for a minimum of twenty minutes between tests and analyzed with the APS for particle concentration decrease to baseline levels between each test.

The chamber was decontaminated at the conclusion of the trials with aerosol/vaporous hydrogen peroxide (35%). The Collison nebulizer and impingers were cleaned at the conclusion of each day of testing by soaking in a 3% bleach bath for 20 minutes. The nebulizer and impingers were then submerged in a DI water bath, removed, and spray rinsed 6x with filtered DI water until use.

General Timeline for Bioaerosol Chamber Testing

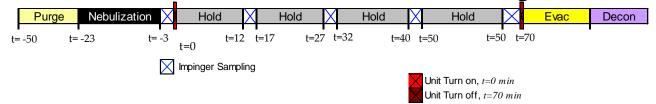


Figure 8: Approximate sampling timeline for the Violett M Air Purifier.



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	Trial	Challenge Organism	Surrogate for	ATCC #	Туре	# of Trials	Sampling	Impinger Sample Times (min)	Viable Cascade Sample Times (min)
	1	MS2	Influenza & SARS-CoV- 2	15597-B1	ssRNA Virus	4	AGI Impingers	0, 15, 30, 45, 60	Upstream: 3 Downstream: 3

Bioaerosol Challenge Test Matrix

Figure 9: Test Matrix for the Violett M Air Purifier.

Data Analysis

Results from the control trials were graphed and plotted to show natural viability loss over time in the chamber. These control trials served as the basis to determine the time required for the Violett M device to achieve at least a 4 log (99.99%) reduction in viable bioaerosol above the natural losses from the control trials. Both the control and test trials are plotted showing the log reduction in viable bioaerosol for each organism. All data is normalized with time zero enumerated concentrations. Subsequent samples are normalized and plotted to show the loss of viability over time.

Methods: Bioaerosol Efficacy Testing

To accurately assess the Violett M unit, test chamber pilot control trials were performed with all organisms over a 90-minute period to characterize the biological challenge aerosol delivery/collection efficiency, and viable concentration over time. Control testing was performed to provide baseline comparative data to assess the actual reduction from the Violett M challenge testing and verify that viable bioaerosol concentrations persisted above the required concentrations over the entire pilot control test period.

During the control trials, a single low velocity fan, located in the corner of the bioaerosol test chamber, was turned on for the duration of the trial to ensure a homogenous aerosol concentration within the aerosol chamber. The mixing fan was used for all control trials and was turned off during Violett M test trials. The two impingers used for bioaerosol collection were pooled and mixed prior to plating and enumeration. A complete test matrix for the bioaerosol trials can be found in Figure 9 above.

For each control and challenge test, the Collison nebulizer was filled with approximately 40 mL of biological stock and operated at 50 psi for a period of 20 minutes. Then, the impingers were filled with 20 mL of sterilized PBS with an addition of 0.005% v/v Tween 80 for bioaerosol collection. The addition of Tween 80 was used to increase the impinger collection efficiency and de-agglomeration of all microorganisms. The chamber mixing fan was turned on during bioaerosol dissemination to assure a homogeneous bioaerosol concentration in the test chamber prior to taking the first impinger sample (T=0).

Following bioaerosol generation, baseline bioaerosol concentrations were established for each pilot control and Violett M test by sampling simultaneously with two AGI-30 impingers located at opposite corners of the chamber. The samples were collected for 3 to 20 minutes at intervals of 15 or 30 minutes throughout the entire test period.

Collected impinger chamber samples were pooled and mixed at each sample interval for each test. Aliquots of impinger samples were collected and then used for plating. Impingers were rinsed 6x with sterile filtered water between each sampling interval and re-filled with sterile PBS using sterile graduated pipettes for sample collection.

For Violett M biological testing, the unit was turned on immediately following a time 0 (T=0) baseline sample and operated for the entirety of the test. Subsequent impinger samples were taken at various time points throughout the trial. These samples were enumerated for viable concentration to measure the effective viable bioaerosol reduction during operation of the Violett M device over time.

All samples were plated in triplicate on tryptic soy agar media over a minimum 3 log dilution range. Plates were incubated for 24-48 hours and enumerated for viable plaque forming units (pfu) to calculate aerosol challenge concentrations in the chamber and reduction of viable microorganisms.

Results:

This study was performed to evaluate the Violett M device's efficacy at the reduction of bioaerosols in a controlled test chamber. Reduction of viable bioaerosols by 4 logs, or 99.99%, is the minimum requirement for FDA approved use. The MS2 bacteriophage was selected specifically for determining the device's efficacy for reducing viral RNA bioaerosols.

The device showed an average log reduction of 6.77 +/-0.09 within 60 minutes. This equates to a net log reduction of 6.42 +/- 0.09 (>99.9999%) when control losses are subtracted. These results show that the Violett M device was extremely effective at rapidly removing viral bioaerosols, achieving a 4-net log (99.99%) reduction within thirty-five (35) minutes. Log reduction data can be found in Figure 10 net log reduction data can be found in Figure 12. A table summarizing all trial results can be found in Figure 11.



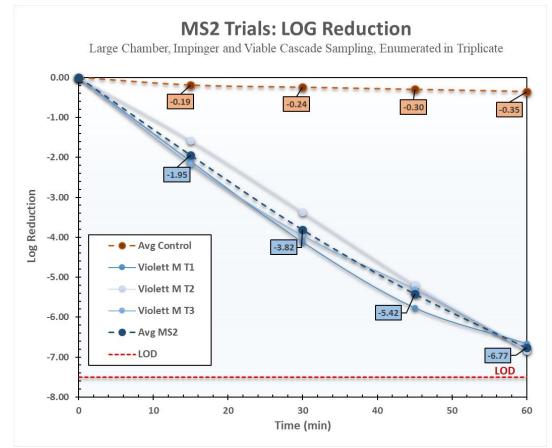


Figure 10: Log Reduction for the Violett M against MS2 bacteriophage bioaerosols.

Conclusion:

In conclusion, the Violett M device achieved >4 net log reduction of the MS2 bioaerosol within about thirty-five (35) minutes and achieved an average 6.42 net log reduction within sixty (60) minutes.

It is anticipated that such a reduction should reduce the likelihood of individuals being exposed to and contracting airborne infectious diseases in any enclosed environment, medical or otherwise. A table summarizing all trial results can be found in **Figure 11**.

Deviations and Acceptance Criteria:

No deviations from the protocol were noted throughout the test trials. All final endpoints were ≤0.35 standard deviations from the mean. In accordance with ARE Labs' standard practices, and in compliance with GLPs, all data was verified for accuracy.

Bioaerosol					Trial Time	(minutes)	
Туре	Species (description)	Trial Name	Reduction Type	15	30	45	60
Virus	MS2	Violett M T1	Net Log Reduction	-1.90	-3.88	-5.47	-6.31
virus	(RNA E. coli phage)	VIOlett IVI 11	Net % Reduction	98.7516%	99.9867%	99.9997%	100.0000%
N.C	MS2	16-1-11 14 72	Net Log Reduction	-1.38	-3.13	-4.90	-6.50
Virus	(RNA E. coli phage)	Violett M T2	Net % Reduction	95.8654%	99.9252%	99.9987%	100.0000%
16	MS2	Vislett M T2	Net Log Reduction	-1.99	-3.71	-5.00	-6.45
Virus	(RNA E. coli phage)	Violett M T3	Net % Reduction	98.9703%	99.9806%	99.9990%	100.0000%
			Net Log Reduction	-1.76 +/- 0.33	-3.57 +/- 0.39	-5.12 +/- 0.3	-6.42 +/- 0.09
	All Trial Averages		Net % Reduction	97.8624% +/- 1.7329%	99.9642% +/- 0.0339%	99.9991% +/- 0.0005%	100% +/- 0%

Figure 11: Executive Summary Data for Violett M device on highest fan speed setting when tested against MS2 bioaerosols.

Violett M MS2 Trials Summary Data



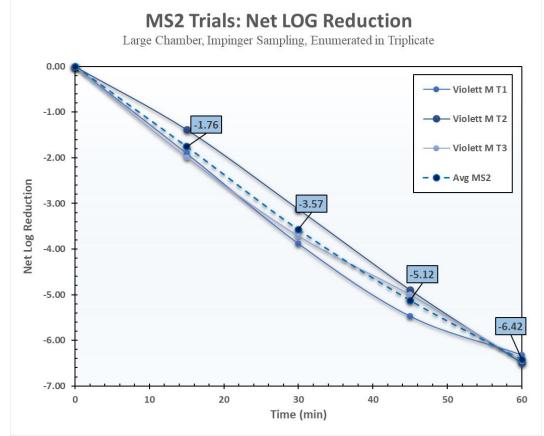


Figure 12: Net log Reduction for the Violett M on highest fan speed setting against aerosolized MS2 bacteriophage.

Clean Air Delivery Rate (CADR):

In addition to testing, the clean air delivery rate (CADR) was calculated for the Violett M. The clean air delivery rate is the air flow from the device that has been purified of particles in each size distribution. This is calculated by multiplying the efficiency of the device by its flow rate in cubic feet per minute (CFM).

For CADR calculations, the difference in slopes for the control and test trials was calculated to determine the equivalent air exchange rate. The slope of the test trials was determined using only the T-0 and T-20 time points due to low bioaerosol concentrations within the chamber that were close to limits of detection past this timepoint. The CADR was then calculated by multiplying the equivalent air exchange rate by the volume of the test chamber (16m³). See Figure 14 for an example of these calculations.

Clean Air Delivery Rate (CADR) Results:

The calculated CADR, based off trial data, suggests that Violett M device can achieve 13.92 equivalent air exchanges (eqACH) per hour. A table breakdown of these results is shown in Figure 13. While this number is only an estimation of the device's ability to remove viruses from a given volume, it does provide a general assessment of the device's performance in the bioaerosol test chamber.

The device is easily able to reach the 4-log reduction threshold with a CADR of 222.79 m^3 which translates to a 131.08 CADR in CFM (cubic feet per minute). These values illustrate an equivalent air exchange of 13.92 per hour, or the theoretical number of turnovers of clean air simulated by the device in a single hour.

CADR Summary Table

Trial Set	Device	eqACH	CADR (m ³)	CADR (CFM)
MS2 Average	Violett M	13.92	222.79	131.08

Figure 13: CADR and eqACH calculation results.



Graphical CADR Calculation - MS2 Virus

Equivalent Air Exchange Calculation and Clean Air Delivery Rate Calcualtion

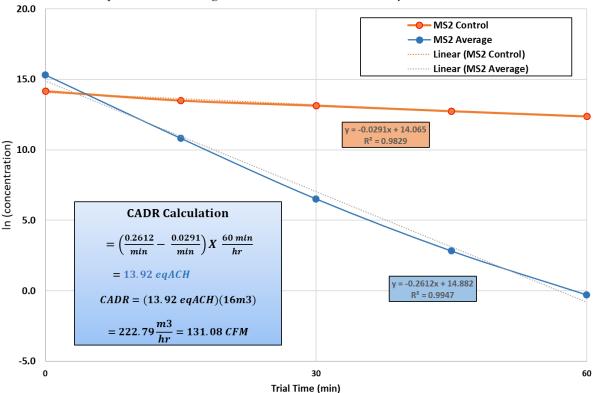


Figure 14: CADR and eqACH calculation example graph.

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Analytical Testing Facility

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Project

10938.30

Study Director

Jamie Balarashti Aerosol Research and Engineering Laboratories

GLP Statement

We, the undersigned, herby certify that the work described herein was conducted by Aerosol Research and Engineering Laboratories in compliance with FDA Good Laboratory Practices (GLP) as defined in 21 CFR, Part 58.

Conflict of Interest Statement

Aerosol Research and Engineering Laboratories, Inc. have no affiliations with, or involvement in any capacity, with Violett's financial interests such as; membership, employment, stock ownership, or other equity interest.

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Rochard V. Lenten

Richard Ludwick Director of Operations ARE Labs, Inc.

12/19/2022 Date

Principal Investigator:

W. andre Derte

W. Andrew Dexter M.S. Staff Research Scientist ARE Labs, Inc.

12/19/2022

Date



APPENDIX A: Raw Data



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Under total t			0	50	90	120 150	180				
SAMPLE TIME rank 0 15 30 45 60 U L00 MBPRONE LISED (rin VLABLE CASCADE LUSED (rin CHAMBER MPIN/CGR RIOBIOARBOOL CONCENTRATION (cir pld. Ar) n		TRIAL COMMENTS/NOTES			Time (min)				Time	(min)	
SAMPLE TIME rank 0 15 30 45 60 U L00 MBPRONE LISED (rin VLABLE CASCADE LUSED (rin CHAMBER MPIN/CGR RIOBIOARBOOL CONCENTRATION (cir pld. Ar) n	BIOA	EBOSOL Sample ID and Summary Data	C1	62	62	E 4	85	56	87	59	LOD
IMPRICE IMPLICATION OF ADD AT A DATA AND A CONSTRUCT OF ADD AT ADD A CONSTRUCT OF ADD A CONSTRUCT OF ADD A ADD A CONSTRUCT OF ADD A	BIUA							30	57	30	_
UNMER CASCAPE USED (7.4) n <td></td> <td></td> <td>-</td> <td></td> <td></td> <td>-</td> <td></td> <td></td> <td></td> <td></td> <td></td>			-			-					
CHAURER MENORS ABORDARKONGLONCENTRATION (Glor plat.Ar) 1.402E-00 5.12E-05 3.448E-05 2.376E-05 9D/01 9D/0											
CHAMBER VIABLE BIOBIDA EBOSIDI CONSTRUCY CIRCLS (6) segrence of VIABLE AND SUBJECT (5) Segrence of VIABLE CONSTRUCY CIRCLS (6) Segrence of VIABLE CONSTRUCY CIRCLS (7) Segrence of VIABLE CONSTRUCTION RECENCE OF VIABLE CONSTRUCT										-	
IMPINGER DILUTION CONSISTENCY CHECKS (% agreement) MF & VIABLE CONSISTENCY CHECKS (% agreement) MF & VIABLE CONSISTENCY CHECKS (% agreement) 1406±06 7.300±05 5.120±05 5.2376±05 2.3762±05 0.1422 0.1422 CHAMBER BIORBOLARE/ROUTION (Chor pHIL-AR) RELATIVE FERCINATION (Chor pHIL-AR) 1.406±06 7.300±05 5.2376±05 2.3762±05 2.3762±05 0.1422 0.1420 RELATIVE FERCINATION (Chor pHIL-AR) 0.0000% 48.8889% 64.444% 7.60556% 3.35000% 100.000% 100.000% 100.000% 100.000% 100.000% 100.000% 7.601 0.0007 100.000% 7.601 0.0007 4.14 4.03 0.33 7.01 100.000% 2.00 <td></td> <td></td> <td>1.440E+06</td> <td>7.360E+05</td> <td>5.120E+05</td> <td>3.448E+05</td> <td>2.376E+05</td> <td>#DIV/0!</td> <td>#DIV/0!</td> <td>#DIV/0!</td> <td>1.422E-01</td>			1.440E+06	7.360E+05	5.120E+05	3.448E+05	2.376E+05	#DIV/0!	#DIV/0!	#DIV/0!	1.422E-01
NUMEE CONSTRUCT CHECKS (% sproved IMP & VIABLE CONSTRUCT (% sproved) Sproved S											
INP & MARLE CROSS CHECK 05 spreamedImage: space		IMPINGER DILUTION CONSISTENCY CHECKS (% agreement)				0 34.23%	0 35.00%				e 100.00%
CHAMBER BIORIOAEROSOL CONCENTRATION (chorpful. Air) RELATIVE PRCENT RAYAINING TROM 1-0 (x) RELATIVE RAYAINING TROM (x) RELA		VIABLE CONSISTENCY CHECKS (% agreement)									
RELATIVE PERCENT REMAINING FROM T=0 (%) RELATIVE PERCENT REMOVAL FLOW T=0 (%) 0.0000% 0.000%51.111% 45.8889% 0.000%35.555% 45.4444% 76.055% 0.000%16.5000% 83.00%10.0000% 10.000% 10.000%RELATIVE PERCENT REMOVAL FLOW T=0 (%) 0.0000.0100.030.030.00070.00		IMP & VIABLE CROSS CHECK (% agreement)									
RELATIVE PERCENT REJAMING FROM T=0 (%) RELATIVE PERCENT REMOVAL FROM T=0 (%) 0.0000% 0.0000%100100,000% 0.0000%100,000% 0.0000%100,000% 0.0000%100,000% 0.0000%100,000% 0.0000%0.000% 0.0000%0.000% 0.0000%0.000% 0.0000%0.000% 0.0000%0.000% 0.0000%0.000% 0.		CHAMBER BIOBIOAEROSOL CONCENTRATION (cfu or pfu/L Air)	1.440E+06	7.360E+05	5.120E+05	3.448E+05	2.376E+05				0.1422
RELATIVE PERCENT REMOVAL FROM T=0 (%) LOG REDUCTION FROM T=0 (%) OO0.000 % 48.889% 0.0164.444% 90.0278.055% 0.0383.500% 0.3595.000% 0.3575.0075.00Improvement representationsSAMPLE TIME (min)01530456000020.0020.00IMPROVER FILL VOL (min)20.015050.0020		RELATIVE PERCENT REMAINING FROM T=0 (%)	100.0000%								
LOG REDUCTION FROM T=0 0ng in SAMPLE TME IN BURNER FILL VOL 01 MPINCER SAMPLING IN MPINCER FILL VOL 01 MPINCER FIL		RELATIVE PERCENT REMOVAL FROM T=0 (%)	0.0000%	48.8889%	64.4444%	76.0556%	83.5000%				100.0000%
Impinger Sampling Conditions SAMPLE TIME (min) 0 15 30 45 60 0 0 LOO IMPROGER FLL VOL (nd) 2.00 2.00 2.0 2.00 2.0 2.0 2.00 2.0 2.0 2.0 2.0 2.00 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>											
	_										
IMPINGER FILL VOL (nit) 20.0 20	Impir										
IMPINGER SAMPLING TIME (m) IMPINGER FLOW RATE (pm) 2.0 5.0 5.0 5.0 5.0 5.0 10.0 5.0 IMPINGER FLOW RATE (pm) 12.5											
Improve the term of the term of term o											
Isone DILUTION RATIO (0) DROPLET SIZE (µ) 4 6 6 1 0		IMPINGER SAMPLING TIME (min)	2.0	5.0	5.0	5.0	5.0	5.0	5.0	10.0	5.0
Normalized biology of the second se		IMPINGER FLOW RATE (lpm)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
No DROPLET SIZE (n) 50 50 50 50 50 50 50 750 Image: Control of the control of t		DILUTION RATIO (10 ^x)	-4	-4	-4	-4	-4	-4	-4	-4	0
Image: height best base in the second seco				50		50	50	50	50	50	
Note that the properties of the properise of the properties of the prop	T#										
Image: concentration (chorp land) 1,800 1,800 1,800,000 1,800,000 900,000 0 0 CHAMBER BIOAEROSOL CONCENTRATION (chorp land), Ary 1,444-66 7,364-05 5,124-05 2,884-05 2,884-05 0 1,402-01 Image: concentration (chorp land), Ary 1,444-66 7,364-05 5,124-05 2,884-05 5,000 3,3	1ge ;										
Image: concentration (chorp land) 1,800 1,800 1,800,000 1,800,000 900,000 0 0 CHAMBER BIOAEROSOL CONCENTRATION (chorp land), Ary 1,444-66 7,364-05 5,124-05 2,884-05 2,884-05 0 1,402-01 Image: concentration (chorp land), Ary 1,444-66 7,364-05 5,124-05 2,884-05 5,000 3,3	Rai	ENUMERATED PLATE COUNTS (# / drop)	5		0	,	5				
Image: concentration (chorp land) 1,800 1,800 1,800,000 1,800,000 900,000 0 0 CHAMBER BIOAEROSOL CONCENTRATION (chorp land), Ary 1,444-66 7,364-05 5,124-05 2,884-05 2,884-05 0 1,402-01 Image: concentration (chorp land), Ary 1,444-66 7,364-05 5,124-05 2,884-05 5,000 3,3	tion										U
Image: concentration (chorp land) 1,800 1,800 1,800,000 1,800,000 900,000 0 0 CHAMBER BIOAEROSOL CONCENTRATION (chorp land), Ary 1,444-66 7,364-05 5,124-05 2,884-05 2,884-05 0 1,402-01 Image: concentration (chorp land), Ary 1,444-66 7,364-05 5,124-05 2,884-05 5,000 3,3	Dilu		0.02	11.50	0.00	6.50	4.50				
CHAMBER BIOAEROSOL CONCETRATION (chi or phi/LAP) 1446-06 7.364-05 5.126-05 2.886-05 2.886-05 1.426-01 New properties DILUTION RATIO (n) DROPLET SIZE (n) 4.4	-										
Image: Difference of the system of											
Image: Decemption of the system of		CHAMBER BIOAEROSOL CONCETRATION (cfu or pfu/L Air)	1.44E+06	7.36E+05	5.12E+05	4.16E+05	2.88E+05				1.42E-01
1 47 34 ENUMERATED PLATE COUNTS (#/drop) 42 30 42 30 42 40 23 1 42 1 <		DILUTION RATIO (10 ^x)	-4	-4	-3	-3	-3	-3	-3	-3	
1 47 34 ENUMERATED PLATE COUNTS (#/drop) 42 30 42 30 42 40 23 1 42 1 <		DROPLET SIZE (µl)	100	100	100	50	50	50	50	50	
browspace 42 30 42 30 42 30 42 30 40 23 PLATE AVERAGE COUNT (# / drop) 42.75 29.25 IMPINGER CONCENTRATION (cfu or plural) 855,000 555,000 CHAMBER BIOAEROSOL CONCETRATION (cfu or plural) 2.744:405 1.874:405	I#					47	34				
IMPINGER CONCENTRATION (cfu or pfurth) 555,000 CHAMBER BIOAEROSOL CONCETRATION (cfu or pfurth) 2,744-05	lge;										
IMPINGER CONCENTRATION (cfu or pfurth) 555,000 CHAMBER BIOAEROSOL CONCETRATION (cfu or pfurth) 2,744-05	Rai	ENUMERATED PLATE COUNTS (# / drop)									
IMPINGER CONCENTRATION (cfu or pfurth) 555,000 CHAMBER BIOAEROSOL CONCETRATION (cfu or pfurth) 2,744-05	tion										
IMPINGER CONCENTRATION (cfu or pfurth) 555,000 CHAMBER BIOAEROSOL CONCETRATION (cfu or pfurth) 2,744-05	Dilut			•							_
CHAMBER BIOAEROSOL CONCETRATION (cfu or pfuL Air) 2,745-05 1.875-05	-										
		CHAMBER BIOAEROSOL CONCETRATION (cfu or pfu/L Air)				2.74E+05	1.87E+05				

Figure 1A: Raw Plate Counts for MS2 Control Trial.

Research and Engineering L a b o r a t o r i e s

ERGSOL

Trial Information			TRIAL LOG	REDUCTION	RESULTS		TR	AL % REMAI	NING RESULT	S
TEST DATE: Thursday, December 15, 2022					0.00				-MS2 T1	
TRIAL PERFORMED BY: WAD			0.0 0				100.0% 9			
TRIAL NUMBER: T1			2							
TEST ORGANSIM: MS2										
TRIAL NAME ID (GRAPHS/TABLES): MS2 T1	_		2.09							
IRIAL NAME ID (GRAPHS/TABLES): MSZ 11	_		-2.0		– – LOD		10.0%			
					-o- Linear Fit					
evice Information						5				
MANUFACTURER: Violett			-4.0	<u>- 😲 2</u>	_/	% Reduction				
UNIT MODEL: Violett M							1.0%			
FAN SPEED (CFM):						2	<u> </u>			
UNIT SERIAL #:	6			- I 🔏 I		8	0.80%			
FITER ID #:	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		-6.0	-6.6						
FILTER LOT #:	LOG Reduction		-7	.80 🛛 🏹			0.1%			
							0.1%			
eneral Testing Conditions (Can Be User Defined)			-8.0 -8.0		\ 					
TEST CHAMBER VOLUME (m ³): 16										
NEBULIZER CONDITIONS: Collison 24-Jet; approx. 20 min neb								0.01%		
		-30		30 60	90	120	0.0%	V		
SAMPLING METHOD: Impinger & Cascade			-10.0							
CHAMBER MIXING FAN: yes					٩					
TEMP (F): 74										
RH (%): 70			-12.0				0.0%			
OTHER INSTRUMENTS: Picarro, Interscan, Tiger								30	60 9	0
TRIAL COMMENTS/NOTES								Time	(min)	
THE & CONNECTORY OF LO	L			Time (min)				mile		
IOAEROSOL Sample ID and Summary Data		S1	S2	S 3	S4	S 5	S 6	S 7	S 8	LOI
SAMPLE T		0	15	30	45	60	90	57		LOD
IMPINGER US		-					y	n	n	
		У	У	У	У	У				У
VIABLE CASCADE US		n	n	n	n	n	n	n	n	n
CHAMBER IMPINGER BIOBIOAEROSOL CONCENTRATION (cfu		89E+06	7.147E+04	6.720E+02	1.525E+01	1.920E+00	#DIV/0!			1.422E
CHAMBER VIABLE BIOBIOAEROSOL CONCENTRATION (cfu or	pfu/L Air)									
IMPINGER DILUTION CONSISTENCY CHECKS (% a	greement)			9.09%	16.67%					🛑 100.00
VIABLE CONSISTENCY CHECKS (% a	greement)									
IMP & VIABLE CROSS CHECK (% a	- greement)									
CHAMBER BIOBIOAEROSOL CONCENTRATION (cfu or p		89E+06	7.147E+04	6.720E+02	1.525E+01	1.920E+00				0.142
RELATIVE PERCENT REMAINING FROM		0.0000%	0.8040%	0.0076%	0.0002%	0.0000%				0.0000
RELATIVE PERCENT REMOVAL FROM		0000%	99.1960%	99.9924%	99.9998%	100.0000%				100.000
LOG REDUCTION FROM T	=0 (log ₁₀)	0.00	-2.09	-4.12	-5.77	-6.67				-7.80
npinger Sampling Conditions										
npinger Sampling Conditions SAMPLE T	ME (min)	0	15	30	45	60	90	0	0	LOD
		0 20.0			45 20.0	60 20.0	90 20.0	0 20.0	0 20.0	20.0
SAMPLE T IMPINGER FILL	VOL (ml)	20.0	15 20.0	30 20.0	20.0	20.0	20.0	20.0	20.0	20.0
SAMPLE T IMPINGER FILL IMPINGER SAMPLING T	VOL (ml) ME (min)	20.0 3.0	15 20.0 5.0	30 20.0 5.0	20.0 5.0	20.0 5.0	20.0 10.0	20.0 10.0	20.0 10.0	20.0 5.0
SAMPLE T IMPINGER FILL IMPINGER SAMPLING T IMPINGER FLOW R	VOL (ml) IME (min) ATE (lpm)	20.0 3.0 12.5	15 20.0 5.0 12.5	30 20.0 5.0 12.5	20.0 5.0 12.5	20.0 5.0 12.5	20.0 10.0 12.5	20.0 10.0 12.5	20.0 10.0 12.5	20.0 5.0 12.5
SAMPLE T IMPINGER FILL IMPINGER SAMPLING T IMPINGER FLOW RA DILUTION RAT	VOL (ml) ME (min) ATE (lpm) TIO (10 ^x)	20.0 3.0 12.5 -5	15 20.0 5.0 12.5 -2	30 20.0 5.0 12.5 -2	20.0 5.0 12.5 0	20.0 5.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0
SAMPLE T IMPINGER FILL IMPINGER SAMPLING T IMPINGER FLOW R	VOL (ml) ME (min) ATE (lpm) TIO (10 ^x)	20.0 3.0 12.5	15 20.0 5.0 12.5	30 20.0 5.0 12.5	20.0 5.0 12.5	20.0 5.0 12.5	20.0 10.0 12.5	20.0 10.0 12.5	20.0 10.0 12.5	20.0 5.0 12.5 0
SAMPLE T IMPINGER FILL IMPINGER SAMPLING T IMPINGER FLOW R DILUTION RAT DROPLET	VOL (ml) ME (min) ATE (lpm) TIO (10 ^x)	20.0 3.0 12.5 -5	15 20.0 5.0 12.5 -2	30 20.0 5.0 12.5 -2	20.0 5.0 12.5 0	20.0 5.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5
SAMPLE T IMPINGER FILL IMPINGER SAMPLING T IMPINGER FLOW R DILUTION RAT DROPLET	VOL (ml) IME (min) ATE (lpm) TO (10 ^x) SIZE (µl)	20.0 3.0 12.5 -5 100 18	15 20.0 5.0 12.5 -2	30 20.0 5.0 12.5 -2 100	20.0 5.0 12.5 0 100	20.0 5.0 12.5 0 500	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750
SAMPLE T IMPINGER FILL IMPINGER FILM IMPINGER FI	VOL (ml) IME (min) ATE (lpm) TO (10 ^x) SIZE (µl)	20.0 3.0 12.5 -5 100 18 16	15 20.0 5.0 12.5 -2	30 20.0 5.0 12.5 -2 100 2 2 2	20.0 5.0 12.5 0 100 4 4 4	20.0 5.0 12.5 0 500 3	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750 1 0
SAMPLE T IMPINGER FILL IMPINGER FILL IMPINGER FLOW R. DILUTION RAT DROPLET ENUMERATED PLATE COUNTS	VOL (ml) IME (min) ATE (lpm) TO (10 ^x) SIZE (µl)	20.0 3.0 12.5 -5 100 18	15 20.0 5.0 12.5 -2	30 20.0 5.0 12.5 -2 100 2	20.0 5.0 12.5 0 100 4	20.0 5.0 12.5 0 500 3	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750 1
SAMPLE T IMPINGER FILL IMPINGER SAMPLING T IMPINGER FLOW R. DILUTION RAT DROPLET ENUMERATED PLATE COUNTS	VOL (ml) ME (min) MTE (lpm) TO (10 ³) SIZE (µl) (# / drop)	20.0 3.0 12.5 -5 100 18 16 16	15 20.0 5.0 12.5 -2	30 20.0 5.0 12.5 -2 100 2 2 2 2 2	20.0 5.0 12.5 0 100 4 4 4 5	20.0 5.0 12.5 0 500 3 3 3	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750 1 0 0
SAMPLE T IMPINGER FILL IMPINGER FILL IMPINGER FILOW R. DILUTION RAT DROPLET ENUMERATED PLATE COUNTS PLATE AVERAGE COUNT	VOL (ml) ME (min) ATE (lpm) TO (10 ²) SIZE (µl) (# / drop) (# / drop)	20.0 3.0 12.5 -5 100 18 16 16 16	15 20.0 5.0 12.5 -2	30 20.0 5.0 12.5 -2 100 2 2 2 2 2 2 2	20.0 5.0 12.5 0 100 4 4 4 5 4.33	20.0 5.0 12.5 0 500 3 3 3 3.00	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750 1 0 0 0
SAMPLE T SAMPLE T IMPINGER FILL IMPINGER SAMPLING T IMPINGER FLOW R DILUTION RAT DROPLET ENUMERATED PLATE COUNTS PLATE AVERAGE COUNT IMPINGER CONCENTRATION (cfu	VOL (ml) ME (min) XTE (lpm) TO (10 ²) SIZE (µl) (# / drop) (# / drop) 16	20.0 3.0 12.5 -5 100 18 16 16 16.67 ,666,667	15 20.0 5.0 12.5 -2	30 20.0 5.0 12.5 -2 100 2 2 2 2 2 2 2 2 2 2 0 0 2,00 2,000	20.0 5.0 12.5 0 100 4 4 5 5 4.33 43	20.0 5.0 12.5 0 500 3 3 3 3.00 6	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750 1 0 0 0 0 0 0 0 33 0
SAMPLE T IMPINGER FILL IMPINGER FILL IMPINGER FILOW R. DILUTION RAT DROPLET ENUMERATED PLATE COUNTS PLATE AVERAGE COUNT	VOL (ml) ME (min) XTE (lpm) TO (10 ²) SIZE (µl) (# / drop) (# / drop) 16	20.0 3.0 12.5 -5 100 18 16 16 16	15 20.0 5.0 12.5 -2	30 20.0 5.0 12.5 -2 100 2 2 2 2 2 2 2	20.0 5.0 12.5 0 100 4 4 4 5 4.33	20.0 5.0 12.5 0 500 3 3 3 3.00	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750 1 0 0 0 0 0 0 0 33 0
SAMPLE T IMPINGER FILL IMPINGER FILL IMPINGER FILOW R. MILUTION RAT DROPLET ENUMERATED PLATE COUNTS PLATE AVERAGE COUNT IMPINGER CONCENTRATION (cfu CHAMBER BIOAEROSOL CONCETRATION (cfu	VOL (ml) ME (min) XTE (lpm) TO (10 ³) SIZE (µ1) (# / drop) (# / drop) or pfi/ml) 16 pfi/L Air) 8	20.0 3.0 12.5 -5 100 18 16 16 16.67 ,666,667	15 20.0 5.0 12.5 -2	30 20.0 5.0 12.5 -2 100 2 2 2 2 2 2 2 2 2 2 0 0 2,00 2,000	20.0 5.0 12.5 0 100 4 4 5 5 4.33 43	20.0 5.0 12.5 0 500 3 3 3 3.00 6	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750 1 0 0 0 0 0 33 0
SAMPLE T IMPINGER FILL IMPINGER FILL IMPINGER SAMPLING T IMPINGER FLOW R DILUTION RAT DROPLET ENUMERATED PLATE COUNTS PLATE AVERAGE COUNT IMPINGER CONCENTRATION (cfu CHAMBER BIOAEROSOL CONCETRATION (cfu	VOL (ml) ME (min) XTE (pm) TO (10 ³) SIZE (µl) (# / drop) (# / drop) or pfu/ml) 16 pfu/L Air) 8. TO (10 ³)	20.0 3.0 12.5 -5 100 18 16 16 16.67 .666,667 .89£+06 -4	15 20.0 5.0 12.5 -2 100	30 20.0 5.0 12.5 -2 100 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	20.0 5.0 12.5 0 100 4 4 5 4.33 43 1.395401 0	20.0 5.0 12.5 0 500 3 3 3 3 3.00 6 1.92E+00	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 0 0 0 33 0
SAMPLE T IMPINGER FILL IMPINGER SAMPLING T IMPINGER SAMPLING T IMPINGER SAMPLING T IMPINGER SAMPLING T IMPINGER CONCENTRATION (cfu CHAMBER BIOAEROSOL CONCETRATION (cfu CHAMBER BIOAEROSOL CONCETRATION (cfu DILUTION RAT DROPLET	VOL (ml) ME (min) XTE (pm) TO (10 ³) SIZE (µl) (# / drop) (# / drop) or pfu/ml) 16 pfu/L Air) 8. TO (10 ³)	20.0 3.0 12.5 -5 100 18 16 16 16.67 ;666,667 :89£+06	15 20.0 5.0 12.5 -2 100 -3 100	30 20.0 5.0 12.5 -2 100 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	20.0 5.0 12.5 0 100 4 4 5 4.33 43 1.35F401 0 500	20.0 5.0 12.5 0 500 3 3 3 3.00 6 1.92E+00	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 0 0 33 0
SAMPLE T IMPINGER FILL IMPINGER FILL IMPINGER FILM IMPINGER FILM BILUTION RAT DROPLET ENUMERATED PLATE AVERAGE COUNT IMPINGER CONCENTRATION (cfu CHAMBER BIOAEROSOL CONCETRATION (cfu DILUTION RAT DROPLET	VOL (ml) ME (min) XTE (pm) TO (10 ³) SIZE (µl) (# / drop) (# / drop) or pfu/ml) 16 pfu/L Air) 8. TO (10 ³)	20.0 3.0 12.5 -5 100 18 16 16 16.67 .666,667 .89£+06 -4	15 20.0 5.0 12.5 -2 100 -3 100 19	30 20.0 5.0 12.5 -2 100 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	20.0 5.0 12.5 0 100 4 4 5 4.33 43 1.395401 0	20.0 5.0 12.5 0 500 3 3 3 3 3.00 6 1.92E+00	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 0 0 33 0
SAMPLE T IMPINGER FILL IMPINGER FILL IMPINGER FILM IMPINGER FILM BILUTION RAT DROPLET ENUMERATED PLATE AVERAGE COUNT IMPINGER CONCENTRATION (cfu CHAMBER BIOAEROSOL CONCETRATION (cfu DILUTION RAT DROPLET	VOL (m) ME (min) VIE (pm) TO (10 ⁵) SIZE (µ1) (# / drop) (# / drop) (# / drop) 16 pfuL Ar) 8 SIZE (µ1)	20.0 3.0 12.5 -5 100 18 16 16 16.67 .666,667 .89£+06 -4	15 20.0 5.0 12.5 -2 100 -3 100 19 30	30 20.0 5.0 12.5 -2 100 2 2 2 2 2 2 2 2 2 2 2 2 2 2 00 5.00 5.	20.0 5.0 12.5 0 100 4 4 5 4.33 43 1.35F401 0 500	20.0 5.0 12.5 0 500 3 3 3 3 3.00 6 1.92E+00	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 0 0 0 33 0
SAMPLE T SAMPLE T IMPINGER FILL IMPINGER FILL IMPINGER FLOW R. DILUTION RAT DROPLET ENUMERATED PLATE AVERAGE COUNT IMPINGER CONCENTRATION (cfu CHAMBER BIOAEROSOL CONCETRATION (cfu DILUTION RAT DROPLET	VOL (m) ME (min) VIE (pm) TO (10 ⁵) SIZE (µ1) (# / drop) (# / drop) (# / drop) 16 pfuL Ar) 8 SIZE (µ1)	20.0 3.0 12.5 -5 100 18 16 16 16.67 .666,667 .89£+06 -4	15 20.0 5.0 12.5 -2 100 -3 100 19	30 20.0 5.0 12.5 -2 100 2 2 2 2 2 2 2 2 2 2 0 0 6.40E+02 -1 100 19	20.0 5.0 12.5 0 100 4 4 5 4.33 43 1.35F401 0 500	20.0 5.0 12.5 0 500 3 3 3 3 3.00 6 1.92E+00	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 0 0 0 33 0
SAMPLE T IMPINGER FILL IMPINGER FILL IMPINGER SAMPLING T IMPINGER FLOW R. DILUTION RAT DROPLET Sădory ENUMERATED PLATE COUNTS IMPINGER CONCENTRATION (cfu CHAMBER BIOAEROSOL CONCETRATION (Cfu CHAMBER BIOAEROSOL C	VOL (m) ME (min) NTE (pm) TO (10 ⁶) SIZE (µ1) (# / drop) (# / drop) IO (10 ⁶) SIZE (µ1) (# / drop) SIZE (µ1) (# / drop)	20.0 3.0 12.5 -5 100 18 16 16 16.67 .666,667 .89£+06 -4	15 20.0 5.0 12.5 -2 100 -3 100 19 30	30 20.0 5.0 12.5 -2 100 2 2 2 2 2 2 2 2 2 2 2 2 2	20.0 5.0 12.5 0 100 4 4 5 4.33 43 1.35F401 0 500	20.0 5.0 12.5 0 500 3 3 3 3 3.00 6 1.92E+00	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 0 0 33 0
IMPINGER FILL IMPINGER SAMPLING T IMPINGER SAMPLING T IMPINGER FLOW R. DILUTION RA' DROPLET S S S S S S S S S S S S S S S S S S S	VOL (m) ME (min) NTE (pm) TO (10 ⁶) SIZE (µ1) (# / drop) (# / drop) IO (10 ⁶) SIZE (µ1) (# / drop) SIZE (µ1) (# / drop)	20.0 3.0 12.5 -5 100 18 16 16 16.67 .666,667 .89£+06 -4	15 20.0 5.0 12.5 -2 100 -3 100 19 30	30 20.0 5.0 12.5 -2 100 2 2 2 2 2 2 2 2 2 2 2 2 2 2 00 5.00 5.	20.0 5.0 12.5 0 100 4 4 5 4.33 43 1.35F401 0 500	20.0 5.0 12.5 0 500 3 3 3 3 3.00 6 1.92E+00	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 0 0 33 0
SAMPLE T IMPINGER FILL IMPINGER FILL IMPINGER SAMPLING T IMPINGER FLOW R. DILUTION RAT DROPLET T Sădugu ENUMERATED PLATE COUNTS IMPINGER CONCENTRATION (cfu CHAMBER BIOAEROSOL CONCETRATION (Cfu CHAMBER BIOAEROSO	VOL (m) ME (min) TTC (pm) TO (10 ⁶) SIZE (µl) (# / drop) (# / drop) (# / drop) SIZE (µl) (# / drop) (# / drop) (# / drop) (# / drop) (# / drop)	20.0 3.0 12.5 -5 100 18 16 16 16.67 .666,667 .89£+06 -4	15 20.0 5.0 12.5 -2 100 -3 100 19 30 18	30 20.0 5.0 12.5 -2 100 2 2 2 2 2 2 2 2 2 2 2 2 2	20.0 5.0 12.5 0 100 4 4 5 4.33 43 1.395+01 0 500 26	20.0 5.0 12.5 0 500 3 3 3 3 3.00 6 1.92E+00	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	5.0 12.5 0 750 1 0 0 0
SAMPLE T IMPINGER FILL IMPINGER SAMPLING T IMPINGER SAMPLING T IMPINGER SAMPLING T IMPINGER SAMPLING T IMPINGER SAMPLING T ENUMERATED PLATE COUNTS IMPINGER CONCENTRATION (cfu CHAMBER BIOAEROSOL CONCETRATION (Cfu CHAMBER ACTU CHAMBER ACTU	VOL (m) ME (min) TO (10 ³) TO (10 ³) SIZE (µ) (# / drop) (# / drop) SIZE (µ) (# / drop) (# / drop) (# / drop) (# / drop) (# / drop) (# / drop) (# / drop)	20.0 3.0 12.5 -5 100 18 16 16 16.67 .666,667 .89£+06 -4	15 20.0 5.0 12.5 -2 100 -3 100 19 30 18 22.33	30 20.0 5.0 12.5 -2 100 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	20.0 5.0 12.5 0 100 4 4 5 4.33 43 1.35F401 0 500 26 26	20.0 5.0 12.5 0 500 3 3 3 3 3.00 6 1.92E+00	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 0 0 33 0

Figure 2A: Raw Plate Counts for MS2 Trial 1.

Research and Engineering L a b o r a t o r i e s

ERGSOL

	formation		TRIAL LOG	REDUCTION	RESULTS		TRI	AL % REMAIN	NING RESULT	S
	TEST DATE: Thursday, December 15, 2022				0.00				MS2 T2	
	TRIAL PERFORMED BY: WAD	Г	0.0				100.0%			
	TRIAL NUMBER: T2									
	TEST ORGANSIM: MS2		4.5							
TDIAL	NAME ID (GRAPHS/TABLES): MS2 T2		Ì Ì							
TRIAL	NAME ID (ORAPHS/TABLES): WSZ 12	-	-2.0		– – LOD		10.0%			
	Information			8.37	-O- Linear Fit					
evice	Information	-		à l		5				
	MANUFACTURER: Violett		-4.0			% Reduction				
	UNIT MODEL: Violett M	음		19			1.0% 2.66%	\		
	FAN SPEED (CFM):	울니								
	UNIT SERIAL #:	, ž	-6.0 -7	.02		×				
	FITER ID #:	LOG Reduction	-0.0	.02						
	FILTER LOT #:	9					0.1%			
								0.04%		
enera	al Testing Conditions (Can Be User Defined)	-	-8.0			_		۲. The second		
TE	EST CHAMBER VOLUME (m ³): 16									
	NEBULIZER CONDITIONS: Collison 24-Jet; approx. 20 min neb	-30	`	30 60	90	120	0.0%			
	SAMPLING METHOD: Impinger & Cascade		-10.0	30 00		120				
	CHAMBER MIXING FAN: yes				•					
	TEMP (F): 74									
							0.0%			
	RH (%): 70	L	-12.0				0.0%	30	60 9	0
	OTHER INSTRUMENTS: Picarro, Interscan, Tiger									
	TRIAL COMMENTS/NOTES			Time (min)				Time	(min)	
										_
OAER	ROSOL Sample ID and Summary Data	S1	S2	S 3	S4	S5	S6	S7	S8	LOI
	SAMPLE TIME (min)	0	15	30	45	60	90			LOD
	IMPINGER USED (y / n)	у	у	У	У	У	У	n	n	у
	VIABLE CASCADE USED (y / n)	n	n	n	n	n	n	n	n	n
CE	HAMBER IMPINGER BIOBIOAEROSOL CONCENTRATION (cfu pfu/L Air)	1.502E+06	4.000E+04	6.400E+02	9.600E+00	2.133E-01	#DIV/0!			1.422E
	HAMBER VIABLE BIOBIOAEROSOL CONCENTRATION (cfu or pfu/L Air)	1.0022100	1.0002101	0.1002.102	0.0002100	2.1002 01	<i>"</i> B1070.			
C.	IMPINGER DILUTION CONSISTENCY CHECKS (% agreement)	31.00%								100.00
		31.00%								• 100.00
	VIABLE CONSISTENCY CHECKS (% agreement)									
	IMP & VIABLE CROSS CHECK (% agreement)									
	CHAMBER BIOBIOAEROSOL CONCENTRATION (cfu or pfu/L Air)	1.502E+06	4.000E+04	6.400E+02	9.600E+00	2.133E-01				0.142
	RELATIVE PERCENT REMAINING FROM T=0 (%)	100.0000%	2.6627%	0.0426%	0.0006%	0.0000%				0.0000
	RELATIVE PERCENT REMOVAL FROM T=0 (%)	0.0000%		00 057 40/	99.9994%	100.0000%				100.000
		0.000070	97.3373%	99.9574%	33.333470					-7.02
	LOG REDUCTION FROM T=0 (log10)	0.00	97.3373% -1.57	-3.37	-5.19	-6.85				
						-6.85				
nping	er Sampling Conditions	0.00	-1.57	-3.37	-5.19					
ping	er Sampling Conditions SAMPLE TIME (min)	0.00 0	-1.57 15	-3.37 30	-5.19 45	60	90	0	0	LOD
ping	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi)	0.00 0 20.0	-1.57 15 20.0	-3.37 30 20.0	-5.19 45 20.0	60 20.0	20.0	20.0	20.0	LOD 20.0
ping	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min)	0.00 0 20.0 3.0	-1.57 15 20.0 5.0	-3.37 30 20.0 5.0	-5.19 45 20.0 5.0	60 20.0 5.0	20.0 10.0	20.0 10.0	20.0 10.0	LOD 20.0 5.0
ping	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi)	0.00 0 20.0	-1.57 15 20.0	-3.37 30 20.0	-5.19 45 20.0	60 20.0	20.0	20.0	20.0	LOD 20.0 5.0
iping	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (lpm)	0.00 0 20.0 3.0 12.5	-1.57 15 20.0 5.0 12.5	-3.37 30 20.0 5.0	-5.19 45 20.0 5.0 12.5	60 20.0 5.0 12.5	20.0 10.0 12.5	20.0 10.0 12.5	20.0 10.0 12.5	20.0 5.0 12.5
ping	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (lpm) DILUTION RATIO (10 ²)	0.00 0 20.0 3.0 12.5 -5	-1.57 15 20.0 5.0 12.5 -3	-3.37 30 20.0 5.0 12.5 -2	-5.19 45 20.0 5.0 12.5 0	60 20.0 5.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	LOC 20.0 5.0 12.5 0
	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (lpm)	0.00 0 20.0 3.0 12.5 -5 100	-1.57 15 20.0 5.0 12.5 -3 100	-3.37 30 20.0 5.0 12.5 -2 100	-5.19 45 20.0 5.0 12.5 0 100	60 20.0 5.0 12.5 0 500	20.0 10.0 12.5	20.0 10.0 12.5	20.0 10.0 12.5	LOC 20.0 5.0 12.5 0 750
T#	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (lpm) DILUTION RATIO (10 ²)	0.00 0 20.0 3.0 12.5 -5 100 7	-1.57 15 20.0 5.0 12.5 -3 100 15	-3.37 30 20.0 5.0 12.5 -2 100 1	-5.19 45 20.0 5.0 12.5 0 100 5	60 20.0 5.0 12.5 0 500 1	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	LOD 20.0 5.0 12.5 0 750 1
T#	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (lpm) DILUTION RATIO (10 ²)	0.00 20.0 3.0 12.5 -5 100 7 2	-1.57 15 20.0 5.0 12.5 -3 100	-3.37 30 20.0 5.0 12.5 -2 100 1 2	-5.19 45 20.0 5.0 12.5 0 100	60 20.0 5.0 12.5 0 500 1 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	LOD 20.0 5.0 12.5 0 750 1 0
Availabe #1	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (pm) DILUTION RATIO (10 ⁵) DROPLET SIZE (µl)	0.00 0 20.0 3.0 12.5 -5 100 7	-1.57 15 20.0 5.0 12.5 -3 100 15	-3.37 30 20.0 5.0 12.5 -2 100 1	-5.19 45 20.0 5.0 12.5 0 100 5	60 20.0 5.0 12.5 0 500 1	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	LOD 20.0 5.0 12.5 0 750 1
Vange #1	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (min) DILUTION RATIO (10 ⁵) DROPLET SIZE (µi) ENUMERATED PLATE COUNTS (# / drop)	0.00 20.0 3.0 12.5 -5 100 7 2 1	-1.57 20.0 5.0 12.5 -3 100 15 10	-3.37 30 20.0 5.0 12.5 -2 100 1 2 3	-5.19 45 20.0 5.0 12.5 0 100 5 1	60 20.0 5.0 12.5 0 500 1 0 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	LOD 20.0 5.0 12.5 0 750 1 0 0 0
Availabe #1	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (pm) DILUTION RATIO (10 ⁵) DROPLET SIZE (µl)	0.00 20.0 3.0 12.5 -5 100 7 2	-1.57 15 20.0 5.0 12.5 -3 100 15	-3.37 30 20.0 5.0 12.5 -2 100 1 2	-5.19 45 20.0 5.0 12.5 0 100 5	60 20.0 5.0 12.5 0 500 1 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	LOD 20.0 5.0 12.5 0 750 1 0
Availabe #1	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (min) DILUTION RATIO (10 ⁵) DROPLET SIZE (µi) ENUMERATED PLATE COUNTS (# / drop)	0.00 20.0 3.0 12.5 -5 100 7 2 1 1 3.33	-1.57 20.0 5.0 12.5 -3 100 15 10	-3.37 30 20.0 5.0 12.5 -2 100 1 2 3	-5.19 45 20.0 5.0 12.5 0 100 5 1	60 20.0 5.0 12.5 0 500 1 0 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	LOD 20.0 5.0 12.5 0 750 1 0 0 0
Availabe #1	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (min) IMPINGER FLOW RATE (min) DILUTION RATIO (10 ²) DROPLET SIZE (µl) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop)	0.00 20.0 3.0 12.5 -5 100 7 2 1 1 3.33	-1.57 15 20.0 5.0 12.5 3 100 15 10 12.50	-3.37 30 20.0 5.0 12.5 2 100 1 2 3 200	-5.19 45 20.0 5.0 12.5 0 100 5 1 3.00	60 20.0 5.0 12.5 0 500 1 0 0 0.33	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	LOD 20.0 5.0 12.5 0 750 750 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Availabe #1	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER FILL VOL (mi) IMPINGER FLOW RATE (dpm) DILUTION RATIO (10*) DROPLET SIZE (µl) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop) IMPINGER CONCENTRATION (cfu or pfurL Ar)	0.00 20.0 3.0 12.5 100 7 2 1 3.33 3,333,333 1.78E+06	-1.57 1.5 20.0 5.0 12.5 -3 100 15 10 12.50 125,000 4.00€+04	-3.37 30 20.0 5.0 12.5 -2 100 1 2 3 2.00 2,000 6.40E+02	-5.19 45 20.0 5.0 12.5 0 100 5 1 3.00 30 9.60€+00	60 20.0 5.0 12.5 0 500 1 0 0 0 0 33 1 2.13E-01	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	LOD 20.0 5.0 12.5 0 750 750 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Availabe #1	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (pm) DILUTION RATIO (10°) DROPLET SIZE (µl) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop) IMPINGER CONCENTRATION (cfu or pfuruh) CHAMBER BIOAEROSOL CONCENTRATION (cfu or pfuruh) CHAMBER BIOAEROSOL CONCENTRATION (cfu or pfuruh)	0.00 20.0 3.0 12.5 -5 100 7 2 1 3.33 3.333333 1.78±06 -4	-1.57 15 20.0 5.0 12.5 -3 100 15 10 12,500 125,000 4.00€+04 -3	-3.37 30 20.0 5.0 12.5 -2 100 1 2 3 2.00 2.000 6.40E+02 -1	-5.19 45 20.0 5.0 12.5 0 100 5 1 1 3.00 30 9.60E+00	60 20.0 5.0 12.5 0 500 1 0 0 0 0.33 1 2.13E-01 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	LOD 20.0 5.0 12.5 0 750 750 0 0 0 0 0 0 0 0 0 0 0 0 0 0
	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER FILL VOL (mi) IMPINGER FLOW RATE (dpm) DILUTION RATIO (10*) DROPLET SIZE (µl) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop) IMPINGER CONCENTRATION (cfu or pfurL Ar)	0.00 20.0 3.0 12.5 -5 100 7 2 1 3.33 3.333333 1.78±46 -4 100	-1.57 1.5 20.0 5.0 12.5 -3 100 15 10 12.50 125,000 4.00€+04	-3.37 30 20.0 5.0 12.5 -2 100 1 2 3 2.00 2,000 6,40E+02	-5.19 45 20.0 5.0 12.5 0 100 5 1 3.00 30 9.60€+00	60 20.0 5.0 12.5 0 500 1 0 0 0 0 33 1 2.13E-01	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	LOD 20.0 5.0 12.5 0 750 750 0 0 0 0 0 0 0 0 0 0 0 0 0 0
#1 Dilution Kange #1	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (pm) DILUTION RATIO (10°) DROPLET SIZE (µl) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop) IMPINGER CONCENTRATION (cfu or pfuruh) CHAMBER BIOAEROSOL CONCENTRATION (cfu or pfuruh) CHAMBER BIOAEROSOL CONCENTRATION (cfu or pfuruh)	0.00 20.0 3.0 12.5 -5 100 7 2 1 3.33 3.333333 1.78±06 -4	-1.57 15 20.0 5.0 12.5 -3 100 15 10 12,500 125,000 4.00€+04 -3	-3.37 30 20.0 5.0 12.5 -2 100 1 2 3 2.00 2.000 6.40E+02 -1	-5.19 45 20.0 5.0 12.5 0 100 5 1 1 3.00 30 9.60E+00	60 20.0 5.0 12.5 0 500 1 0 0 0 0.33 1 2.13E-01 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	LOD 20.0 5.0 12.5 750 750 0 750 0 0 0 0 0 0 0 0
#1 Dilution Kange #1	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (pm) DILUTION RATIO (10°) DROPLET SIZE (pl) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop) IMPINGER CONCENTRATION (cfu or pfurh) CHAMBER BIOAEROSOL CONCENTRATION (cfu or pfurh) CHAMBER BIOAEROSOL CONCENTRATION (cfu or pfurh) DROPLET SIZE (pl)	0.00 20.0 3.0 12.5 -5 100 7 2 1 3.33 3,33333 1.78±06 -4 100	-1.57 15 20.0 5.0 12.5 -3 100 15 10 12,500 125,000 4.00€+04 -3	-3.37 30 20.0 5.0 12.5 -2 100 1 2 3 2.00 2.000 6.40E+02 -1	-5.19 45 20.0 5.0 12.5 0 100 5 1 1 3.00 30 9.60E+00	60 20.0 5.0 12.5 0 500 1 0 0 0 0.33 1 2.13E-01 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	LOD 20.0 5.0 12.5 750 750 0 750 0 0 0 0 0 0 0 0
#1 Dilution Kange #1	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (pm) DILUTION RATIO (10°) DROPLET SIZE (µl) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop) IMPINGER CONCENTRATION (cfu or pfuruh) CHAMBER BIOAEROSOL CONCENTRATION (cfu or pfuruh) CHAMBER BIOAEROSOL CONCENTRATION (cfu or pfuruh)	0.00 20.0 3.0 12.5 -5 100 7 2 1 3.33 3,333,333 1.78±+06 -4 100 26	-1.57 15 20.0 5.0 12.5 -3 100 15 10 12,500 125,000 4.00€+04 -3	-3.37 30 20.0 5.0 12.5 -2 100 1 2 3 2.00 2.000 6.40E+02 -1	-5.19 45 20.0 5.0 12.5 0 100 5 1 1 3.00 30 9.60E+00	60 20.0 5.0 12.5 0 500 1 0 0 0 0.33 1 2.13E-01 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	LOD 20.0 5.0 12.5 0 750 750 0 0 0 0 0 0 0 0 0 0 0 0 0 0
#1 Dilution Kange #1	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (pm) DILUTION RATIO (10°) DROPLET SIZE (pl) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop) IMPINGER CONCENTRATION (cfu or pfurh) CHAMBER BIOAEROSOL CONCENTRATION (cfu or pfurh) CHAMBER BIOAEROSOL CONCENTRATION (cfu or pfurh) DROPLET SIZE (pl)	0.00 20.0 3.0 12.5 -5 100 7 2 1 3.33 3,333,333 1.78E+06 -4 100 26 20	-1.57 15 20.0 5.0 12.5 -3 100 15 10 12,500 125,000 4.00€+04 -3	-3.37 30 20.0 5.0 12.5 -2 100 1 2 3 2.00 2.000 6.40E+02 -1	-5.19 45 20.0 5.0 12.5 0 100 5 1 1 3.00 30 9.60E+00	60 20.0 5.0 12.5 0 500 1 0 0 0 0.33 1 2.13E-01 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	LOD 20.0 5.0 12.5 0 750 750 0 0 0 0 0 0 0 0 0 0 0 0 0 0
#1 Dilution Kange #1	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) MPINGER FLOW RATE (hmi) DILUTION RATIO (10 ⁵) DROPLET SIZE (µi) ENUMERATED PLATE COUNTS (# / drop) IMPINGER CONCENTRATION (cfu or pfuril) CHAMBER BIOAEROSOL CONCENTRATION (cfu or pfuril) CHAMBER BIOAEROSOL CONCENTRATION (cfu or pfuril) DROPLET SIZE (µi) ENUMERATED PLATE COUNTS (# / drop) ENUMERATED PLATE COUNTS (# / drop)	0.00 20.0 3.0 12.5 -5 100 7 2 1 3.33 3.333,333 1.78±06 -4 100 26 20 23	-1.57 15 20.0 5.0 12.5 -3 100 15 10 12,500 125,000 4.00€+04 -3	-3.37 30 20.0 5.0 12.5 -2 100 1 2 3 2.00 2.000 6.40E+02 -1	-5.19 45 20.0 5.0 12.5 0 100 5 1 1 3.00 30 9.60E+00	60 20.0 5.0 12.5 0 500 1 0 0 0 0.33 1 2.13E-01 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	LOD 20.0 5.0 12.5 750 750 0 750 0 0 0 0 0 0 0 0
Dilution Kange #1 Dilution Kange #1	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER SAMPLING TIME (min) MPINGER FLOW RATE (hpm) DILUTION RATIO (10 ⁶) ROPLET SIZE (µi) ENUMERATED PLATE COUNTS (# / drop) IMPINGER CONCETRATION (chi or phurla) CHAMBER BIOAEROSOL CONCETRATION (chi or phurla) ENUMERATED PLATE COUNTS (# / drop)	0.00 20.0 3.0 12.5 -5 100 7 2 1 3.33 3.333333 1.78±+06 -4 100 26 20 23 23.00	-1.57 15 20.0 5.0 12.5 -3 100 15 10 12,500 125,000 4.00€+04 -3	-3.37 30 20.0 5.0 12.5 -2 100 1 2 3 2.00 2.000 6.40E+02 -1	-5.19 45 20.0 5.0 12.5 0 100 5 1 1 3.00 30 9.60E+00	60 20.0 5.0 12.5 0 500 1 0 0 0 0.33 1 2.13E-01 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	LOD 20.0 5.0 12.5 750 750 0 0 0 0 0 0 0 0
#1 Diution Kange #1	er Sampling Conditions SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) MPINGER FLOW RATE (hmi) DILUTION RATIO (10 ⁵) DROPLET SIZE (µi) ENUMERATED PLATE COUNTS (# / drop) IMPINGER CONCENTRATION (cfu or pfuril) CHAMBER BIOAEROSOL CONCENTRATION (cfu or pfuril) CHAMBER BIOAEROSOL CONCENTRATION (cfu or pfuril) DROPLET SIZE (µi) ENUMERATED PLATE COUNTS (# / drop) ENUMERATED PLATE COUNTS (# / drop)	0.00 20.0 3.0 12.5 -5 100 7 2 1 3.33 3.333,333 1.78±06 -4 100 26 20 23	-1.57 15 20.0 5.0 12.5 -3 100 15 10 12,500 125,000 4.00€+04 -3	-3.37 30 20.0 5.0 12.5 -2 100 1 2 3 2.00 2.000 6.40E+02 -1	-5.19 45 20.0 5.0 12.5 0 100 5 1 1 3.00 30 9.60E+00	60 20.0 5.0 12.5 0 500 1 0 0 0 0.33 1 2.13E-01 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	LOD 20.0 5.0 12.5 750 1 0 0 0 0 0

Figure 3A: Raw Plate Counts for MS2 Trial 2.

Research and Engineering L a b o r a t o r i e s

ERSSOL

			TRIAL LOG	REDUCTION	RESULTS		TR	IAL % REMAII		s
	TEST DATE: Thursday, December 15, 2022				0.00		100.0%		MS2 T3	
TRIAL PEI	RFORMED BY: WAD	F	0.0 9				100.0% 9			
TR	IAL NUMBER: T3		Ň							
	T ORGANSIM: MS2									
TRIAL NAME ID (GRA			<u></u>	3						
IKIAL NAME ID (GKA	PHS/TABLES): MS2 13		-2.0		– – LOD		10.0%			
					-O- Linear Fit					
evice Informatio				N 06		5				
	NUFACTURER: Violett		-4.0	Y`		% Reduction				
	UNIT MODEL: Violett M	<u>.</u>					1.0%			
FAN	SPEED (CFM):	털		5.30		2				
U	NIT SERIAL #:			?		8	0.669			
	FITER ID #:	LOG Reduction	-6.0				0.667			
	FILTER LOT #:	B S I	-7	.68	,					
		_		—			0.1%			
onoral Tasting (Conditions (Con Bo Usor Defined)		-8.0		\ - - +					
	Conditions (Can Be User Defined)		-8.0							
TEST CHAMBER								0.01%		
	CONDITIONS: Collison 24-Jet; approx. 20 min neb	-30) 0	30 60	90	120	0.0%	<u>×</u>		
SAMPL	ING METHOD: Impinger & Cascade		-10.0							
	MIXING FAN: yes				٩					
	TEMP (F): 74									
							0.0%			
	RH (%): 70	L	-12.0				0.0%	30	60 91	0
	ISTRUMENTS: Picarro, Interscan, Tiger									
TRIAL COMM	MENTS/NOTES			Time (min)				Time	(min)	
										90 LOI LOI 90 0.142 0.0000 100.000 -7.66 100.000 -7.66 0 100.000 -7.65 0 750 0 750 0 0 0 100 0 0 100 0 0 12.5 100 0 100 0 100 0 100 0 0 100 0 0 100 0 0 100 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0
OAEROSOL Sam	ple ID and Summary Data	S1	S2	S 3	S4	S 5	S6	S 7	S8	_
	SAMPLE TIME (min)	0	15	30	45	60	90			LOD
	IMPINGER USED (y / n)	У	У	У	У	У	У	n	n	у
	VIABLE CASCADE USED (y/n)	n	n	n	n	n	n	n	n	
CHAMBER IMPIN	GER BIOBIOAEROSOL CONCENTRATION (cfu pfu/L Air)	6.756E+06	4.480E+04	7.467E+02	3.413E+01	1.067E+00	#DIV/0!			1 422E
	LE BIOBIOAEROSOL CONCENTRATION (cfu or pfu/L Air)	0.7502100	4.4002104	1.407 2 102	0.410E101	1.007 2100	#010/0:			1.4226
	· · · · · · · · · · · · · · · · · · ·									_
IMPI	NGER DILUTION CONSISTENCY CHECKS (% agreement)				40.00%					100.00
	VIABLE CONSISTENCY CHECKS (% agreement)									
	IMP & VIABLE CROSS CHECK (% agreement)									
CHAMBER	BIOBIOAEROSOL CONCENTRATION (cfu or pfu/L Air)	6.756E+06	4.480E+04	7.467E+02	3.413E+01	1.067E+00				0.142
	RELATIVE PERCENT REMAINING FROM T=0 (%)	100.0000%	0.6632%	0.0111%	0.0005%	0.0000%				
	RELATIVE PERCENT REMOVAL FROM T=0 (%)	0.0000%	99.3368%	99.9889%	99.9995%	100.0000%				
	LOG REDUCTION FROM T=0 (log ₁₀)	0.000	-2.18	-3.96						
	LOG REDUCTION FROM 1=0 (log ₁₀)	0.00	-2.10	-3.90	-5.30	-6.80				-7.00
pinger Samplin	g Conditions									
npinger Samplin	g Conditions SAMPLE TIME (min)	0	15	30	45	60	90	0	0	LOD
npinger Samplin	SAMPLE TIME (min)	-			45 20.0				-	
ipinger Samplin	SAMPLE TIME (min) IMPINGER FILL VOL (ml)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
pinger Samplin	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min)	20.0 3.0	20.0 5.0	20.0 5.0	20.0 5.0	20.0 5.0	20.0 10.0	20.0 10.0	20.0 10.0	20.0 5.0
pinger Samplin	SAMPLE TIME (min) IMPINGER FILL VOL (ml)	20.0 3.0 12.5	20.0 5.0 12.5	20.0 5.0 12.5	20.0 5.0 12.5	20.0 5.0 12.5	20.0 10.0 12.5	20.0	20.0 10.0 12.5	20.0 5.0
pinger Samplin	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min)	20.0 3.0	20.0 5.0	20.0 5.0	20.0 5.0	20.0 5.0	20.0 10.0	20.0 10.0	20.0 10.0	20.0 5.0 12.5
pinger Samplin	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (lpm)	20.0 3.0 12.5	20.0 5.0 12.5	20.0 5.0 12.5	20.0 5.0 12.5	20.0 5.0 12.5	20.0 10.0 12.5	20.0 10.0 12.5	20.0 10.0 12.5	20.0 5.0 12.5 0
	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (lpm) DILUTION RATIO (10 ⁵)	20.0 3.0 12.5 -5 100	20.0 5.0 12.5 -3 100	20.0 5.0 12.5 -2 100	20.0 5.0 12.5 0 100	20.0 5.0 12.5 0 500	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750
T#	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (lpm) DILUTION RATIO (10 ⁵)	20.0 3.0 12.5 -5 100 10	20.0 5.0 12.5 -3 100 20	20.0 5.0 12.5 -2 100 5	20.0 5.0 12.5 0 100 11	20.0 5.0 12.5 0 500 3	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750 1
T#	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (lpm) DILUTION RATIO (10 ⁵)	20.0 3.0 12.5 -5 100 10 14	20.0 5.0 12.5 -3 100 20 17	20.0 5.0 12.5 -2 100 5 2	20.0 5.0 12.5 0 100 11 20	20.0 5.0 12.5 0 500 3 2	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750 1 0
	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (dpm) DILUTION RATIO (10 ⁶) DROPLET SIZE (µl)	20.0 3.0 12.5 -5 100 10	20.0 5.0 12.5 -3 100 20	20.0 5.0 12.5 -2 100 5	20.0 5.0 12.5 0 100 11	20.0 5.0 12.5 0 500 3	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750 1 0
	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (dpm) DILUTION RATIO (10°) DROPLET SIZE (µi) ENUMERATED PLATE COUNTS (# / drop)	20.0 3.0 12.5 -5 100 10 14 14	20.0 5.0 12.5 -3 100 20 17 5	20.0 5.0 12.5 -2 100 5 2 0	20.0 5.0 12.5 0 100 11 20 9	20.0 5.0 12.5 0 500 3 2 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750 1 0 0
	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (dpm) DILUTION RATIO (10 ⁶) DROPLET SIZE (µl)	20.0 3.0 12.5 -5 100 10 14	20.0 5.0 12.5 -3 100 20 17	20.0 5.0 12.5 -2 100 5 2	20.0 5.0 12.5 0 100 11 20	20.0 5.0 12.5 0 500 3 2	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750 750 1 0 0
	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (dpm) DILUTION RATIO (10°) DROPLET SIZE (µi) ENUMERATED PLATE COUNTS (# / drop)	20.0 3.0 12.5 -5 100 10 14 14	20.0 5.0 12.5 -3 100 20 17 5	20.0 5.0 12.5 -2 100 5 2 0	20.0 5.0 12.5 0 100 11 20 9	20.0 5.0 12.5 0 500 3 2 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750 1 0 0 0 0 0
	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (pm) DILUTION RATIO (10 ⁵) DROPLET SIZE (mi) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop) IMPINGER CONCENTRATION (cfu or pfurni)	20.0 3.0 12.5 -5 100 10 14 14 14 12.67 12.666,667	20.0 5.0 12.5 -3 100 20 17 5	20.0 5.0 12.5 -2 100 5 2 0 0 2.33 2,333	20.0 5.0 12.5 0 100 11 20 9	20.0 5.0 12.5 0 500 3 2 0 1.67	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 10.0 12.5 0	20.0 5.0 12.5 0 750 1 0 0 0 0 33 0
	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (pm) DILUTION RATIO (10 ⁵) DROPLET SIZE (d) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop) IMPINGER CONCENTRATION (cfu or pfu/L Air) IAMBER BIOAEROSOL CONCETRATION (cfu or pfu/L Air)	20.0 3.0 12.5 -5 100 10 14 14 14 12.67 12,666,667 6.76E+06	20.0 5.0 12.5 -3 100 20 17 5 	20.0 5.0 12.5 -2 100 5 2 0 0 2.33 2,333 7.47E+02	20.0 5.0 12.5 0 100 11 20 9 3 13.33 133 4.27E+01	20.0 5.0 12.5 0 500 3 2 0 0 1.67 3 1.07E+00	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 0 33 0
	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER FILL VOL (mi) IMPINGER FLOW RATE (pm) DILUTION RATIO (10 ⁵) DROPLET SIZE (mi) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop) IMPINGER CONCENTRATION (chi or phinh) IAMBER BIOAEROSOL CONCETRATION (chi or phinh) IAMBER BIOAEROSOL CONCETRATION (chi or phinh)	20.0 3.0 12.5 -5 100 10 14 14 14 12.67 12.66,667 6.76E+06 -4	20.0 5.0 12.5 -3 100 20 17 5 -3 14.00 140,000 4.48E+04 -3	20.0 5.0 12.5 -2 100 5 2 0 2.33 2.33 7.47E+02 -1	20.0 5.0 12.5 0 100 11 20 9 13.33 133 4.27E+01 0	20.0 5.0 12.5 0 500 3 2 0 1.67 3 1.07E+00 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 0 33 0
	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER FILL VOL (mi) IMPINGER SAMPLING TIME (min) IMPINGER FLOW RATE (pm) DILUTION RATIO (10 ⁵) DROPLET SIZE (m) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop) IMPINGER CONCENTRATION (cfu or pfu/L Air) IAMBER BIOAEROSOL CONCETRATION (cfu or pfu/L Air)	20.0 3.0 12.5 -5 100 10 14 14 14 12.67 12,666,667 6.76E+06	20.0 5.0 12.5 -3 100 20 17 5 	20.0 5.0 12.5 -2 100 5 2 0 0 2.33 2,333 7.47E+02	20.0 5.0 12.5 0 100 11 20 9 3 13.33 133 4.27E+01	20.0 5.0 12.5 0 500 3 2 0 0 1.67 3 1.07E+00	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 33 0
T# Story 10000000	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER FILL VOL (mi) IMPINGER FLOW RATE (pm) DILUTION RATIO (10 ⁵) DROPLET SIZE (mi) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop) IMPINGER CONCENTRATION (chi or phinh) IAMBER BIOAEROSOL CONCETRATION (chi or phinh) IAMBER BIOAEROSOL CONCETRATION (chi or phinh)	20.0 3.0 12.5 -5 100 10 14 14 14 12.67 12.66,667 6.76E+06 -4	20.0 5.0 12.5 -3 100 20 17 5 -3 14.00 140,000 4.48E+04 -3	20.0 5.0 12.5 -2 100 5 2 0 2.33 2.33 7.47E+02 -1	20.0 5.0 12.5 0 100 11 20 9 13.33 133 4.27E+01 0	20.0 5.0 12.5 0 500 3 2 0 1.67 3 1.07E+00 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 33 0
	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER FILW VOL (mi) IMPINGER FLOW RATE (pm) DILUTION RATIO (10 ⁵) DROPLET SIZE (mi) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop) IMPINGER CONCENTRATION (chi or phi/mi) IAMBER BIOAEROSOL CONCETRATION (chi or phi/mi) IAMBER BIOAEROSOL CONCETRATION (chi or phi/mi) DILUTION RATIO (10 ⁵) DROPLET SIZE (mi)	20.0 3.0 12.5 -5 100 10 14 14 14 12.67 12.66,667 6.76€+06 -4	20.0 5.0 12.5 -3 100 20 17 5 -3 14.00 140,000 4.48E+04 -3	20.0 5.0 12.5 -2 100 5 2 0 2.33 2.33 7.47E+02 -1	20.0 5.0 12.5 0 100 11 20 9 13.33 133 4.27E+01 0 500	20.0 5.0 12.5 0 500 3 2 0 1.67 3 1.07E+00 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 33 0
	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER FILL VOL (mi) IMPINGER FLOW RATE (pm) DILUTION RATIO (10 ⁵) DROPLET SIZE (mi) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop) IMPINGER CONCENTRATION (chi or phinh) IAMBER BIOAEROSOL CONCETRATION (chi or phinh) IAMBER BIOAEROSOL CONCETRATION (chi or phinh)	20.0 3.0 12.5 -5 100 10 14 14 14 12.67 12.66,667 6.76€+06 -4	20.0 5.0 12.5 -3 100 20 17 5 -3 14.00 140,000 4.48E+04 -3	20.0 5.0 12.5 -2 100 5 2 0 2.33 2.33 7.47E+02 -1	20.0 5.0 12.5 0 100 11 20 9 13.33 133 4.27E+01 0 500	20.0 5.0 12.5 0 500 3 2 0 1.67 3 1.07E+00 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 0 33 0
	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER FILW VOL (mi) IMPINGER FLOW RATE (pm) DILUTION RATIO (10 ⁵) DROPLET SIZE (mi) ENUMERATED PLATE COUNTS (# / drop) PLATE AVERAGE COUNT (# / drop) IMPINGER CONCENTRATION (chi or phi/mi) IAMBER BIOAEROSOL CONCETRATION (chi or phi/mi) IAMBER BIOAEROSOL CONCETRATION (chi or phi/mi) DILUTION RATIO (10 ⁵) DROPLET SIZE (mi)	20.0 3.0 12.5 -5 100 10 14 14 14 12.67 12.66,667 6.76€+06 -4	20.0 5.0 12.5 -3 100 20 17 5 -3 14.00 140,000 4.48E+04 -3	20.0 5.0 12.5 -2 100 5 2 0 2.33 2.33 7.47E+02 -1	20.0 5.0 12.5 0 100 11 20 9 13.33 133 4.27E+01 0 500	20.0 5.0 12.5 0 500 3 2 0 1.67 3 1.07E+00 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 33 0
	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER FILL VOL (mi) IMPINGER FLOW RATE (pm) DILUTION RATIO (10 ⁵) DROPLET SIZE (mi) ENUMERATED PLATE COUNTS (# / drop) IMPINGER CONCENTRATION (cfu or pfu/mi) IAMBER BIOAEROSOL CONCENTRATION (cfu or pfu/mi) IAMBER BIOAEROSOL CONCENTRATION (cfu or pfu/mi) DILUTION RATIO (10 ⁵) DROPLET SIZE (mi) ENUMERATED PLATE COUNTS (# / drop)	20.0 3.0 12.5 -5 100 10 14 14 14 12.67 12.66,667 6.76€+06 -4	20.0 5.0 12.5 -3 100 20 17 5 -3 14.00 140,000 4.48E+04 -3	20.0 5.0 12.5 -2 100 5 2 0 2.33 2.33 7.47E+02 -1	20.0 5.0 12.5 0 100 11 20 9 13.33 133 4.27E+01 0 500 40	20.0 5.0 12.5 0 500 3 2 0 1.67 3 1.07E+00 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 33 0
	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER FILL VOL (mi) IMPINGER FLOW RATE (pm) DILUTION RATIO (10 ⁵) DROPLET SIZE (µi) ENUMERATED PLATE COUNTS (# / drop) IMPINGER CONCENTRATION (chu or phurh) IMPINGER CONCENTRATION (chu or phurh) ENUMERATED PLATE AVERAGE COUNTS (# / drop) PLATE AVERAGE COUNTS (# / drop)	20.0 3.0 12.5 -5 100 10 14 14 14 12.67 12.66,667 6.76€+06 -4	20.0 5.0 12.5 -3 100 20 17 5 -3 14.00 140,000 4.48E+04 -3	20.0 5.0 12.5 -2 100 5 2 0 2.33 2.33 7.47E+02 -1	20.0 5.0 12.5 0 100 11 20 9 13.33 133 4.27E+01 0 500 40	20.0 5.0 12.5 0 500 3 2 0 1.67 3 1.07E+00 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	5.0 12.5 0 750 1 0 0 0 0
	SAMPLE TIME (min) IMPINGER FILL VOL (mi) IMPINGER FILL VOL (mi) IMPINGER FLOW RATE (pm) DILUTION RATIO (10 ⁵) DROPLET SIZE (mi) ENUMERATED PLATE COUNTS (# / drop) IMPINGER CONCENTRATION (cfu or pfu/mi) IAMBER BIOAEROSOL CONCENTRATION (cfu or pfu/mi) IAMBER BIOAEROSOL CONCENTRATION (cfu or pfu/mi) DILUTION RATIO (10 ⁵) DROPLET SIZE (mi) ENUMERATED PLATE COUNTS (# / drop)	20.0 3.0 12.5 -5 100 10 14 14 14 12.67 12.66,667 6.76€+06 -4	20.0 5.0 12.5 -3 100 20 17 5 -3 14.00 140,000 4.48E+04 -3	20.0 5.0 12.5 -2 100 5 2 0 2.33 2.33 7.47E+02 -1	20.0 5.0 12.5 0 100 11 20 9 13.33 133 4.27E+01 0 500 40	20.0 5.0 12.5 0 500 3 2 0 1.67 3 1.07E+00 0	20.0 10.0 12.5 0 500	20.0 10.0 12.5 0 100	20.0 10.0 12.5 0 100	20.0 5.0 12.5 0 750 1 0 0 0 0 33 0

Figure 4A: Raw Plate Counts for MS2 Trial 3.



Appendix B: Calculations

To evaluate the viable aerosol delivery efficiency and define operation parameters of the system, calculations based on (theoretical) 100% efficacy of aerosol dissemination were derived using the following steps:

- Plating and enumeration of the biological to derive the concentration of the stock suspension (*C_s*) in pfu/mL or cfu/mL, or cfu/g for dry powder.
- Collison 24 jet nebulizer use rate (R_{neb}) (volume of liquid generated by the nebulizer/time) at 28 psi air supply pressure = 1.0 mL/min.
- Collison 24 jet Generation time (t) = 20 or 30 minutes, test dependent.
- Chamber volume $(V_c) = 15,993$ Liters

Assuming 100% efficiency, the quantity of aerosolized viable particles (V_P) per liter of air in the chamber for a given nebulizer stock concentration (C_s) is calculated as:

Nebulizer:
$$V_P = \frac{C_s \cdot R_{neb}}{V_c} t$$

Plating and enumeration of the biological to derive the concentration of the dry powder (C_p) in cfu/g.

- Eductor use rate (M_p) (Mass of powder generated by the eductor in grams)
- Chamber volume $(V_c) = 15,993$ Liters

Assuming 100% efficiency, the quantity of aerosolized viable particles (V_P) per liter of air in the chamber for a given dry powder stock concentration (C_p) is calculated as:

Eductor:
$$V_p = \frac{C_p \cdot M_p}{V_c}$$

AGI – 30 impinger or 47mm filter collection calculation:

- Viable aerosol concentration collection $(C_a) = cfu$ or pfu/L of chamber air.
- Viable Impinger concentration collection (*C*_{Imp}) = cfu or pfu/mL from enumeration of impinger sample or filter sample.
- Impinger sample collection volume $(I_{vol}) = 20$ mL collection fluid/impinger, or extraction fluid for filter.
- AGI-30 impinger or filter sample flow rate $(Q_{imp}) = 12.5 \text{ L/min.}$
- AGI-30 impinger or filter sample time (t) = 5 or 10 minutes, test dependent.

For viable impinger or filter aerosol concentration collection (C_a) = cfu or pfu/L of chamber air:

$$C_a = \frac{\mathbf{C}_{\mathrm{Imp}} \cdot \mathbf{I}_{\mathrm{vol}}}{\mathbf{Q}_{\mathrm{imp}}} \mathbf{t}$$



The aerosol system viable delivery efficiency (expressed as %) is:

$$Efficiency = \frac{C_a}{V_p} \cdot 100$$

The table below is based on the principle that, as the number of viable particles being impinged on a given plate increases, the probability of the next particle going into an "empty hole" decreases. This can be corrected statistically by using the conversion formula of Feller [4]:

Pr = N [1/N + 1/N-1 + 1/N-2 + 1/N-r+1]

N is the number of holes (400) in the sampling head.

For easy use of this formula please refer to the table in chapter 17.2

For each colony count **r** a statistically corrected total count **Pr** can be easily seen in the table.

r	Pr	r	Pr	R	Pr	R	Pr	R	Pr	r	Pr	R	Pr	R	Pr
	- 51		FI	K	FL	N	- 11	K			FI	K	- 61	K	- PL
1	1	51	54	101	116	151	189	201	279	251	394	301	557	351	836
2	2	52	56	102	118	152	191	202	281	252	397	302	561	352	844
3	3	53	57	102	119	153	193	202	283	252	400	303	565	353	853
4	4	54	58	103	120	154	194	203	285	254	400	303	569	354	861
5	5	55	59	104	120	155	194	204	205	255	402	305	573	355	870
6	6	56	60	105	122	155	190	205	289	255	405	305	578	356	879
7	7	57	61	100	123	150	197	200	209	250	400	307	582	357	888
8	8	58	63	107	124	157	201	207	293	258	413	308	586	358	897
9	9	59	64	100	120	159	201	200	295	259	415	309	591	359	907
10	10	60	65	110	128	160	202	209	295	260	410	310	595	360	917
11	11	61	66	111	130	161	204	210	299	260	413	311	595	361	927
12	12	62	67	112	131	162	200	212	301	261	425	312	604	362	937
13	12	63	68	113	131	163	207	212	304	262	425	313	604	363	947
14	14	64	70	114	134	164	203	213	306	263	420	314	613	364	958
15	15	65	71	115	135	165	212	214	308	265	433	315	618	365	969
16	16	66	72	116	137	166	212	215		265	435	316	622	366	981
17	10		73	117	137	167		210	310 312	267	430	317	627	367	992
18	18	67 68	74	118	140	167	216 218	217	314	267	439	318	632	368	1005
19	10	69	76	119	140	169	210	210	317	269	442	319	637	369	1005
20		70	10 10 10 10 10 10 10 10 10 10 10 10 10 1	120		170	· ····································	219		269		320		370	
	20		77		142		221		319		449	***************	642		1030
21	22	71	78 79	121	144	171	223	221	321	271	452	321	647 652	371	1043
22	23 24	73	1. 10 Percent	122	145	172	224 226	222	323	272	455 458	322 323	657	372 373	1057
23		74	80	123	147	173		223	325	273		323		374	
	25		82 83		148		228		328		461		662 667		1086
25 26	26 27	75	84	125 126	150 151	175	230 232	225	330 332	275	464 467	325 326	673	375 376	1102
20	28	77	85	120	151	170	232	226	335	270	407	320	678	377	1118 1134
28		78	and the second	127		178		228		278		328		378	
	29		87		154		235		337		474		684		1152
29	30 31	79	88 89	129 130	156	179	237	229	339	279	477	329 330	689	379 380	1170
30	32	80 81	90	130	157 158	181	239 241	230	342 344	280	480 484	331	695 701	381	1189 1209
32		82		131		182		231		282		332		382	
	33		92	132	160		242	232	346		487		706		1230
33	34	83	93		161	183	244		349	283	491	333	712	383	1252
34 35	35 37	84 85	94 95	134 135	163	184	246 248	234	351 353	284	494 497	334 335	718 724	384 385	1276 1301
35				135	164			235				335		385	
	38	86	97		166	186	250		356	286	501		730		1327
37	39	87	98	137	167	187	252	237	358	287	504	337	737	387	1356
38	40	88	99	138	169	188	254	238	361	288	508	338	743	388	1387
39	41	89	101	139	171	189	255	239	363	289	511	339	749	389	1420
40	42	90	102	140	172	190	257	240	366	290	515	340	756	390	1456
41	43	91	103	141	174	191	259	241	368	291	519	341	763	391	1496
42	44	92	104	142	175	192	261	242	371	292	522	342	769	392	1541
43	45	93	106	143	177	193	263	243	373	293	526	343	776	393	1591
44	47	94	107	144	178	194	265	244	376	294	530	344	783	394	1648
45	48	95	108	145	180	195	267	245	378	295	534	345	791	395	1715
46	49	96	110	146	181	196	269	246	381	296	537	346	798	396	1795
47	50	97	111	147	183	197	271	247	384	297	541	347	805	397	1895
48	51	98	112	148	185	198	273	248	386	298	545	348	813	398	2028
49	52	99	114	149	186	199	275	249	389	299	549	349	820	399	2228
50	53	100	115	150	188	200	277	250	391	300	553	350	828		

17.2 Positive hole conversion table for all MAS-100 air monitoring systems r = number of colony forming units counted on 100 mm petri dish Pr = probable statistical total count