

MANN+HUMMEL  
LS&E R&D  
O'Dell Associates Webinar  
Air Filtration and Pandemic

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## Who Am I?

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**MANN+**  
**HUMMEL**



## Short Bullet -Talking Points

- 1. The pandemic has created a frenzy of customer inquiries that are all *so site specific* as to not lend themselves to any kind of white paper or market segment blanket response. Our current reality.
- 2. ACH design theory and building reality.
- 3. Natural Ventilation and KISS.
- 4. Virus filtering; pathogen or particle size.
- 5. Filters in bank(s); upgrade or not?
- 6. Fixed speed or variable speed ventilation availability.
- 7. Standalone units.
- 8. Cycle time and ductwork changes.
- 9. Addition of UV light, bipolar ionization and other “trap and kill” features.
- 10. Are used filters hazardous waste?
- 11. Are HVAC insides such that service techs need exceptional PPE?

## Air Changes per Hour (ACH) theory and reality

<https://www.contractingbusiness.com/service/article/20868246/use-the-air-changes-calculation-to-determine-room-cfm>  
<https://www.hvacrschool.com/air-changes-confusion/>

- **Wells-Riley Equation** *number density reduction and dilution* Titus Timeout Podcast - Wells Riley Equation and HVAC System Design, <https://www.youtube.com/watch?v=EvuFOeLOWn0>
- One of many ACH guidance lists comes from “the Engineering Toolbox website at [www.engineeringtoolbox.com](http://www.engineeringtoolbox.com) and is a reasonable reference for ACH’s.
- In the absence of a pandemic customers we serve that care about ACH: hospitals, schools, casinos. We have many customers with other primary metrics. Spray paint shops, in vitro fertilization...
- Journal of Thoracic Disease, 10 (2018) S2295-S2304. “Ventilation control for airborne disease transmission of human exhaled bio-aerosols in buildings.” H. Qian and X. Zheng.

## Natural Ventilation and KISS

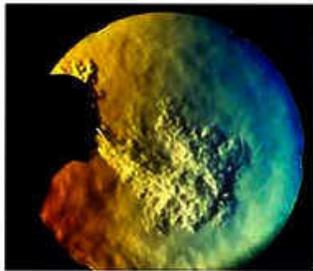
Natural Ventilation for Infection Control in Health-Care Settings (especially section 3)

[https://www.who.int/water\\_sanitation\\_health/publications/natural\\_ventilation.pdf](https://www.who.int/water_sanitation_health/publications/natural_ventilation.pdf)



O'Dell Associates Webinar

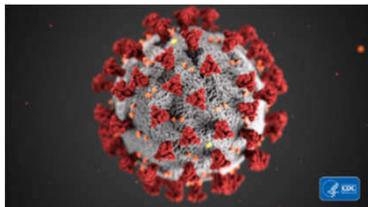
## Virus Filtering; Pathogen or Particulate Nuclei. Size Matters...



(A)



(B)



(A) and (B) Sneeze and Cough imaged with optical techniques.

Coronavirus itself is sub-micrometer in size.

Droplet nuclei are typically 1 – 5 micrometer in size after moisture evaporation. Airborne suspension times consistent with particle size and impact of gravity and local air currents in space.

Early press releases INCORRECTLY reported NEJM only hours of airborne activity, when in fact the testing was simply suspended after 3 hours.

<https://www.nih.gov/news-events/news-releases/new-coronavirus-stable-hours-surfaces>

# Virus Filtering; Pathogen or Particulate Nuclei. Size Matters...

A typical filter utilized in schools is a MERV 8 pleated filter. We are recommending during the height of the outbreak that filtration be upgraded to a MERV 14. The chart to the right shows the removal efficiency by particle size for a MERV 8 Pleat and a MERV 14 ULTRA X2 filter. As you can

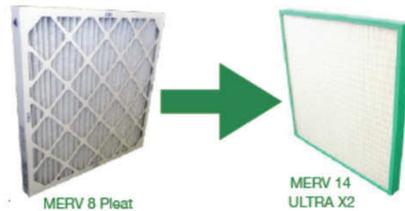
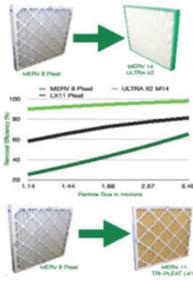
## Coronavirus Precautions for Healthcare Air Filtration Enhancements

Even though air filtration is not the silver bullet to stop the coronavirus outbreak it is an important component of any Coronavirus response. The CDC states that the main transmission method is through airborne droplet nuclei which confirms the importance of air filtration in the prevention of virus infection. When we also consider the number of people (staff and patients) in our healthcare facilities as well as realize that the activity is among the high risk groups for the virus we see the importance of our response to this threat.

The particle size of viruses ranges from 0.05 to less than 0.200 microns but typically attach to larger particles when airborne. These particles are generally around 1 micron in size. Viruses typically become airborne via droplet nuclei. Droplet nuclei are microscopic particles < 5 µm in size that are the airborne particles of evaporated droplets and are produced when a person coughs, sneezes, breaths, or talks. These particles can remain suspended in the air for prolonged periods of time and can be carried great distances on air currents.

A typical pleat filter utilized is a MERV 8 pleated filter. We are recommending during the height of the outbreak that filtration be upgraded to a MERV 14. The chart to the right shows the removal efficiency by particle size for a MERV 8 Pleat and a MERV 14 ULTRA X2 filter. As you can see there is a dramatic difference in removal efficiency. This translates for every 1,000 one micron particles that reach the filter the MERV 8 will let 100 pass through the filter. The MERV 14 will let only 100 pass through - that's a reduction of over 90%.

The TR9-PLAT LX11 was also included on the graph to allow for a similar comparison with upgrading from a MERV 8 pleat to a MERV 11 filter.



## Can You Increase the Airspeed Employed?

- Fixed gear bike.



- Ten speed racing bike.  
Takes equipment and intelligence to change gears!





# FSAT worksheet, bldg 92, SAS 1086

## EngA, submittal record, B92-SAS-005

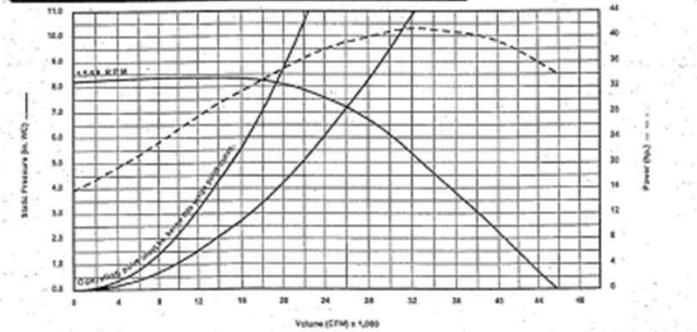
PERFORMANCE (Elevation ft. = 0, Airstream Temperature °F = 70, Start Up Temperature °F = 70)

Qty	Model	Volume (CFM)	SP (in. WC)	CSP (in. WC)	TS (ft/min)	OV (ft/min)	FRPM	Max. Class FRPM	Operating Power (hp.)	SE %
1	SG-APDW-21	26,000	7.13	7.13	12,472	2,753	1,388	1757	42.13	73

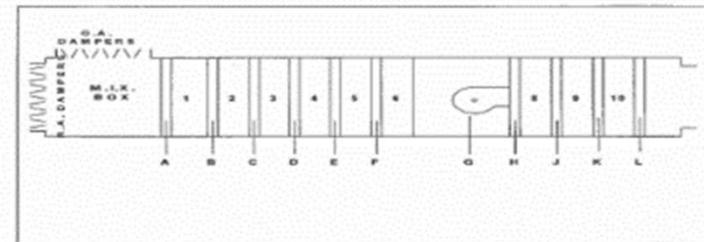
SOUND

1/3 Oct. "Duct" Sound Power by Octave Band										LwA	dSA	Noise Criteria
63	125	250	500	1000	2000	4000	8000					
104	95	105	95	93	90	86	84	100	89	81		
105	101	100	94	92	88	84		96	87	81		

LwA - A weighted sound power level, based on ANSI S1.A. dSA - A weighted sound pressure level, based on 11.5 dB attenuation per octave band at 5.0 ft. Noise Criteria (NC) based on an average attenuation of 11.5 dB per octave band at 5.0 ft.



## Designtest & Balance Co. Ltd Static Pressure Profile Sheet



1	FILTERS
2	GLYCOL HEATING COIL
3	COOLING COIL
4	REHEAT COIL
5	
6	
7	
8	FILTERS
9	DAMPER
10	

Unit	a	b	c	d	e	f	g	h	i	j
B92-SAS-005	-1.16	-2.04	-2.16	-2.75	-	-	-2.81	4.88	4.71	1.95

# FSAT worksheet, bldg 92, SAS 1086

**Fan System Assessment Tool**

File Edit Operate Windows Help

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**Fan and motor inputs:**

Fan style: CENTRIFUGAL - Airfoil (DIDW)

Speed: Fan speed, rpm: 1757

Fan configuration: Motor nameplate hp: 50

Fixed: Motor nameplate rpm: 1775

Estimate: Nameplate Full Load Amps: 46.0

Motor efficiency class: Energy efficient

Nominal motor voltage, volts: 575

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**Operating parameters:**

Operating fraction: 1.000

Electricity cost, cents/kwhr: 6.60

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**Electrical power or current and drive inputs:**

Current: Measured current, amps: 44.2

Measured voltage, volts: 575

Drive type: Belt drive

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**System inputs:**

Required: Required flow rate, cfm: 24320

Required fan static pressure, in H2O: 4.37

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**Gas property inputs:**

Gas density, lbm/cu ft: 0.0748

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**Calculated Results:**

	Existing fan, motor	Existing fan, EE motor	Optimal fan, EE motor
Fan efficiency, %	36.4	36.4	64.4
Motor rated hp	50	50	40
Motor shaft power, hp	47.9	47.9	27.2
Motor efficiency, %	93.9	93.9	93.9
Motor power factor, %	86.5	86.5	80.8
Motor current, amps	44.2	44.2	26.9
Electric power, kW	36.1	36.1	21.6
Annual energy, MWhr	333.7	333.7	189.3
Annual cost, \$1,000	22.0	22.0	12.5
Annual savings, \$1,000	0.0	0.0	9.6

Size margin (%) for optimal fan motor: 15

Optimization rating: 56.7

Click for background information

**STOP**

fluid hp: 16.7

Existing W-G eff: 32.7

Optimal W-G eff: 57.9

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**Log file controls:**

Log current data | Retrieve Log data | Select a file for individual log deletion

**Summary file controls:**

Create new or append existing summary file -> | Existing summary files: CREATE NEW

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Facility: Sanofi Pasteur Bldg 92, Toronto | Application: Sterile Air Supply

# VFD modeling granularity required

The screenshot shows a Microsoft Excel spreadsheet titled "VSD\_Calculator\_for\_Fans.xls [Read-Only] [Compatibility Mode]". The spreadsheet is in "Compatibility Mode" and shows the following inputs and table:

**Inputs**

Nameplate Horsepower	<input type="text"/>	hp	Annual Operating Hours	<input type="text"/>
Nameplate Efficiency	<input type="text"/>	%	Fan Type	<input type="text"/>
Motor Load at Fan Design CFM	<input type="text"/>	%	Cost of Electricity	<input type="text"/> \$/kWh

Duty Cycle:

Percent of Capacity (cfm)	Percent of Time at this Capacity
<input type="text" value="10"/>	<input type="text" value="0"/>
<input type="text" value="20"/>	<input type="text" value="0"/>
<input type="text" value="30"/>	<input type="text" value="15"/>
<input type="text" value="40"/>	<input type="text" value="0"/>
<input type="text" value="50"/>	<input type="text" value="55"/>
<input type="text" value="60"/>	<input type="text" value="0"/>
<input type="text" value="70"/>	<input type="text" value="25"/>
<input type="text" value="80"/>	<input type="text" value="0"/>
<input type="text" value="90"/>	<input type="text" value="5"/>
<input type="text" value="100"/>	<input type="text" value="0"/>

## Standalone Units

### Tri-Kleen 400 with UV



### Fine Dust Eater



## Cycle Time Impact - Calculation for Giorgio Mushroom AHU 12

$$50 \times 10^{-6} \text{ g TSP per m}^3$$

$$1 \text{ m}^3 = 35 \text{ ft}^3$$

$$50/35 \times 10^{-6} \text{ g TSP per ft}^3$$

∴ AHU 12 @ 126,000 CFM

$$50/35 \times 10^{-6} \text{ g} \cdot 1.26 \times 10^5 \text{ CFM}$$

↓

0.18 g per minute

$$0.18 \frac{\text{g}}{\text{min}} \cdot 60 \frac{\text{min}}{\text{hr}} \cdot 24 \frac{\text{hr}}{\text{day}} \cdot 365 \frac{\text{day}}{\text{yr}} = 94,000 \frac{\text{g}}{\text{yr}}$$

94,000 g/yr or 14,900 g/18 months

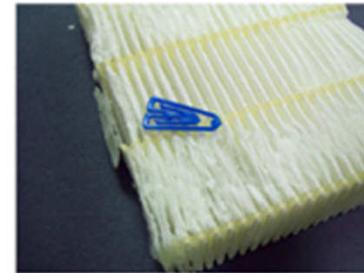
	1,500 g Filter	2,250 g Filter	
∴ 63 equiv.			
Filter size	3.3 lb / Filter	5 lb / Filter	
Filter cost			



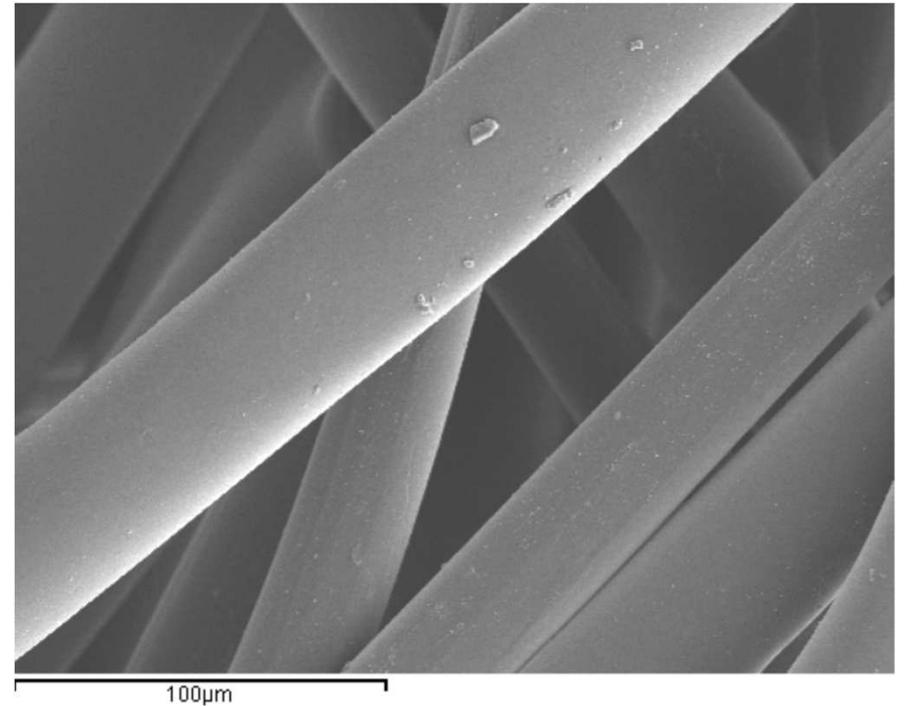
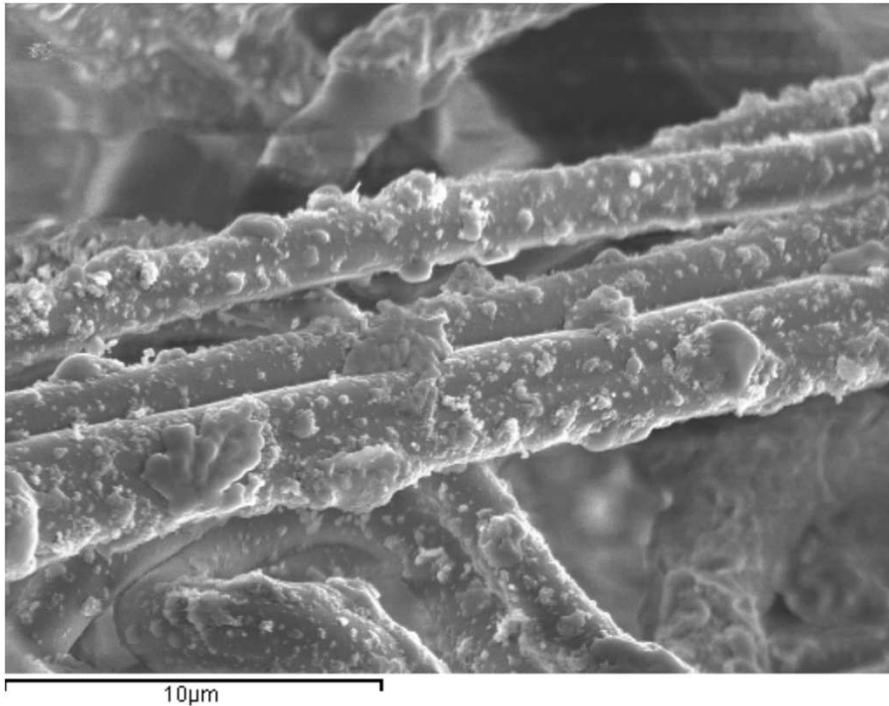
UV light, bipolar ionization and other *Twilight Zone* variations.

### KOCH synthetic

- 4 months of UV irradiation.
- Media basically crumbles when touched.



UV light 24/7 on Tri-Dim “ULTRA” V-bank Merv 16 hospital filter for 2.5 years. Returned to Louisa for reverse engineering and integrity testing.



Bipolar ionization and other *Twilight Zone* variations.

### The Reactor 1, Louisa County VA



### Guess what is going on here?



Capitalizing or serendipity solution?

# BLUE BOX CORONAVIRUS (COVID-19) DISINFECTION PROTOCOL

For the last 3 years, Blue Box has been working with many of the leading healthcare facilities within the United States to thoroughly clean and disinfect their HVAC heat transfer coils as a new approach to improving a healthcare facility's indoor air quality and energy efficiency. In response to the recent outbreak of the Coronavirus (COVID-19), Blue Box has modified its current HVAC coil disinfection process to better address this new health risk and to deliver an even higher level of disinfection.

Blue Box's Coronavirus disinfection protocol is designed to remove the biofilm growths that often form deep within the heat transfer coils of the HVAC system, thereby eliminating potential breeding areas for viruses, bacteria, and fungi. The objective is to mitigate the potential risks of a building's HVAC system exposed to Coronavirus\* (COVID-19) and other pathogens.

The chemical comes with lots of warnings, not the least of which is that the sodium chlorite and other versions such as hypochlorite are used to make BOMBS! Yes I am not kidding they are common components is homemade bombs.

Capitalizing on brand name.



- **Clorox® Total 360® System**
- Due to the COVID-19 outbreak, we've increased production of our Total 360® devices and Total 360® Disinfectant Cleaner<sub>1</sub>. Please contact your distributor to place an order.

Keep your facility healthier while saving time, money and labor. The innovative electrostatic sprayer, with the patented PowerWrap™ nozzle, delivers trusted Clorox solutions to the front, back and sides of surfaces. Superior coverage for better germ protection.

## List N: Disinfectants for Use Against SARS-CoV-2

<https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2>

- **How does EPA know that these products work on SARS-CoV-2?**
- While the products included in [List N: Disinfectants for Use Against SARS-CoV-2](#) have not been tested against SARS-CoV-2, the cause of COVID-19, they are expected to be effective based on:
  - Demonstrated efficacy against a harder-to-kill virus;
  - Qualified for the [emerging viral pathogens claim](#); or
  - Demonstrated efficacy against another human coronavirus similar to SARS-CoV-2.

Serionix converted media; antiviral effectiveness?



## Are used filters and the insides of HVAC bldg. systems hazardous now?

<https://www.hvacrschool.com/hvac-contractors-guide-to-covid-19-sars-cov-2-coronavirus/>

- On the Grand Princess, SARS-CoV-2 RNA was identified on a variety of surfaces in cabins of both symptomatic and asymptomatic infected passengers up to **17 days after cabins were vacated on the Diamond Princess but before disinfection procedures had been conducted.** (Takuya Yamagishi, National Institute of Infectious Diseases, personal communication, 2020).

Centers for Disease Control and Prevention  
**MMWR**  
Early Release / Vol. 69

Morbidity and Mortality Weekly Report  
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