Global Plasma Solutions®

Engineering Air for a Cleaner World™

Charlie Waddell – Founder & CTO

How to Make your HVAC System Pandemic Ready using Needlepoint Bipolar Ionization

Member ASHRAE SSPC 62.1, TC 2.3, ICC, USGBC

Formerly Secretary of TC 8.12

Installation Base

- Over 1,000 K-12 Schools with OA reduced to 5 CFM Per Person or LESS
- Many Healthcare Applications including hospitals, outpatient centers and MOBs
- Sports Arenas
- Hospitality
- Over 150,000 installations Worldwide

Hospitals

- ✓ NY Presbyterian, NYC
- ✓ Children's Hospital, Boston
- ✓ University of Miami Medical Center
- ✓ Tulane Medical, New Orleans
- ✓ Methodist Hospital, Houston, TX
- ✓ Anderson Medical Center, Houston, TX
- ✓ Baylor College of Medicine, Houston, TX
- ✓ Winn Army Hospital, Ft. Stewart, GA
- ✓ Duke Medical, Raleigh, NC
- ✓ Banner Healthcare, Phoenix, AZ
- ✓ AI Dupont Hospital, Wilmington, DE
- ✓ Abbott NW Heart Hospital, Minn, MN
- ✓ Women's Hospital Greensboro, NC
- ✓ Cleveland Clinic, Cleveland Ohio & Weston, FL

Healthcare Applications Include:

- Odor Control – NPBI can be used as a Substitute for Carbon
- Coil Cleaning – NPBI can be used as a Substitute for UVC
- Pathogen Control – NPBI can be used to kill* pathogens in the air and on surfaces
- Particle Reduction – NPBI will decrease particles in the space due to agglomeration
- Static Control – NPBI will reduce static electricity in the space
- Face Mask Efficiency – Increased space ion levels increases face mask efficiency

*Deactivates virus

The Whitehouse

Higher Education

Aviation

GPS is the only ionization company to pass DO-160 for mounting products on airplanes, in this technology category. DO-160 tests for shock, vibration, EMF, line noise, extreme cold and high pressure

Aviation Unit

View Inside Duct

Ground Based Aircraft Cleaning

Google
Chicago & San Jose

Google

GPS' Ion Bars Throughout Facility

Airports

CLT
CHARLOTTE DOUGLAS SM
INTERNATIONAL AIRPORT

YYC Control Tower

ACA
AVIATION CLEAN AIR
Cleaning the Air We Breathe in Flight

International Aero Engineering
"Creating the Standard Others Follow"

MILITARY CUSTOMERS

- **Special Air Missions Joint Base Andrews**
- Ramstein Air Force Base
- 435th Contingency Response Group
- Hickam Air Force Base
- Fleet Logistics Support Squadron JBA
- 909th AMU
- USAF 113 WG
- 932 MXG
- NORAD
- US Navy
- AIRSTA Washington
- 673 CONS/PKC
- NAS JRB Fort Worth
- 86 MXG/AMXS/CCR
- 718 AMXS/MXAW/909th AMU
- USAF 113 WG
- Fleet Logistics Support Squadron 57 (VR-57)
- Fleet Logistics Support Squadron 51 (VR-51)
- Fleet Logistics Support Squadron VR-56 Supply
- M1 Support Services
- US Government - 89th Airlift Wing
- US Marines
- US Air Force
- US Army
- March ARB
- 374th AMXS/MXABS Yokota AB, Japan
- 718 AMXS/909th AMU KC-135 Kadena Air Base, Japan
- 15th Operations Group
- Joint Base Pearl Harbor-Hickam
- Camp Lemonnier, Republic of Djibouti
- JBPHH
- 154 Civil Engineer Squadron
- 774 EAS/AFE NCOIC
- 718 AMXS / 909 AMU
- 435th Security Forces Squadron
- Eielson Air Force Base

ACA
AVIATION CLEAN AIR
Cleaning the Air We Breathe in Flight

International Aero Engineering
"Creating the Standard Others Follow"

FEATURED CLIENTS

- Andrews Air Force Base
- Aloft Aero Architects
- 3M
- Abbott Labs
- Bombardier
- Comlux
- AMAC
- Delta Airlines
- United States DOD
- DynCorp
- Dubai Air Wing
- H.M. The Sultans Flight
- JetBlue
- Jet Aviation
- L3 Technologies
- Lear Jet
- Leonardo Helicopters
- Netflix
- Gulfstream Aerospace
- Target Corp
- United States Air Force
- United States Marines
- United States Navy
- United States Army

ACA
AVIATION CLEAN AIR
Cleaning the Air We Breathe in Flight

International Aero Engineering™
"Creating the Standard Others Follow"

STC's / AML

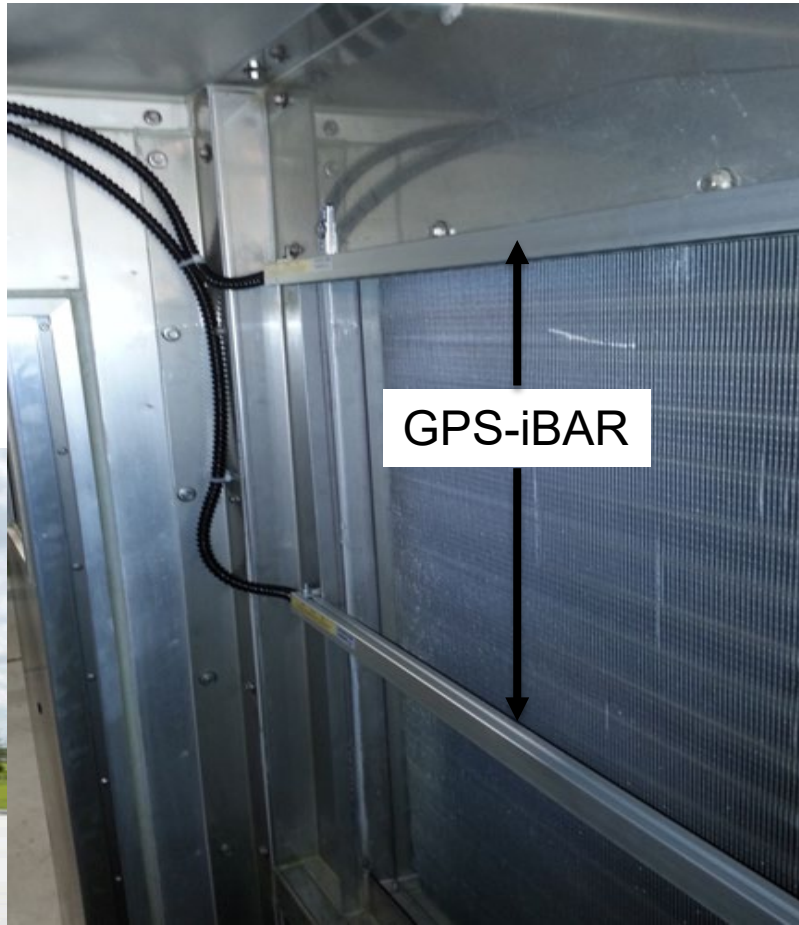
- Our patented airborne system is DO160 certified, as well as having many STC's, and soon an AML for the 737.
- We are approved for numerous US military aircraft.
- There are many hospitals, residences and facilities all over the world that use our technology for the neutralization of pathogens, allergens and spores, many of whom did their independent testing both before installing our systems, as well as after their installations.

Valencia College – 3 Green Globes

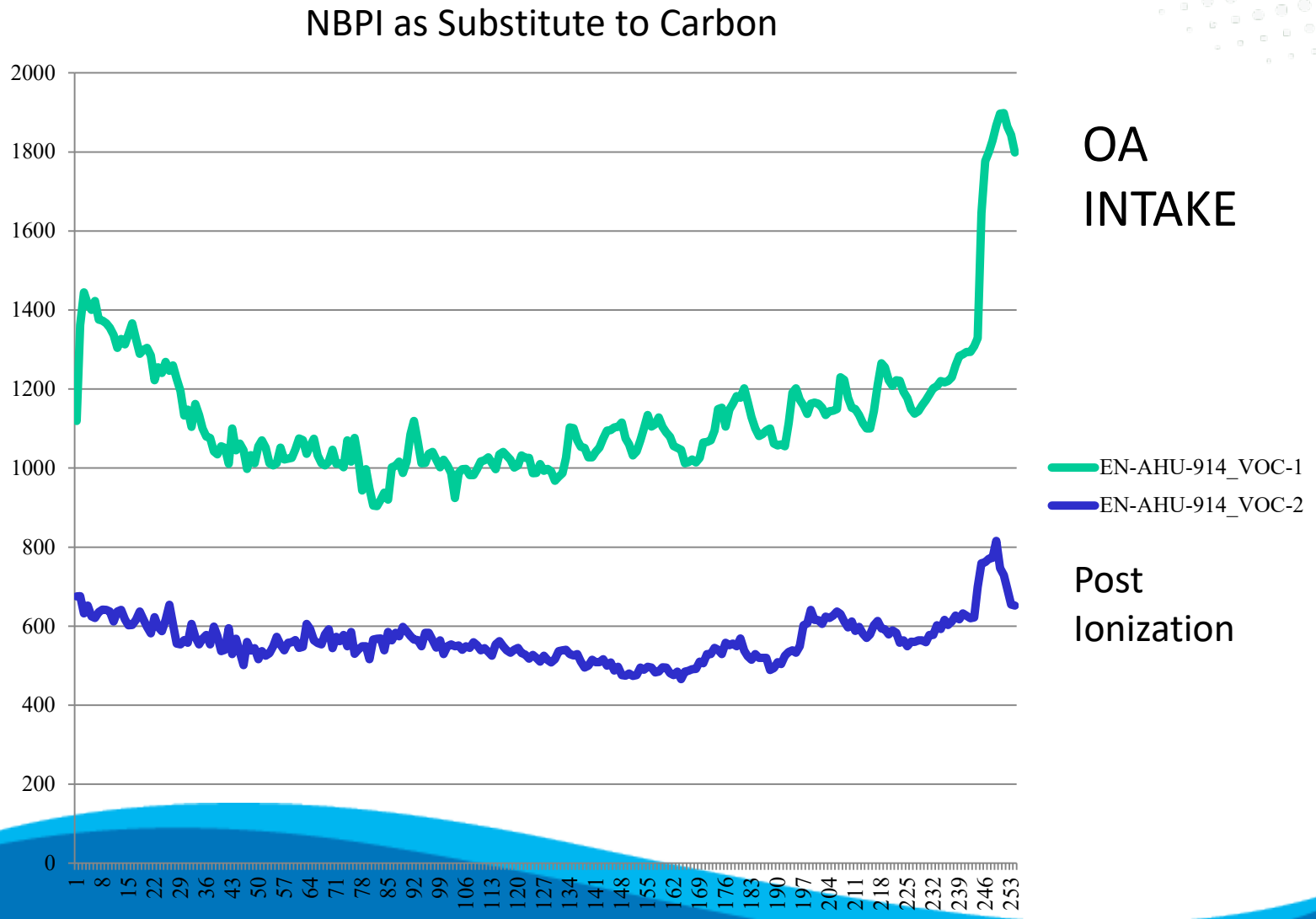
Independent
Testing Results:

0 Bacteria - 0 Fungi
Throughout Entire Depth
Of Cooling Coil

Indoor VOCs < OA VOCs!
No E/A Fans
No DCV
No Relief Fans



Boston Children's Hospital
Bus Diesel Odor Control



OA
INTAKE

Post
Ionization

Case Study - Amalie Arena

Year Built:	1996
Year Renovated:	2011
Size:	670,000 square feet
Occupancy:	21,500 Occupants
OA Reduction:	94,274 CFM
Capacity Saved:	700 Tons
Equipment:	12 – 40,000 AHU's with Needlepoint Equip.
Renovation $ Saved:	> $1 million
Annual Energy $:	>$115,000
C02 Reduction:	> 1.25 millions pounds C02 annually
Environment Impact:	Equivalent to planting > 3,000 trees
Design/Build Contractor:	Tappouni Mechanical, Tampa, FL

ASHRAE 62

- VRP – Dilution method, most often used
- IAQP – included since 1981, engineered app

5.7 Ozone Generating Devices. The use of ozone generating devices shall comply with the following sections.

Exception to 5.7: Electronic devices used exclusively for the operation of HVAC equipment and controls.

Informative Note: Ozone generation is expected from ozone generators, corona discharge technology, some ultraviolet lights, electronic devices that create chemical reactions within the system, and some devices using a high voltage (>480 V). Motors and relays are examples of electronic devices that would be exempt.

5.7.1 Air-Cleaning Devices. Air-cleaning devices shall be listed and labeled in accordance with UL 2998.

Informative Note: The use of devices not intended for air cleaning with the potential to generate ozone should be avoided.

ANSI/ASHRAE Standard 62.1-2019

ASHRAE 62.1-2019 REQUIRES UL 2998

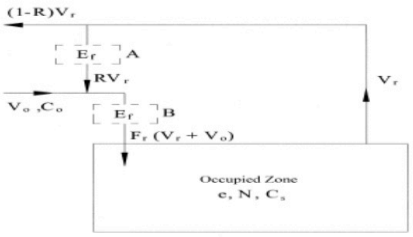
UL 867 vs UL 2998

- UL 867 – All EACs tested to this standard for electric safety
  - Requires an ozone test, if the EAC is a portable room air cleaner
  - If product is duct mounted, no ozone test required! LOOP HOLE!
  - Ozone limit is 50.0 PPB when testing required

- UL 2998 – Certification Standard “Certifies Ozone Free Technology”
  - Uses same ozone chamber test as UL 867
  - Maximum ozone output is 5.0 PPB!
  - Now required per ASHRAE 62.1-2019 Section 5.7.1
  - Applies to all devices requiring power to purify the air
  - Includes UV Lights, Polarized Filters, Ionizers, etc.

Zone Tag	Facility Type	Zone Use	Zone Floor Area (square ft) Az	Zone Max Occupancy Pz	Table 6.1 OA per Occupant Rp	Table 6.1 cfm/ft2 Ra	Pz * Rp	Az * Ra	Table 6.2 Ventilation Effectiveness Ez	Outdoor Air to Zone (CFM) with Ez correction (Vbz/Ez)
Classrooms	Educational Facilities	Classrooms (AGE 9 +)	800.0	28.0	10.0	0.12	280	96	0.8	470 OA required per VRP

Zone Height (feet)	9
Desired Outside Air (Vo) IAQP	140
Supply Air (Vs)	1,000
Return Air (Vr)	860
Recirc. Flow Factor (R)	0.86
Ventilation Effectiveness (Ez)	0.8
Level of Physical Activity	Standing (desk work)
Filter Location	B
HVAC Flow Type	Constant
Outdoor Air Flow Type	Constant



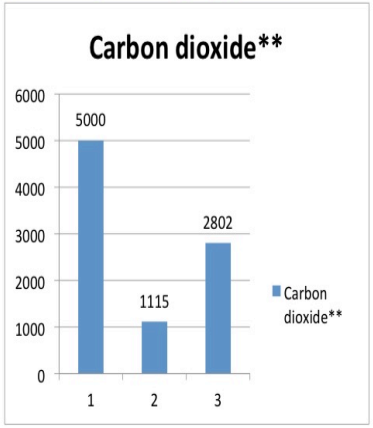
Air Changes Per Hour	8.3	VRP OA CFM per person	16.8
Outside Air Per VRP	470 CFM	IAQ OA CFM per person	5.0
Outside Air Per IAQ	140 CFM		
Outside Air Savings	330 CFM	Winter Heating Savings	
OA Summer Drybulb	94.0	OA Winter Design DB (F)	0
OA Summer Wetbulb	74.0	Supply Air DB Setpoint (F)	85
Coil Leaving Air Drybulb (F)	55.0	MBH Saved Winter	30.4
Coil Leaving Air Wetbulb (F)	54.0	KW Saved Winter	8.9
OA MBH Saved Summer*	27.1		
OA Tons Saved Summer*	2.3		

*OA = Outside Air

***OSHA, NIOSH & WHO most conservative values used

http://www.cdc.gov/niosh/npg/npgsyn-a.html

Indoor Contaminants Generated By People	Maximum Threshold Value (PPM)	Steady State Using the VRP* (Prescribed OA) Plasma Off	Steady State Using the IAQ Method (Reduced OA) Plasma On	Is Steady State Level Acceptable at Reduced OA Levels?	Contaminant Generation Rate (PPM)	Filtration Effectiveness	Cognizant Authority***
Acetaldehyde	100.0	0.01112	0.00139	Yes	0.00048	50%	OSHA
Acetone	250.0	0.00175	0.00102	Yes	0.00654	25%	NIOSH
Ammonia	25.00	0.01771	0.01339	Yes	0.21460	50%	NIOSH
Benzene	1.0000	0.00252	0.00092	Yes	0.00022	20%	OSHA
2- Butanone (MEK)	200.0	0.00020	0.00019	Yes	0.00133	20%	NIOSH
Carbon dioxide**	5000	1115	2802	Yes	441	0%	NIOSH
Chloroform	2.0000	0.00011	0.00001	Yes	0.00004	80%	NIOSH
Dioxane	100.0	0.00000	0.00000	Yes	0.00000	10%	OSHA
Hydrogen Sulfide	10.0	0.00000	0.00000	Yes	0.00000	25%	NIOSH
Methane	NA	1.68094	1.68094	Yes	0.00000	0%	NA
Methanol	200.0	0.00000	0.00000	Yes	0.00000	0%	NIOSH
Methylene Chloride	25.0	0.00078	0.00057	Yes	0.00121	10%	OSHA
Propane	1000.0	0.00998	0.00998	Yes	0.00000	0%	NIOSH
Tetrachloroethane	5.0000	0.00000	0.00000	Yes	0.00000	15%	OSHA
Tetrachloroethylene	100.0000	0.00037	0.00016	Yes	0.00001	15%	OSHA
Toluene	100.0000	0.00533	0.00134	Yes	0.00032	30%	NIOSH
1,1,1 - Trichloroethane	350.0000	0.00078	0.00013	Yes	0.00058	50%	NIOSH
Xylene	100.0000	0.00230	0.00057	Yes	0.00000	30%	OSHA



1 = ASHRAE & NIOSH C02 Limit
2 = C02 Level at Ventilation Rate OA Flow Rate
3 = C02 Level at IAQ Procedure OA Flow Rate

**Carbon dioxide has been provided for reference only for gathering demand control ventilation (DCV) setpoints. The National Research Council was commissioned by the US Navy to prove C02 is not a contaminant of concern when using air purification to control the other contaminants of concern, as found on submarines.

Building materials and furnishings assumed to have no VOCs and off-gassing is complete

All yellow shaded boxes require user input or review

Is IAQ acceptable at reduced outside air levels?	Yes

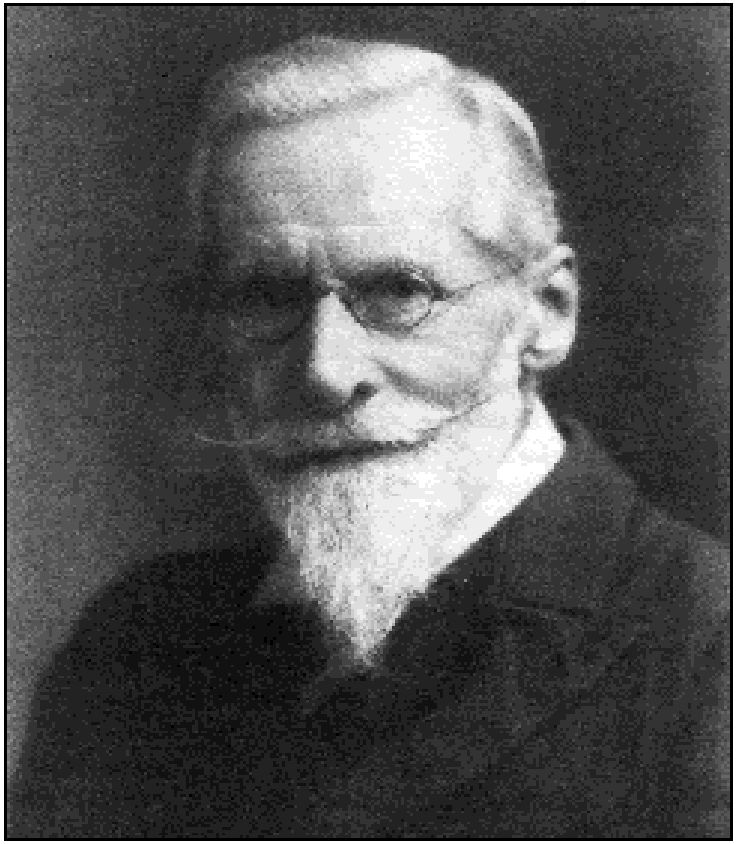
Date	1/12/16
Job Name	-
Representative	-
Engineer	-

IMC 2006 & later allows for ASRHAE 62 IAQP through the engineered exception found in Section 403.2

Exhaust flow rates may differ from Table 6.5 based on ASHRAE 62 IAQP via Section 6.5.2

History of Air Ionization

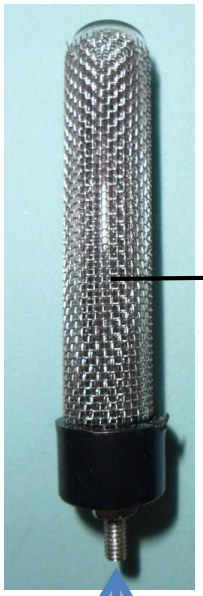
Plasma was first identified in a Crooks tube, and so described by Sir William Crookes in 1879 (he called it "radiant matter"). The nature of the Crookes tube “cathode ray” matter was subsequently identified by British physicist Sir J.J. Thomson in 1897. The term "plasma" was coined by Irving Langmuir in 1928, perhaps because the glowing discharge molds itself to the shape of the Crooks tube. Other terms associated with this technology are Dielectric Barrier Discharge, DBD and Corona Discharge.



Sir William Crookes, OM, FRS was a British chemist and physicist who attended the Royal College of Chemistry, London, and worked on spectroscopy.

NPBI vs Corona Tube Technology

Glass/Ceramic/Mica/Composite material is the dielectric (insulator) barrier to voltage completing the path to ground. Voltage and current (power) must be higher than NPBI systems to make the dielectric conduct electricity to complete the electrical circuit. That overall power level exceeds 12.07 eV; therefore, oxygen is ionized and ozone produced.



NPBI systems can operate with precise power output since there is no dielectric, which prevents ionizing oxygen and ensures no ozone is produced

Ions leave tip based on polarity of voltage applied

Ions emit directly into the airflow and the ion polarity Is based on the polarity of voltage applied to the needles

Types of NPBI

Direct Current (DC) Output –

- Each needle stays the same polarity
- Metal needles will corrode over time and dull, reducing ion output
- Carbon fiber brushes do not corrode or dull over time, regardless of DC or AC output
- Input voltage may be AC or DC

Alternating Current (AC) Output –

Each needle cluster alternates between +/- at the frequency applied

CLEAN THE AIR NATURALLY

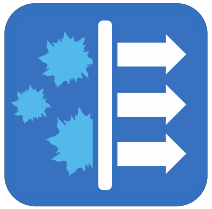
Ions are present naturally in the air and are found in the highest concentrations where the ocean meets the shore and high elevation in the mountains.

The plasma process will artificially create the ions found in these desirable locations and supply them into the building, enhancing the indoor air quality. Process has been around since the late 1800's

Units of Measure = ions/cc (cubic centimeter)
Waterfalls/High Elevation – 5,000 i/cc
City – 200 ions/cc
Inside Buildings - <100 ions/cc

Ions Have a 60 Second Life Max!

"P.O.P.E." – NPBI BENEFITS



Particle Reduction – Technology makes particles clump together and a lower efficiency filter can capture them from the air

Odor Control – Odors, volatile organic compounds and the like are oxidized to gases already prevalent in the air such as oxygen, nitrogen, water vapor or carbon dioxide, eliminating the odors

Pathogen Control – Independent testing by CDC Affiliate Labs confirms kill rates as high as 99.9% of various pathogens and mold spores. Keeps new cooling coils clean and cleans up old coils.

Energy Savings by Outside Air Reduction – By cleaning indoor air and recirculating it – Less Outside Air is required.

Less OA = Less Load on Cooling/Heating System – ASHRAE 62 & IMC Compliant

PM 10 is a Highway for Virus

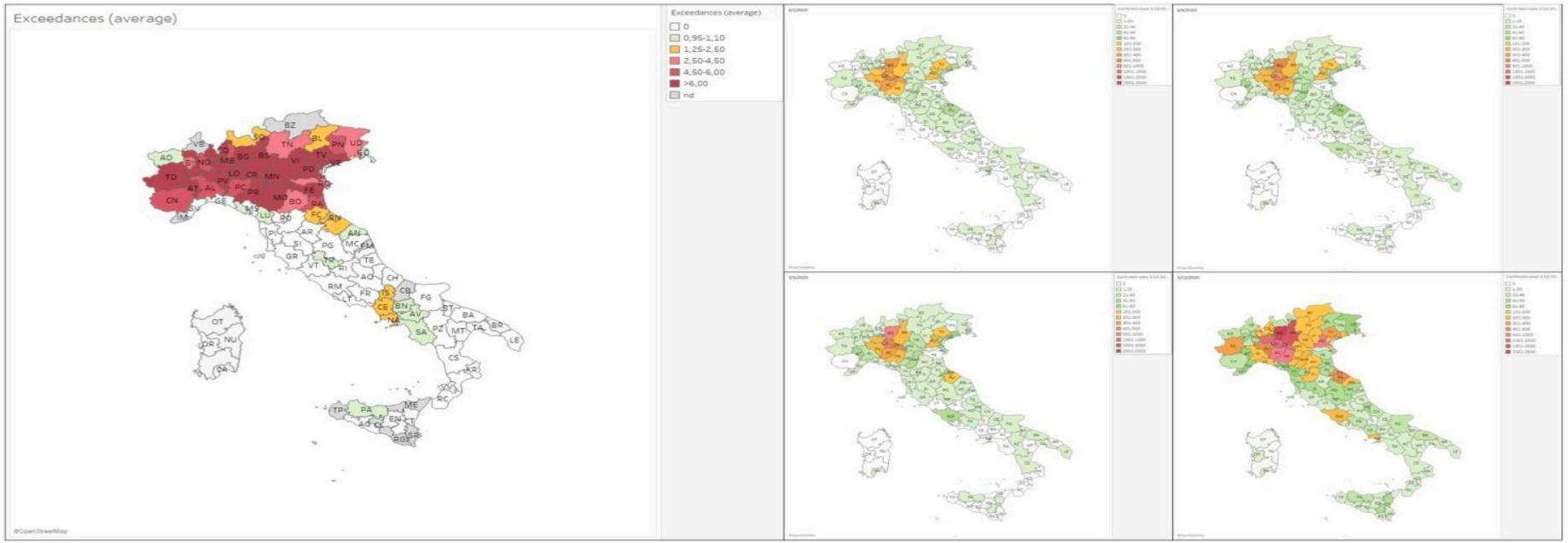


Figure 2: Mean of PM_{10} exceedances/number of monitoring stations in selected Italian Provinces in the period 10th-29th February 2020.

This evidence leads the authors to the hypothesis of a direct relationship between the number of persons infected by COVID-19 and the PM_{10} concentration levels in specific areas of Italian territory, confirming previous findings of recently published studies regarding environmental factors involved in viral infection spread. The hypothesis of a direct relationship between COVID-19 cases and PM_{10} levels is strengthened by the evidence that concentration of COVID-19 outbreaks notified in Pianura Padana was higher than in other parts of Italy (Figure 2).

VIRUS TRANSMITS VIA AIR

Cite as: K. A. Prather *et al.*, *Science* 10.1126/science.abc6197 (2020).

1. **Reducing transmission of SARS-CoV-2**

Kimberly A. Prather[1], Chia C. Wang,[2,3] Robert T. Schooley[4]

[1]Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA 92037, USA. [2]Department of Chemistry, National Sun Yat-sen University, Kaohsiung, Taiwan 804, Republic of China. [3]Aerosol Science Research Center, National Sun Yat-Sen University, Kaohsiung, Taiwan 804, Republic of China. [4]Department of Medicine, Division of Infectious Diseases and Global Public Health, School of Medicine, University of California San Diego, La Jolla, CA 92093, USA. Email: kprather@ucsd.edu

Masks and testing are necessary to combat asymptomatic spread in aerosols and droplets

Environment International 139 (2020) 105730

2.

Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

Airborne transmission of SARS-CoV-2: The world should face the reality

Lidia Morawska[a,*], Junji Cao[b]

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[b] *Key Lab of Aerosol Chemistry & Physics (KLACP), Chinese Academy of Sciences, Beijing, China*

VIRUS TRANSMITS VIA AIR

Risk Analysis, Vol. 40, No. 5, 2020

DOI: 10.1111/risa.13500

Commentary

3. **Consideration of the Aerosol Transmission for COVID-19 and Public Health**

Elizabeth L. Anderson,[1,*] Paul Turnham,[1] John R. Griffin,[1] and Chester C. Clarke[2]

4. 

Taylor & Francis
Taylor & Francis Group

Aerosol Science and Technology

ISSN: 0278-6826 (Print) 1521-7388 (Online) Journal homepage: https://www.tandfonline.com/loi/uast20

The coronavirus pandemic and aerosols: Does COVID-19 transmit via expiratory particles?

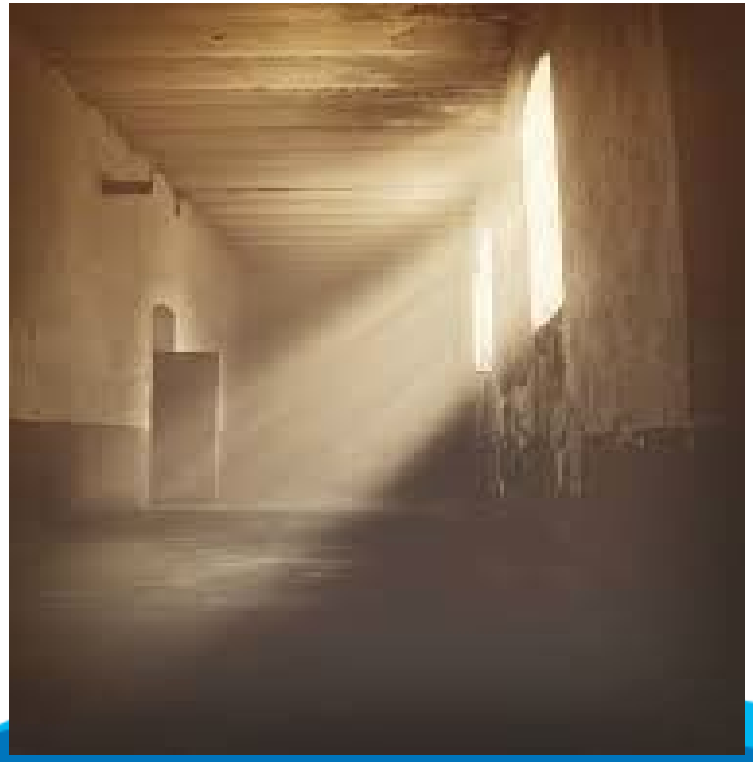
Sima Asadi, Nicole Bouvier, Anthony S. Wexler & William D. Ristenpart

To cite this article: Sima Asadi, Nicole Bouvier, Anthony S. Wexler & William D. Ristenpart (2020) The coronavirus pandemic and aerosols: Does COVID-19 transmit via expiratory particles?, Aerosol Science and Technology, 54:6, 635-638, DOI: 10.1080/02786826.2020.1749229

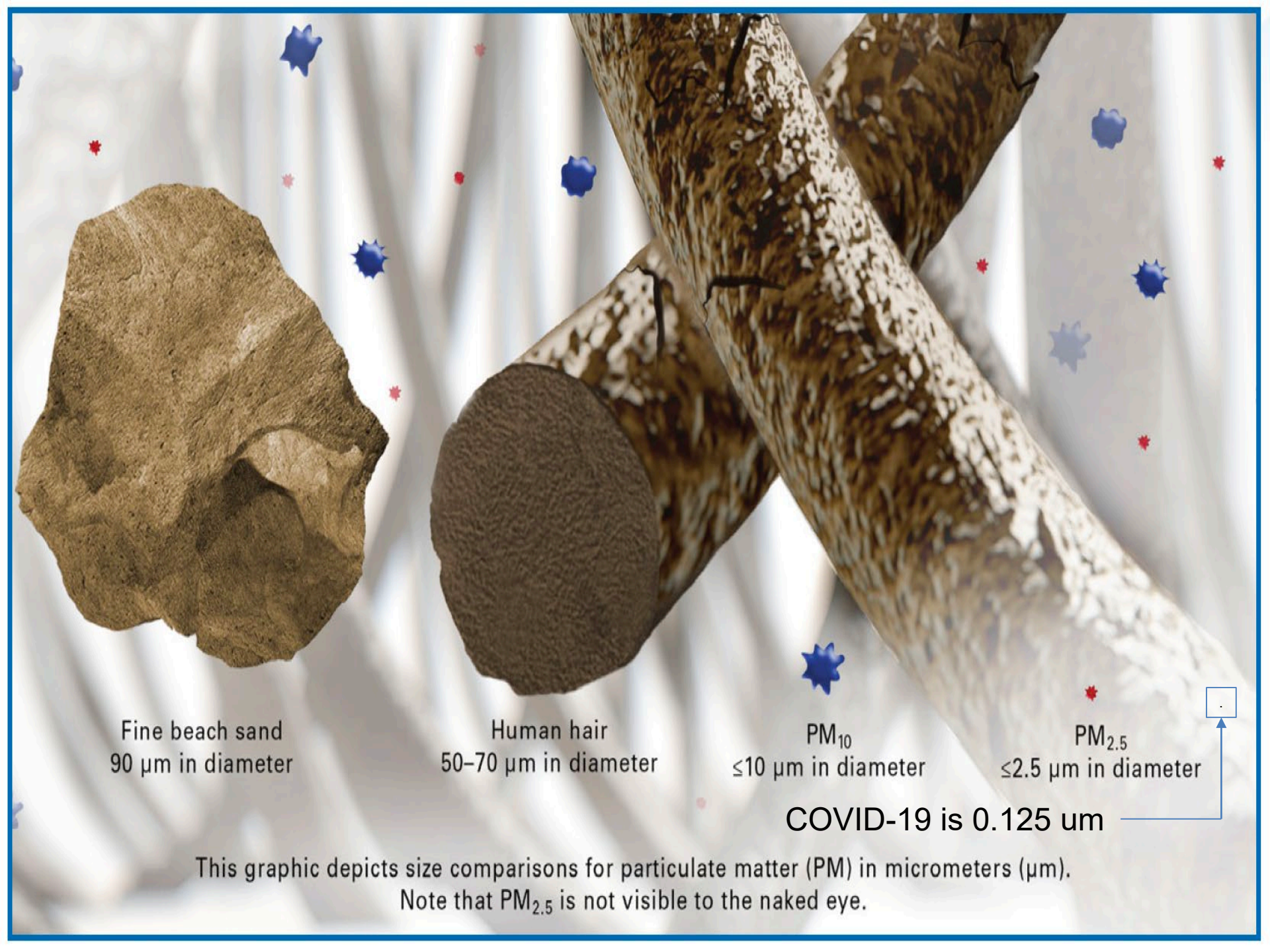
To link to this article: https://doi.org/10.1080/02786826.2020.1749229

HOW PARTICLES ARE CREATED

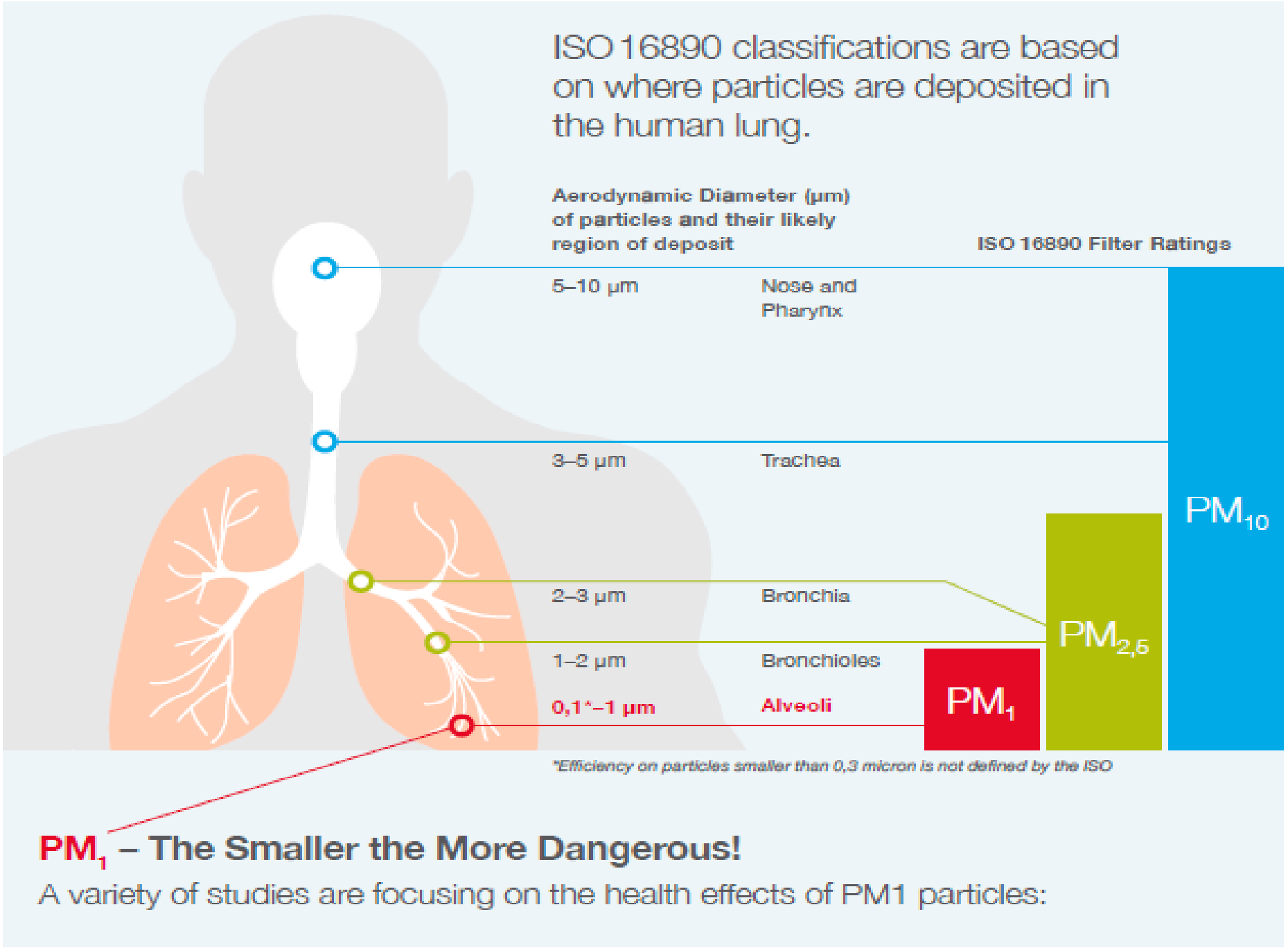
- A person sitting or stopped generates about 100,000 particles per cubic ft.
- Sitting down or standing up generates about 2,500,000 particles cubic ft.
- Walking generates about 10,000,000 particles per cubic ft.
- Horseplay generates about 30,000,000 particles per cubic ft.
- Grinding, sweeping, welding adds billions of particles per cubic ft.
- Two surfaces rubbing generate billions of particles per cubic ft.



There are over 18 Million particles in 1 cubic ft of air



This graphic depicts size comparisons for particulate matter (PM) in micrometers (µm).
Note that $PM_{2.5}$ is not visible to the naked eye.


ISO 16890 classifications are based on where particles are deposited in the human lung.
Aerodynamic Diameter (µm) of particles and their likely region of deposit
ISO 16890 Filter Ratings
5–10 µm
Nose and Pharynx
3–5 µm
Trachea
2–3 µm
Bronchia
1–2 µm
Bronchioles
0,1*–1 µm
Alveoli
PM10
PM2,5
PM1
*Efficiency on particles smaller than 0,3 micron is not defined by the ISO
PM1 – The Smaller the More Dangerous!
A variety of studies are focusing on the health effects of PM1 particles:

GPS' technology can reduce particles, control odors & kill pathogens.

The Problem - A large Midwest medical device manufacturer contacted GPS due to a new chemical being introduced into the manufacturing process that was creating odor issues for the employees working in those rooms and adjoining spaces that shared the same air handling system. Upon reviewing the molecular structure of the chemical, it was determined that GPS' cold plasma technology could control the odor effectively.

The Solution - A GPS-iBar system was installed on the air entering side of the cooling coil in the air handler conditioning the clean rooms.

The Results – After installation of the GPS-iBar system, the odors were eliminated in less than 24 hours. The GPS-iBar system also provided a pleasant surprise to the owner when the annual clean room certification occurred. The clean room certification company found the total particle counts to be 89.7% less than any other time prior to the GPS-iBar installation, which includes over 10 years of prior testing with similar, consistent results.

Pharmaceutical Manufacturing Facility

Total Particle Counts

Date	Before	After
6/17/2013	2015	
6/25/2014		208*

Total Particle Count Reduction 89.7%

*GPS-iBar installed & activated 6 months prior to "After" testing

GPS®
GLOBAL PLASMA SOLUTIONS

MERV 8 + GPS = > MERV 13

Blue Heaven Technologies

2820 S. English Station Rd.
Louisville, Ky 40299
Tel: (502) 357-0132
Fax: (502) 267-8379

Date:	23-Oct-17
Report No.	17-618
MODIFIED CADR CHAMBER TEST	
TEST REPORT SUMMARY	
Chamber Smoke Concentration Decay Test	
MERV 13 vs. MERV 8 w/GPS Device	

Test Results

1 It was determined that the 1" MERV 13 Panel filter reduced particle count from 2,730,958 to 808 particles in a timeframe of 34 minutes.

2 It was determined that the 1" MERV 8 Panel filter with GPS Technology reduced particle count from 3,645,943 to 745 particles in a timeframe of 16 hours.

3 It was determined that the 1" MERV 8 Panel filter with GPS Technology reduced particle count from 2,753,181 to 745 particles in a timeframe of 15 hours - 40 minutes in comparison to the MERV 13 at 34 minutes.

Quantitative Results

MERV 13 Filter

Elapsed Time, Min.	Microns 0.30	0.40	0.55	0.70	1.00	1.30	1.60	2.20	# total Particles	#/cm3 Concentration
4	1805492	738537	144867	40941	865	153	96	3	2730958	2730
34	636	101	25	23	8	5	2	5	808	0.81

MERV 8 Filter with GPS Technology

Elapsed Time, Min.	Microns 0.30	0.40	0.55	0.70	1.00	1.30	1.60	2.20	# total Particles	#/cm3 Concentration
5	1958081	1222632	332433	129698	2610	341	136	6	3645943	3645
19	1876059	736434	117644	22892	116	11	20	5	2753181	2753
16 hours	619	90	12	17	2	1	2	2	745	0.74

National Research Council of Canada

The combination of the NPBI with MERV 12 has the same efficiency as a MERV 16 filter for size bin E2 (PM2.5), i.e. a filter eff. ≥ 95%

Testing based on GPS-iMOD in a western CA hospital

YYC Control Tower Particle Testing

October 23, 2017

Particulate Report

Location: YYC Air Traffic Control Tower
7811 22nd Street NE
Calgary, AB T2E 5T3

Test dates: October 20 and October 23, 2017

Testing equipment: Particles Plus
Model number: Handheld 8303
Serial number : 1399

An initial particulate reading was performed Sept 20. Existing filters were not changed before test. Readings attained as follows:

Particle Size µm	Quantity/ft³
0.3	364,766
0.5	170,868
1.0	77,846

Global Plasma Solutions Bi-Polar Ion generator model number GPS-iMOD was installed in each of the AHU's supplying air to the control tower.

A secondary particulate reading was performed Oct 23. Readings attained as follows:

Particle Size µm	Quantity/ft³
0.3	46,665
0.5	7,814
1.0	3,264

Percentage Reduction:

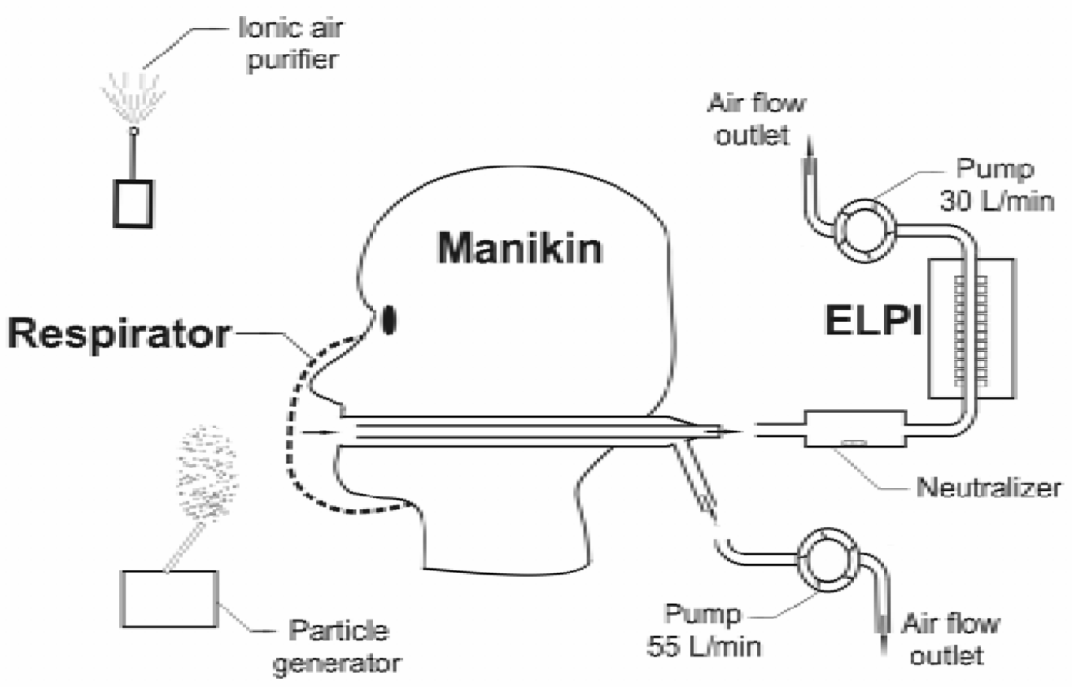
Particle Size µm	Reduction %
0.3	87.2
0.5	95.4
1.0	95.8

Filtering Efficiency of N95- and R95-Type Facepiece Respirators, Dust-Mist Facepiece Respirators, and Surgical Masks Operating in Unipolarly Ionized Indoor Air Environments

Table 1. Enhancement factors due to the ion emission for four facepiece filtering masks.

Half-mask respirator	N95	R95	Dust-mist respirator	Surgical mask
Enhancement factor	48.4	22.3	3250	194

Note: Ion emitter = VI-2500; inhalation flow rate = 30 L/min; emission time = 12 min.



Data Provided by:

Center for Health-Related Aerosol Studies

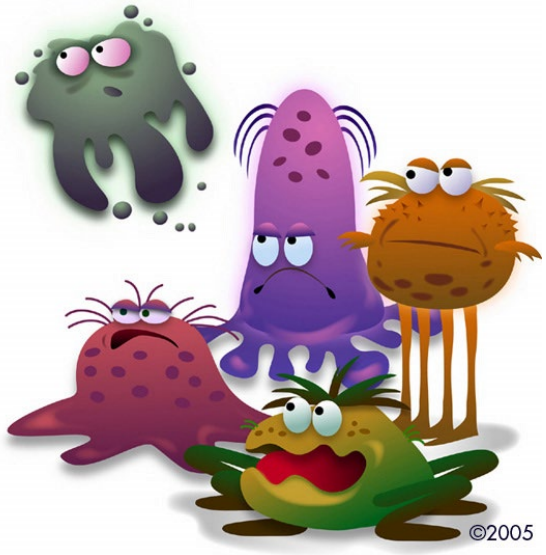
Dept. of. Environ. Health
University of Cincinnati

Needlepoint Bipolar Ionization for TVOC CONTROL

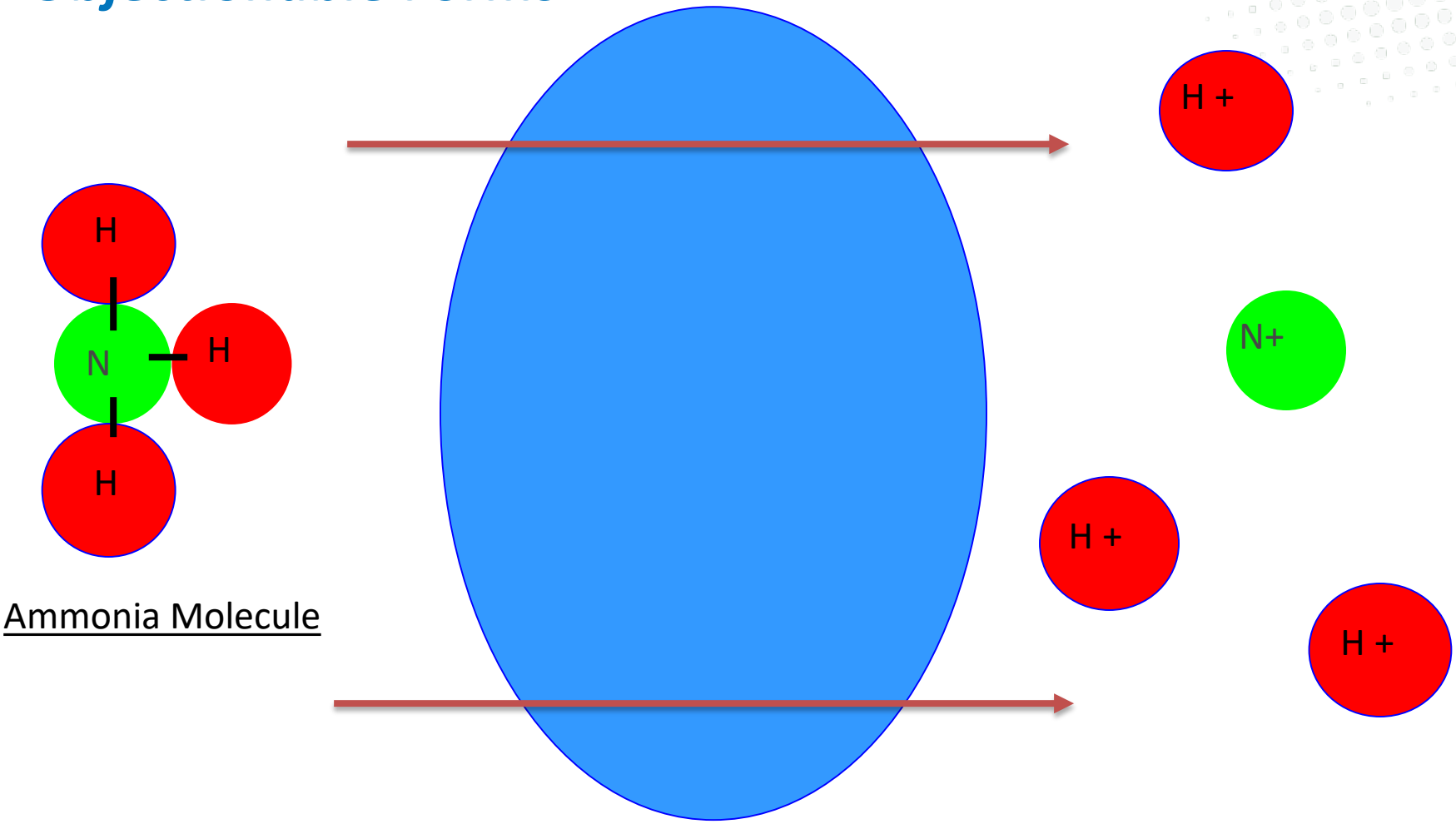
What Are VOCs?

Volatile: Vapor at Room Temperature
Organic: Contains Hydrogen & Carbon
Compounds: More than one gas

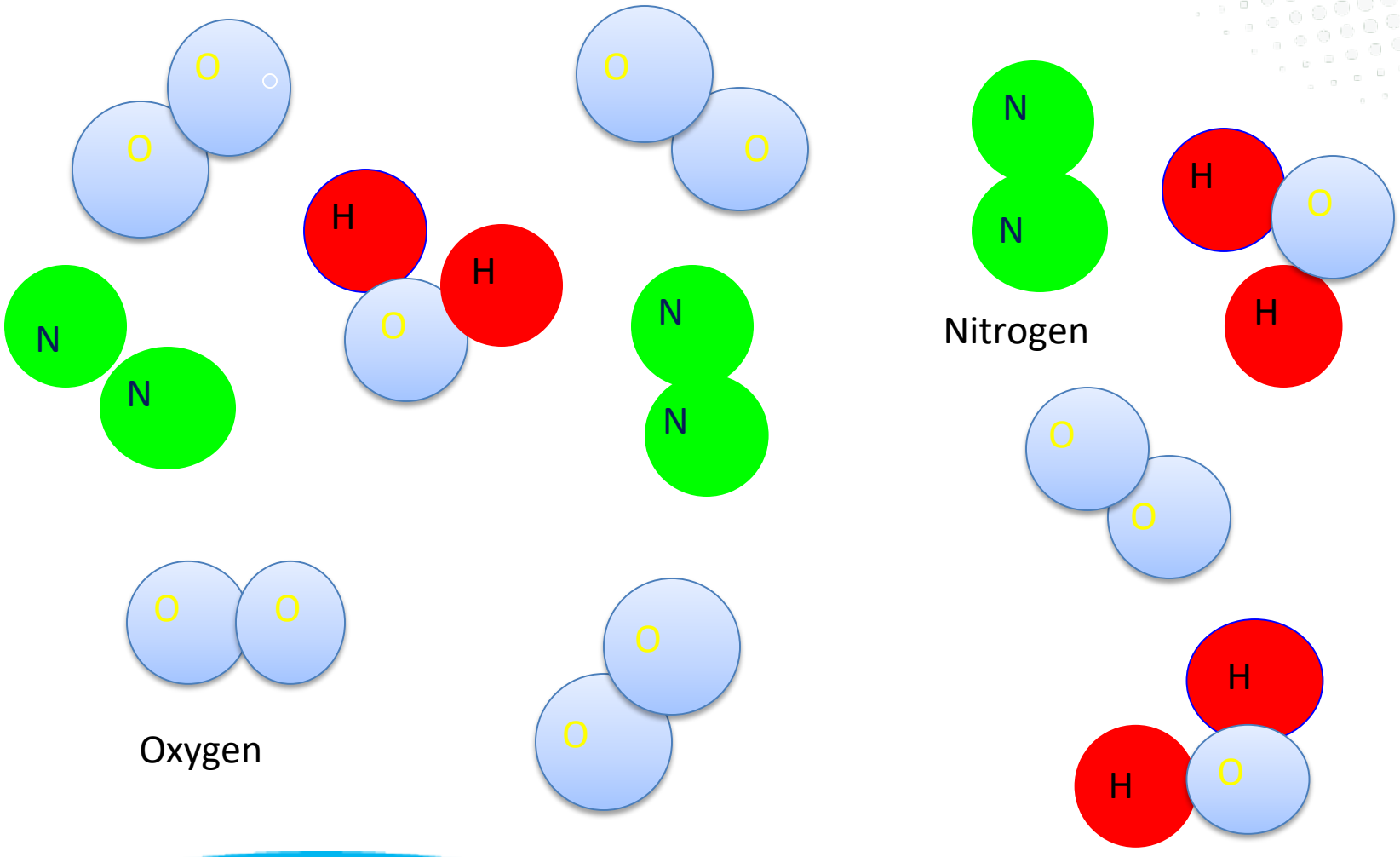
- Natural & Man-Made
- We Come in Contact w/100's Each Day
- Human & Non-Human Sources



Plasma Breaks Down Gases To Less Objectionable Forms



The Objectionable Gases Regroup To Form Safe & Desirable Gases Already Prevalent in Our Atmosphere!



Chemical Compounds Ionization Can Control

CHEMICAL	FORMULA	Electron Volt
Xylene*	C_8H_{10}	7.89
Styrene*	C_8H_8	8.46
Methyl Ethyl Ketone*	C_3H_8O	9.52
Ammonia*	NH_3	10.07
Acetaldehyde*	CH_3CHO	10.23
Ethyl Alcohol*	C_2H_5OH	10.48
Formaldehyde*	CH_2O	10.88
Oxygen	O_2	12.07
Corona tubes require >12.07 to break down the dielectric		

NPBI

DIELECTRIC/CORONA DISCHARGE TUBE > 12.07eV

* Typical contaminants of concern as contained within ASHRAE 62.1

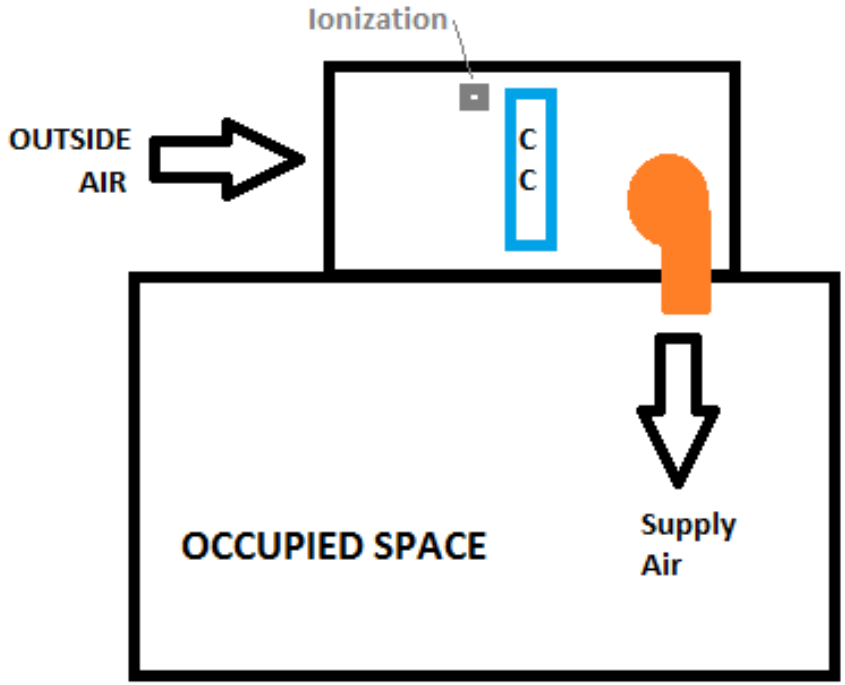
- Electron Volt Energy greater than 12Ev, creates ozone (O_3)

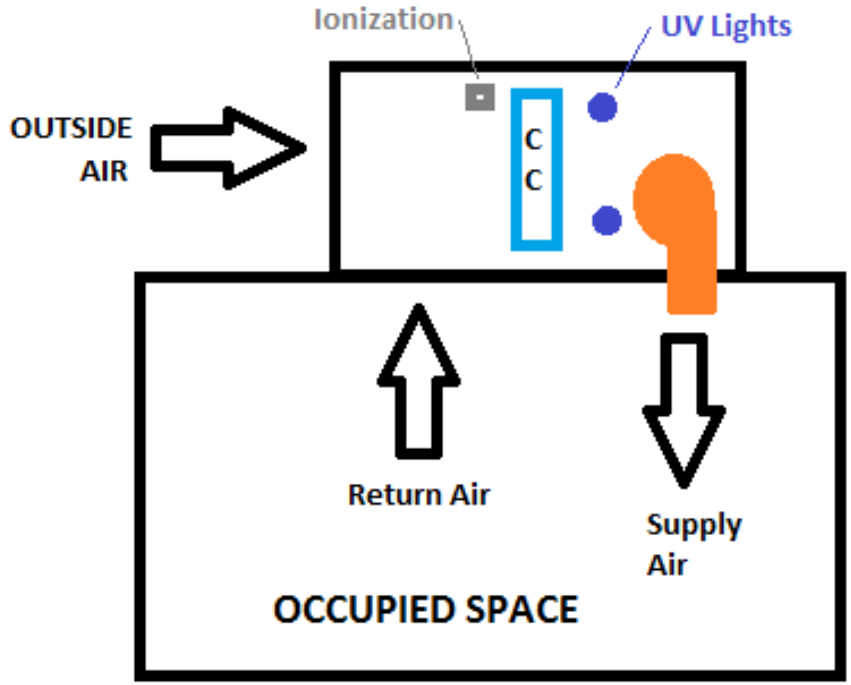
Independent Testing by World Renowned EMSL & ATS Labs

Pathogen	Time Exposed	Kill/Deactivation Rate
E.coli	15 minutes	99.68%
MRSA	30 minutes	96.24%
TB	60 minutes	69.01%
Noro Virus*	30 minutes	93.50%
Human Coronavirus**	60 minutes	90.00%
C.diff	30 minutes	86.50%

*Norovirus in not an enveloped virus and is harder to kill than COVID-19, an enveloped virus.

**Residential product with 40% less output used for first test





% of SARS VIRUS CONTROLLED BASED ON TECHNOLOGY[1]

MERV Rating	Filter Only	Filter+UVC***	Filter + Ionization*, **
6	6.2%	10%	34%
7	7%	12%	61%
8	11%	19%	84%
10	12%	35%	89%
13	46%	84%	97%
15	71%	97%	99%
16	76%	98.80%	99.90%
17 (HEPA)	99.90%	99.99%	99.999%

*Ionization increases the filter efficiency 4-5 MERV levels – this column added by GPS
**Does not take into account ionization kills in the space and on surfaces
***UVC does not effectively kill airborne pathogens in high RH conditions[2]

2. ASHRAE Technical Paper on Airborne Infectious Diseases

1. 2009 EPA Tech Paper

UVC Wavelength Decreases Over Time

Effective UV Lamp Life – 1 year

UV output decreases over time

All UV performance data reviewed to date is based on new lamps

Eventually UV lamps become “NEON” lights and then mold, bacteria and virus can survive on the surface of the light as shown in the photo

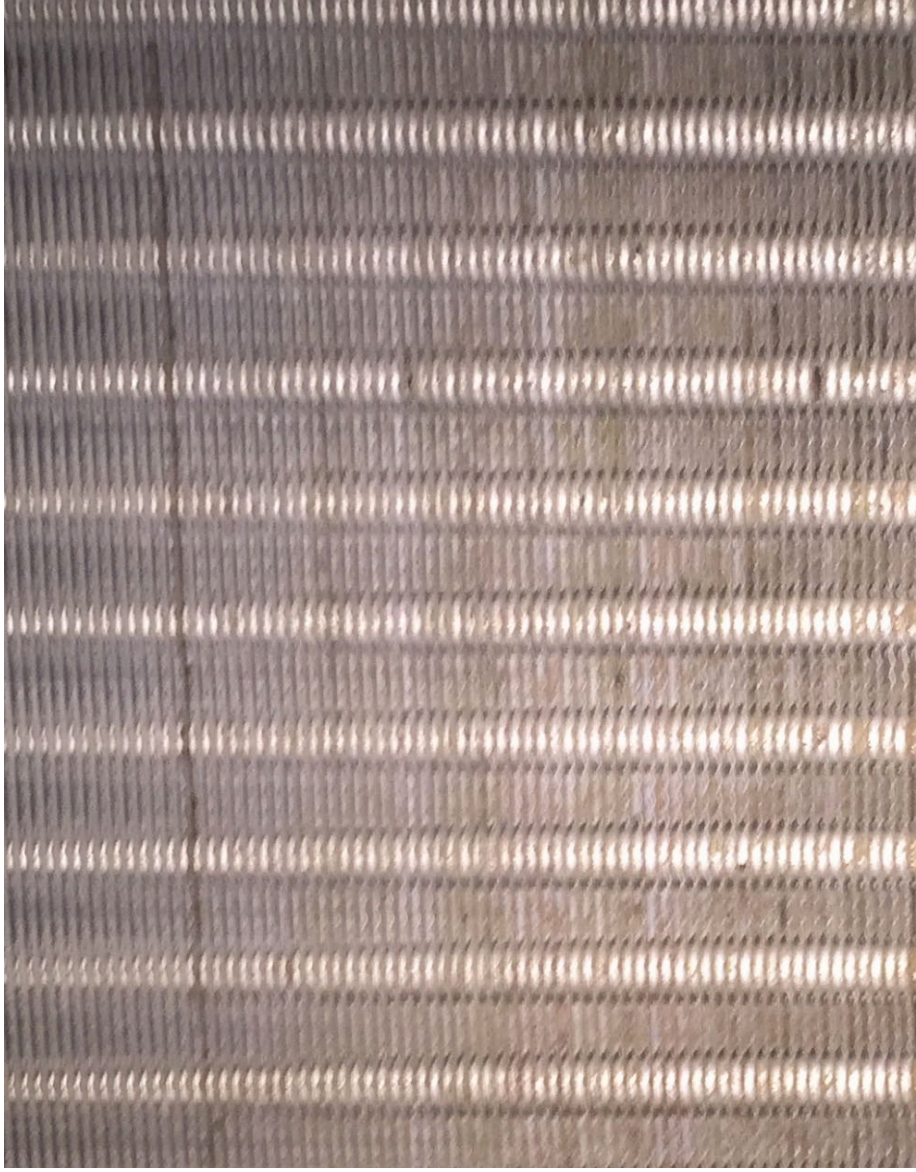
This photo was taken just after the lights were turned off for the safety of the photographer. The lamps still had “blue” light produced, but not enough output to kill mold since it was growing!

GPS’ NPBI *DOES NOT* DECREASE OVER TIME!

Biofilm Reduces Heat Transfer

- Amount of Scale.....% Heat Transfer Reduction
- 0.006”.....16%
- 0.012”.....20%
- 0.024”.....27%
- 0.036”.....33%

- “Equipment operating with dirty coils may use as much as 37% more energy than equipment with clean coils.”
- Source: Air Conditioning, Heating & Refrigeration News



BEFORE GPS

THREE WEEKS AFTER GPS

GREENSBORO HOSPITAL

Classroom Dirty Coil Analysis

3	System Tons

Scale Thickness	% Loss	Added Tons	Added Annual Cost
0.006	16%	0.48	$86.40
0.012	20%	0.6	$108.00
0.024	27%	0.81	$145.80
0.036	33%	0.99	$178.20

Annual Hours	2000
$/KWh	$0.100
KW per Ton	0.9

Notes:

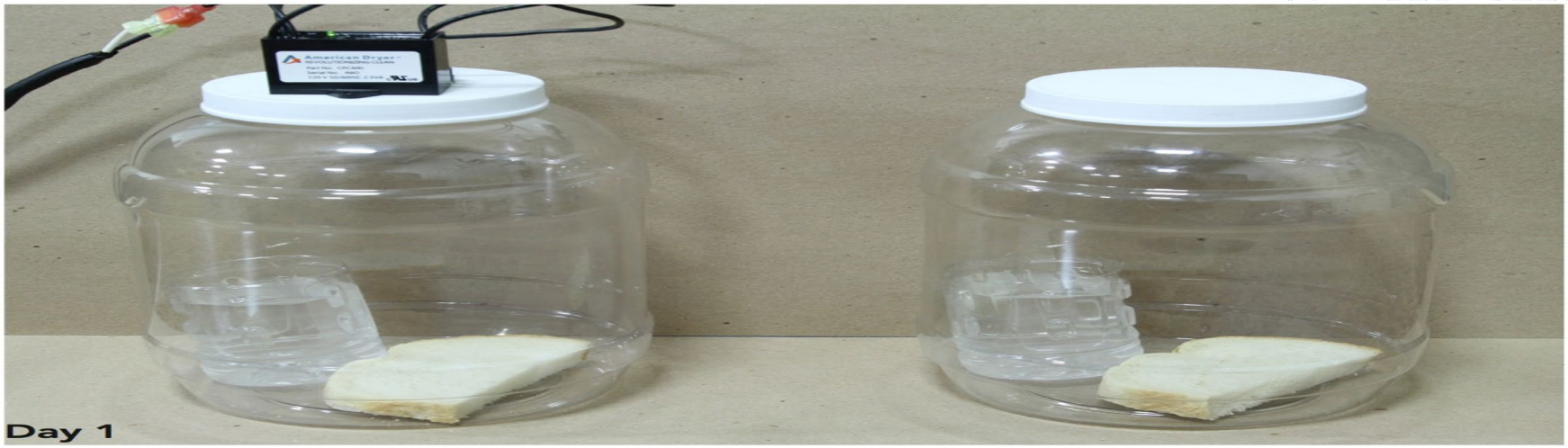
1. Savings only applies to cooling hours unless it is a heatpump coil

Fan Power Savings

- CFM = 1,000
- Increased Static PD Due to Dirty Coil = 1.0” WC
- $ / KW = $0.10
- Operational Hours = 2000 (typical school annual hours)
- Total Savings = $37.28 Per 1,000 CFM @ 1” Static

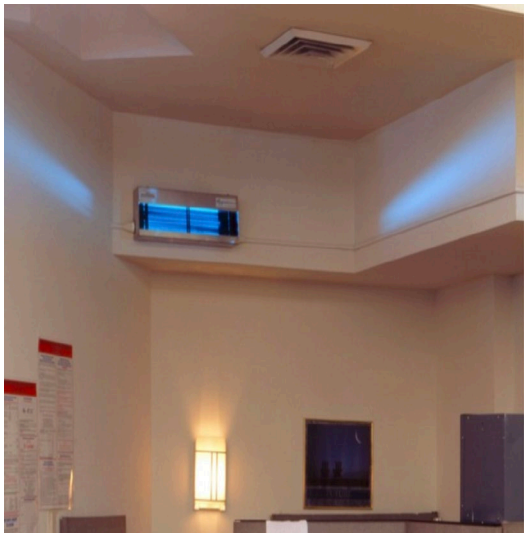
Dirty Coil Surfaces Affect Heat Transfer By Imposing More Load on System

Mold Test (with & without NPBI)



ASHRAE COVID-19 TASK FORCE

1. Recommends MERV 13 filters – Can your System Handle It?
2. Use UVC in the Duct – How many lamps and where?
3. Use Upper Room UVC - Not effective over 6 ACH
4. Turn off energy wheels, wait, what?
5. Ventilate as much as possible…but what about all those particles in the OA? Energy? Low RH Air?



Upper Room UVC

Why Does ASHRAE Not Comment On EACs?

- ASHRAE is a Volunteer Organization– Most participants are supported by a company with self-serving interests and they want a ROI in the form of favorable testing requirements, standards, etc. and that is why people participate.

- ASHRAE Handbook – There is no chapter on EACs, so there is no point of reference. The chapters in the Handbook are there because participants backed by companies such as UV, carbon, filters, etc. have worked to create test standards for their own technology. It is not in those participants interests to help EAC companies because many will compete with UV, carbon and filters.

- EAC Technology Varies Significantly – It is hard to create a test standard that can apply to all EAC technology. Until the last two years, EAC companies were not broadly participating in ASHRAE, but that has now changed.

- Proposed RTARs & Conference Papers Rejected – ASHRAE has never accepted RTAR proposals and conference paper submissions on EACs

- ASHRAE Claims there's insufficient independent research on EACs. That's a false statement and there are well over 100 independent studies on EACs and their benefits as long as they are UL 2998 certified as ozone free.

NPBI PRODUCT OFFERING

GPS-iRIB-36 or -18

Flexible Ionization Ribbon – 110V to 240VAC or DC

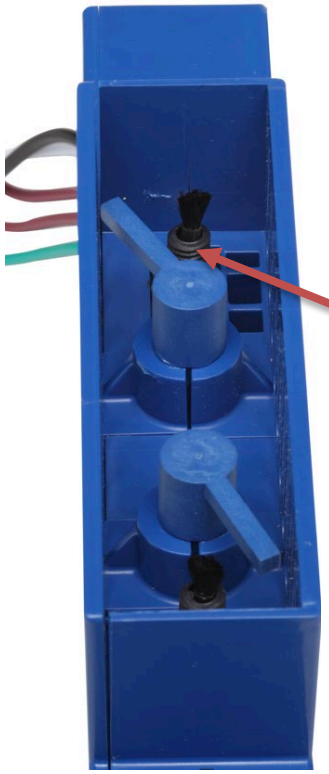
Typical Location Install on Ductless Wall System:

Figure 6

Affix the iRIB power pack to back of cabinet and wire to L1/L2 or S1/S2, leave on 24/7. Alarm contacts provided

Affix the iRIB to the top of the coil on the plastic strip or to the top of the fins to treat the coil, blower and space

Self-Cleaning Ion Generator
GPS-FC24-AC



Two self-cleaning wiper blades for low profile

Designed for VRF/VRV Ceiling Cassette Units (only 1” high)
0-2,400 CFM
24VAC-240VAC or DC Input, includes BAS contacts

SELF CLEANING ION GENERATOR
GPS-FC48-AC

Capacity: 0-4,800 CFM
Self-Cleaning – No Maintenance
Universal Voltage: 24VAC-240VAC, with BAS contacts

GPS-DM48-AC

WORLD'S FIRST SELF-CLEANING NPBI GENERATOR

2016 HVAC IAQ PRODUCT OF THE YEAR!

0-4,800 CFM, Mounts Indoors or Out
24-240VAC Universal Voltage Input w/BAS Contacts
Provided with Display for Operation Status

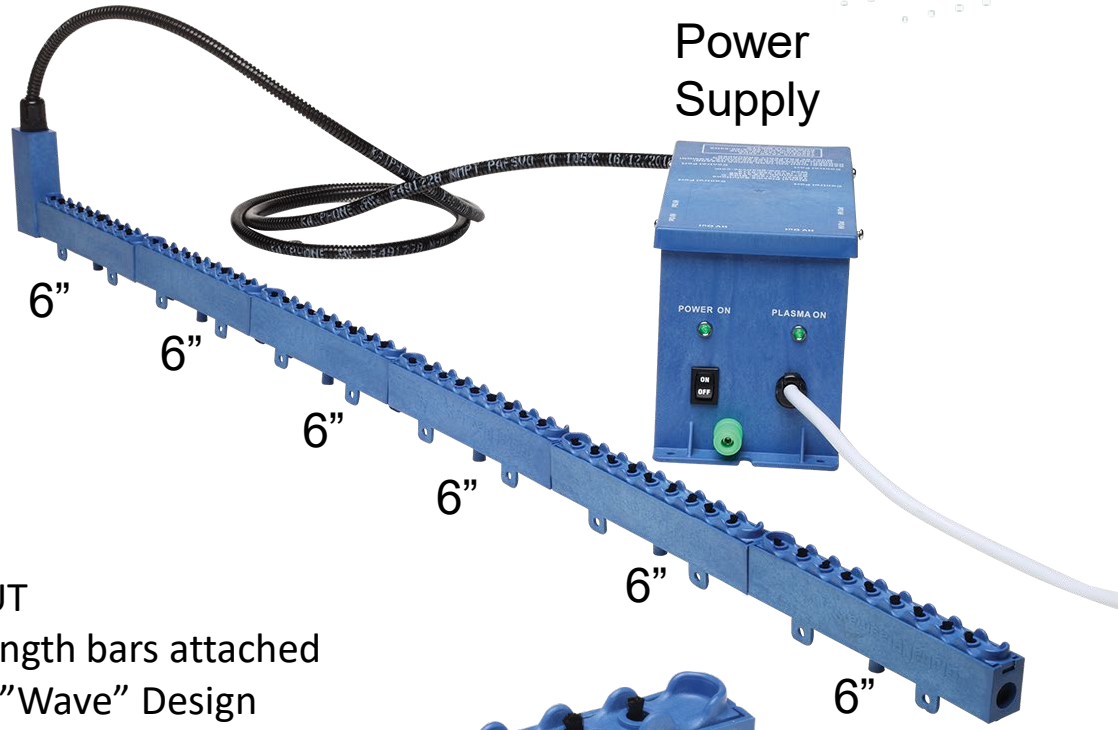
GPS-iMOD (AC Output Device)

Modular Ionization Product – Fits Any Size HVAC System

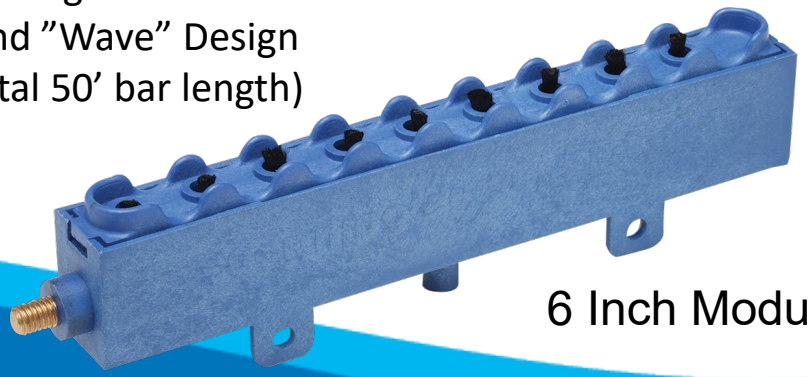
VALIDATED

- ZERO OZONE EMISSIONS - MEASURED OZONE EMISSIONS FROM GPS IMOD DURING USE PHASE DOES NOT EXCEED 0.005 PPM AS TESTED BY UL 2998

UL.COM/ECV



- 24VAC, 110VAC or 208-240VAC INPUT
- 15W power total for any quantity/length bars attached
- Self-Cleaning Due to AC Output and ”Wave” Design
- Up to 6 bars per power supply (total 50’ bar length)
- OSHPD CERTIFIED



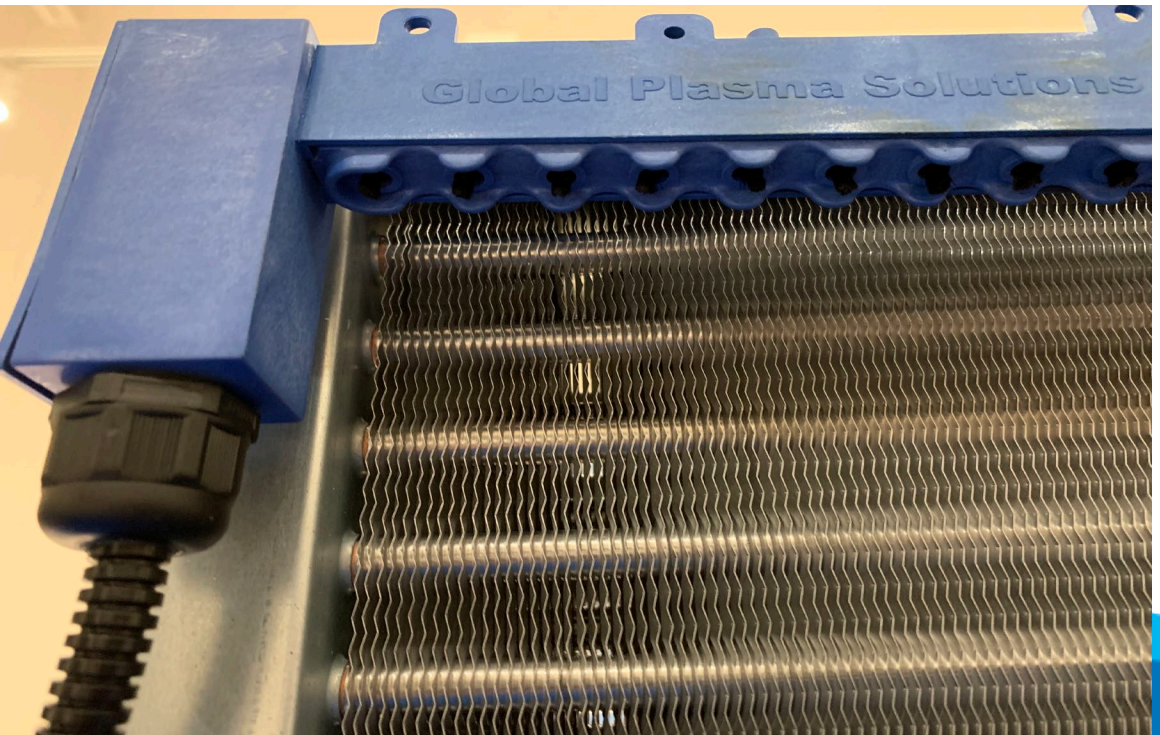
6 Inch Modular Section

GPS-iMOD Sizing

- Coil Cleaning – 1 bar for every 5’ of coil height
- Odor Control – 2 bars per coil, one at top and one midway down, both pointing towards floor
- Space Pathogen Control – Mount after final filters and provide 1” of bar length per 400 CFM

GPS-iMOD Installation

GPS-iMOD
Installation Pics



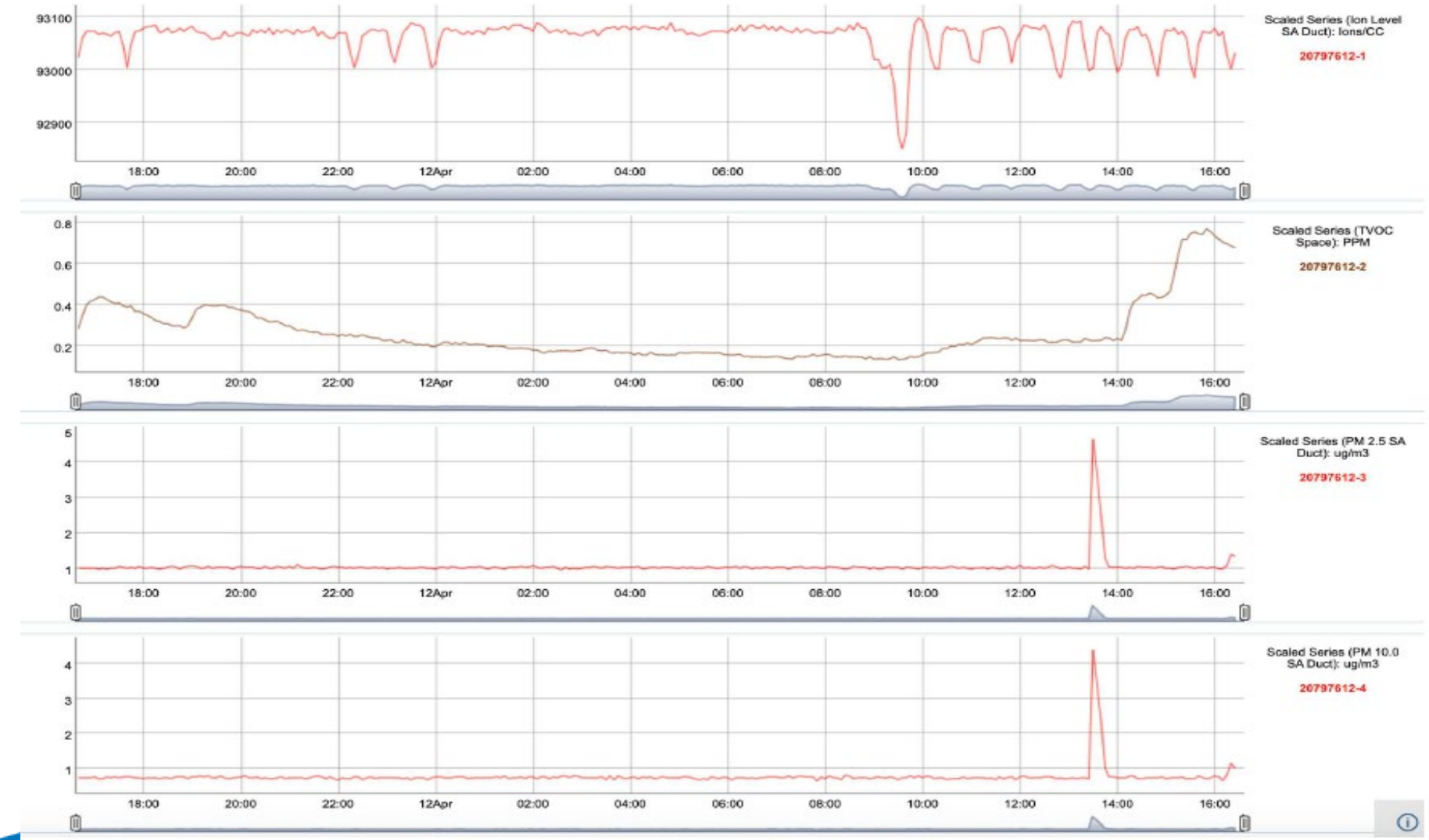
How do you know it's working?

Measurement and Verification

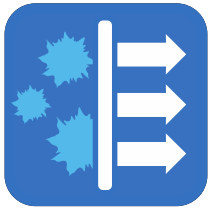
Building Automation System integration and Sensors

- Unit operating (on/off)
- Ion meters
- Particle meters
- Sense of smell
- Lab results (EMSL and ATS)

Monitoring Ions, TVOCs and Particles (PM10 and PM2.5)



Remember "P.O.P.E." – NPBI BENEFITS



Particle Reduction – Technology makes particles clump together and a lower efficiency filter can capture them from the air

Odor Control – Odors, volatile organic compounds and the like are oxidized to gases already prevalent in the air such as oxygen, nitrogen, water vapor or carbon dioxide, eliminating the odors

Pathogen Control – Independent testing by CDC Affiliate Labs confirms kill rates as high as 99.9% of various pathogens and mold spores. Keeps new cooling coils clean and cleans up old coils.

Energy Savings by Outside Air Reduction – By cleaning indoor air and recirculating it – Less Outside Air is required.

Less OA = Less Load on Cooling/Heating System – ASHRAE 62 & IMC Compliant

How to Prepare?

- Increase Filter Efficiency – may not be possible, but you can add a GPS device without adding pressure drop and increase existing filters by 4-5 MERV points
- Use Active Technology – GPS' NPBI is "active" technology that is always seeking out particles and pathogens in the space. Filters/HEPA and UVC are "Passive" devices, meaning they "wait" to react and do their work.
- Ventilate- but only if particles are controlled and if system can handle the higher outside air without creating other issues

Questions?


GPS-DM48-AC
Cleaning Cycle Test
Power
POWER ON
PLASMA ON
ON
OFF