

Should Ionization be Part of an Effective IAQ Strategy

August 17, 2021



Negative Ionization News

2

- Global Plasma Solutions is sued in a class action lawsuit claiming GPS made false advertising statements and claims for financial gains.
- Trane tests ionization. Mixed results on ionization benefits.
- Boeing tests ionization and determines it does not clean surfaces.
- 3 Colleges (Portland State University, Illinois Tech and Colorado State University) test ionization and question if ionization works.
- Several media outlets run stories about ionization manufacturers taking advantage of consumers especially schools spending federal grants on ionization.
- Ionization competitors putting out articles/reports attacking ionization claims.
- Articles questioning ion testing procedures and their results.



Negative Ionization News

- Some commentators say that ionization has not been around long enough to have been peer reviewed.
- When researching ionization online, some articles show how well ionization works and some articles talk about how ionization doesn't work.
- Boeing conducted testing on ionization. Their conclusion was they could not duplicate other 3rd party testing.
- Several major HVAC companies are not utilizing ionization:
 - Trane
 - JCI
 - Siemens
 - Watsco
- Much of this information is very technical. It is hard to know what studies and data are accurate even if you are a technically savvy.



iAIRE's Opinion on Ionization

- Ionization has been around for more than over 100 years.
- Claims made by other ionization manufacturers have hurt the ionization industry as a whole and many of these claims are not true.
- Ionization is not the “magic bullet” that will solve all indoor air quality issues.
- Ionization is a very good air cleaner and purifies the space.
- Ionization does help remove SARS-CoV-2 from the air when used properly.
- Ionization has proven to remove 436 VOCs of a total of 477 from the air when used properly.
- Ionization should be used properly with the rest of the HVAC system to deliver predictable results.
- Ionization helps agglomerate particulates in the air which leads to better filter efficiencies. – Proven to increase MERV Ratings by 4 – 5 MERV (MERV 8 to 13 and MERV 12 to over 16)
- Ionization has the lowest total installed cost to help improve indoor air quality. Low to no maintenance costs or replacement parts and components.
- Ionization is easy to install.
- Most of the cleaning done by the ions are done near the device producing the ions.
- Ionization does very little surface cleaning.
- Monitoring ionization in a space does not guarantee that the air is clean.
- iAIRE does not recommend downsizing the HVAC system with the use of the ASHRAE 62 IAQ procedure.



Ionization has been around forever

5

- Ionization occurs naturally like rain, waterfalls, high mountain regions so ionization has existed on Earth since water first formed on the planet.
- Ionization has been known for many years having been recognized by the Father of Modern Chemistry, JJ Thompson, in 1899.
- It has been tested by numerous universities and manufacturers.
- Ionization has been shown to be a very effective air cleaner when properly used.
- The production of ions has changed in the last 15 years as it was determined that ionization could produce ozone that was harmful to humans if produced improperly.
 - Reduced ion output to eliminate ozone.
 - Meet UL867 standard.



False Claims by other manufactures

7

- Ionization will solve all your indoor air quality issues.
 - It is a “magic bullet” solution
- Ionization is a good surface cleaner.
- Monitoring ionization in the space guarantees that the air is clean.
 - There are appropriate levels of ionization in the space that ensures clean, healthy air
- There is only one manufacturer of ionization that is UL867 certified.
- Ionization output on submittals is accurate.
- Other ionization manufacturer’s ionization product is inferior.



False Claims by other manufacturers

1. Ionization will solve all indoor air quality issues. It is a “magic bullet” solution.
 - Ionization is **not** an end all solution for indoor air quality. It is a very good air cleaner when used appropriately.
2. Ionization is a good surface cleaner.
 - Testing done by iAIRE as well as many other sources has shown there is a small amount of surface cleaning provided by ionization, but ionization should **not** be relied upon to clean surfaces.
 - Some other technology should be used to clean surfaces.
3. Monitoring ionization in a space guarantees that the air is clean.
 - All ionization monitoring reports is the presence of ions in the space. It does **not** indicate if the monitored air is clean or dirty
 - In systems that are installed and working properly, small amounts of ions will be present in the space. These ions do help to clean pathogens from the air, but the bulk of the cleaning is done very near the ionization device, normally after the fan.
 - Monitoring VOCs indicates if the air is clean or unhealthy. iAIRE recommends the use of VOC sensors **with** ionization generators for proper feedback of the condition of the air space.
4. There are precise levels of ionization in a space that ensures clean air.
 - As stated above with ionization monitoring, a specific level of ionization in a space does **not** guarantee the air in the space is clean and healthy.
5. There is only one manufacturer of ionization that is UL867 certified for **NO** ozone Production.
 - Almost every major US manufacturer of ionization has UL867 certification



False Claims by other manufacturers

9

6. Ionization output on submittals is accurate.
- The published data of manufacturers of ionization is very different than what iAIRE has tested under controlled conditions. How do these manufacturers really know what is required to clean the air. How can a device with a lower ion count clean more CFM?

	Max tested Ion count (Millions)			Published Ion Counts (Millions)		Difference	Published	Actual
<u>Unit</u>	<u>±</u>	<u>:</u>	<u>Total</u>	<u>:</u>	<u>Total</u>	<u>(Millions)</u>	<u>Airflow (CFM)</u>	<u>Ion/cfm</u>
iAIRE ION-0AA00	156	133	289	155	310	0	2500	115600
GPS-FC24	48	111	159	150	300	-141	2400	66250
GPS-FC48	129	169	298	200	400	-102	4800	62083
GPS-DM48	138	156	294	200	400	-106	4800	61250
Phenomenal Aire R6.0	57	56	904	1500	3000	-2096	6000	150667

All units tested AC voltage



False Claims by other manufacturers

10

7. Other ionization manufacturer's ionization product is inferior technology.

- Since it is understood that the way ionization cleans air is by the production of the most ionization without producing ozone, then the best technology in the market would be the company producing the most ions **without** producing ozone. As seen from the ionization output chart from the previous page, iAIRE produces the most ions **without** producing ozone for the lowest price in the market. That would mean that iAIRE has the best technology in the market.



Ionization is a very good air cleaner

11

- Ions are present naturally in the air and are found in the highest concentrations near ocean shores, waterfalls and high elevation in the mountains and after rainstorms.
- The ionization process will artificially create the ions found in these desirable locations and supply them into the building, enhancing the indoor air quality. The process has been around since the late 1800's



What does Ionization impact?

12

- Virus
- Bacteria
- Mold & Mildew
- Smoke
- Radon
- Pathogens
 - Staphylococcus (Staph)
 - E. Coli
 - MRSA
 - Legionella
- VOCs

Independent Laboratory Tests			
Human Coronavirus Incubation Period - 60 Minutes Rate of Reduction - 90.0% Surrogate for Human Coronavirus SARS-CoV-2, actual strain tested was Human Coronavirus 229E ALG	Legionella Incubation Period - 30 Minutes Rate of Reduction - 99.7% EMSL	E.coli Incubation Period - 15 Minutes Rate of Reduction - 99.6% EMSL	Tuberculosis Incubation Period - 60 Minutes Rate of Reduction - 69.0% EMSL
Staphylococcus Incubation Period - 30 Minutes Rate of Reduction - 96.2% EMSL	Norovirus Incubation Period - 30 Minutes Rate of Reduction - 93.5% Surrogate for Norovirus, actual strain tested was Feline Calicivirus, ATCC VR-782, Strain F-9 ATS LABS EXCELLENCE IN ANTIMICROBIAL TESTING	Clostridium Difficile Incubation Period - 30 Minutes Rate of Reduction - 86.8% EMSL	MRSA Incubation Period - 30 Minutes Rate of Reduction - 96.2% EMSL



Ionization does help remove SARS-CoV-2

14

- Independent test results (see previous slide) show that ionization can aid in the **reduction** of the amount of SARS-CoV-2 in the air.
- Testing by Trane reported in “A Taxonomy of Air-Cleaning Technologies Featuring Bipolar Ionization” (used by Trane to explain why Trane was not utilizing ionization) shows that ionization **reduces** SARS-CoV-2 in the air.



Ionization does help remove VOCs

15

- There have been various studies by numerous universities and manufacturers that have tested ionization's impact on the removal of VOCs from the air.
- The results from these studies are contradictory.
- When reviewing how ionization was applied to the space being tested, almost all these tests and how ionization was applied in the space used different methodologies.
- iAIRE believes that if ionization is installed properly (see next section), ionization will reduce many VOCs from the air.
- The ionization energy level when ions are produced electrically is high enough to help remove many VOCs (even new devices with lower power that meet UL 2998 ozone production).
 - The maximum power limit to not produce ozone would be 12.07 eV



Proper installation

16

- Install the ionization device **after** the filters prior to the supply fan.
- Size appropriately to clean the CFM moving in the air. The only time iAIRE reduces the CFM load of the ionization is in smoking or kitchen equipment environments.
- HVAC distribution and filtration system sized appropriately.
- Constantly circulate the air during occupied hours. This is required to bring the appropriate outside air into the space and helps the ionization work better.
- Almost all the air cleaning is done near the ionization device.
 - Need mixing of air
 - Installation after the blower because the most turbulent air mixes the ions and allows the ions to be spread over a larger area for cleaning
 - Ions normally are gone in about 60 seconds
 - The most ionization and potential to clean the air flow is near the ion device



Ionization and filtration

17

- Because of way that ionization works, there is an agglomeration process that happens with some airborne particles that make them larger. This makes it easier for these particles to be caught in filters or potentially fall to surfaces easier, removing them from the air.
- The larger particles are prevented from getting into human lungs.
- Ionization helps improve filtration rates on filters. A MERV 8 filter used with ionization increases the effectiveness of the filter to a MERV 12 rating.

Particle Sizes

18

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

PM_{2,5}

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:



Independent Test Results

19

% of SARS VIRUS CONTROLLED BASED ON TECHNOLOGY¹

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%	98.8%
15	71%	97%	99.0%
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 later

**Does not take into account ionization treats the occupied space

***UVC does not effectively kill airborne pathogens in high RH conditions²

2. ASHRAE Technical Paper on
Airborne Infectious Diseases

1. 2009 EPA Tech Paper



Ionization Increases Filter Merv Rating 4-5 Points

20

If MERV 13 Filters cannot be installed, consider the following:

- Increase the filtration in the Unit to the maximum available
 - Provide a recirculation fan filtration unit and duct into the return of units
 - Provide a HEP filtration unit which recirculates the air within the space
 - **Consider Air Ionization system or static charge on filters**
 - Consider UV treatment BUT review location to avoid impacts of liners and other internal components
 - Refer to ASHRAE filtration and Disinfection System section for additional information
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- MERV 8 + NPBI => MERV 13 (Blue Heaven labs)
 - MERV 12 + NPBI => MERV 16 (NRC Canada)
 - Saves cost of higher MERV filter + fan energy





Ionization and filtration

21

- In an existing building (and HVAC system) iAIRE believes ionization with MERV 13 filters provides the best approach to provide clean air to building occupants and visitors.
 - Most standard units have 1-2" MERV 7 or 8 filters
 - The cleaning potential of a filter **only** is around 11%
 - The cleaning potential of a filter **plus** ionization is around 80%
 - Going to 4" MERV 13 filters has the same static pressure drop as a 2" MERV 7 or 8 filter.
 - No changes to the fan or electric system
 - The cleaning potential of a filter **only** is around 46%
 - The cleaning potential of a filter **plus** ionization is around 98%



Cost of ionization

22

- Changing existing HVAC systems to add HEPA filters and/or UV lights to help clean the air is very difficult.
 - HEPA filters would add significant static to the system. This would require a new fan/motor combination to overcome the increased static. This larger fan/motor might not fit in the existing unit. It would also require additional electrical capacity to run the larger fan/motor.
 - Normal UV light installation is designed to keep the coils clean on the unit, but only cleans what it sees. Shadowing only allows the top 1/3rd of the fins to be cleaned. The dwell time of the air in the vicinity of the UV light is not long enough to kill most airborne particles. To kill the particles, there would need to be more UV lights added into the ductwork, so that the UV light is in contact with the air long enough to kill airborne pathogens. Installing UV lights and electrical in ductwork not designed for this application is almost impossible.
 - UV lights lose efficacy by more than 50% in less than 6 months. Install costs and the need to protect all insulation, wiring and belts is timely and mundane, but necessary.
- Ionization can be installed in an existing HVAC system to help clean the air without a major overhaul of the HVAC system.



Comparing Air Cleaning Technologies

23

	<u>NPBI</u>	<u>Corona Discharge</u>	<u>HEPA Filters</u>	<u>Carbon B</u>	<u>Ultraviolet (UV)</u>	<u>UV-PCO</u>	<u>Scent Generators</u>
Destroys VOC's	Yes	Yes	No	Captures	No	Yes	No
Reduces Airborne particulates	Yes	Yes	Yes	No	No	No	No
Kills Pathogens, bacteria, virus & germs	Yes	Yes	No	Captures	Yes	Yes	No
Treats in-room air	Yes	Yes	No	No	No	No	Yes
Produces harmful byproducts	No	Yes	No	No	Yes	No	Yes
Maintenance	When brushes go bad	2 years	Quarterly	Monthly	Yearly	Yearly	Monthly
Easy to install	Yes	No	No	No	No	No	Yes
Low total cost	Yes	No	No	No	Yes	Yes	No
Reduces Energy Cost	Yes	Yes	No	No	No	No	No
Re-engineering of HVAC needed	No	No	Yes	Yes	No	No	No
Produces Ozone	No	No	No	No	Yes	Yes	No

NPBI = Needle point bi-polar ionization - This is the form that iAIRE sells



Does ion count in the space matter

24

- Systems that were described previously with properly installed ionization will eventually cause ions to migrate to a space downstream from the ionization source.
- Low quantities of ions that are measured in the space by themselves are not enough to clean the air.
 - Several manufacturers claim that 1,200 ions/CC or 5,000 ions/CC are enough ion concentration in a space to clean the air
 - This is why some of the testing that has been done by 3rd parties have shown that ionization does not clean VOCs (and other contaminants from the air).
- This means that even if the BAS is reading ion concentrations in a space, there is no guarantee that the air is clean.
- Therefore, iAIRE has **always** recommended measuring VOCs in the space. Measurement of the VOC level in a space is the best way to know if there is clean, healthy air in the space.



ASHRAE 62 IAQ procedure

25

- ASHRAE 62 is the standard that describes how much outside air is required to be brought into a building to maintain a healthy environment for occupants.
- There are two recommended procedures on how to calculate this standard:
 - Ventilation rate procedure (VRP). VRP is used for most buildings.
 - IAQ procedure (allows an engineer to determine a lesser amount of outside air to be used in the building).
- Less outside air means less load on the system.
 - Potentially lower capital costs because of smaller units
 - Lower utility operating cost because of less air to heat/cool/dehumidify in the space
- 2 Ways to apply IAQ procedure
 - Design system up front to bring in less outside air
 - HVAC system is downsized to permanently bring in less outside air
 - Gets both a capital and utility savings
 - Utilize iAIRE's patented process
 - Use a system sized for VRP
 - Use VOC and CO₂ sensors to monitor the air and bring in less outside air when sensors determine less outside air is required based on the iAIRE algorithm
 - **Only** utility savings but can be as much as 30% savings



ASHRAE 62 IAQ procedure

26

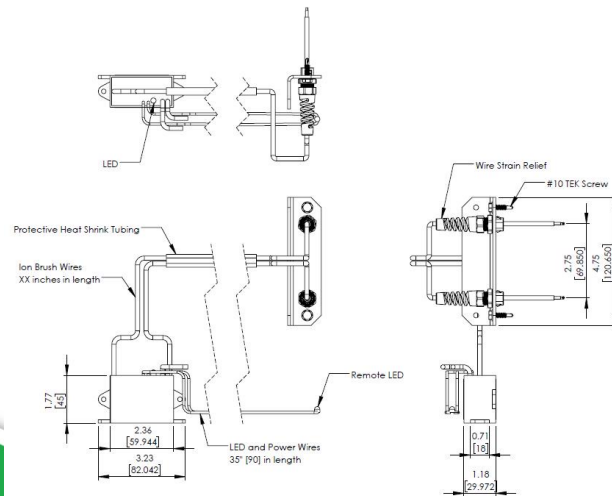
- One of ASHRAE's main goals is that all HVAC designs do not cause **any harm** to the occupants of the building.
- ASHRAE has always relied on **diluting the air** to make a building safe for occupants.
- Designing a system with the IAQ procedure that **permanently** reduces the outside air could mean
 - If something happened where a contaminant existed in a space that ionization or the reduced amount of outside air could **not** remove/dilute, the possibility exists that high concentrations of contaminants or pathogens that are harmful to the occupants could then build up in the space.
- iAIRE believes that ionization **does reduce** many of the harmful contaminants or pathogens in the air, but it does not reduce **all** of them. Because of this, iAIRE recommends **not** utilizing the IAQ procedure to reduce the size of the equipment. iAIRE **only** recommends:
 - Utilize a system designed to bring in the VRP outside air
 - Utilize the iAIRE patented system with a VOC and CO₂ sensor to reduce the outside air when the space can handle the outside air reduction
 - **NO** capital equipment saving
 - Significant utility savings
 - The reduced outside air intake should not cause an issue with occupants as the system will deliver the VRP outside air to the space, if the system is properly installed and maintained according to the ASHRAE 62 procedure.



Made in America

27

- iAIRE has two ion devices that comply with the Made in America ACT.
 - Stand alone device 61% Made in America
 - Duct device 78% Made in America





Why utilize iAIRE's ionization

28

- iAIRE has the best understanding of how to apply ionization in systems.
- iAIRE is not making claims that can possibly lead to legal issues.
- iAIRE has been advising for years to monitor clean air with VOC sensors when using ionization as the only way to tell if ionization is cleaning the air in a space.
- iAIRE's patented process.
 - If this is specified, there will be **NO** competition due to the patented process
 - The patented process can be installed on any OEM platform