



See Air Differently



4+ Decades of Experience

It's all part of **how we deliver** a clearer vision of what's possible with **better air** – and **turns** the **invisible into something incredible**.

90% of the top 30 MEP consultants have specified AtmosAir.







AtmosAir Selected World Class Customers in Core Market Verticals



How It Works



- AtmosAir leverages a patented and proprietary Dielectric Barrier Discharge Bi-Polar Ionization technology.
- In pristine environments there are naturally higher ion levels. AtmosAir's goal is to increase indoor Bi-polar ion concentration by 3-4x ambient (500-1500 ions/cm3) replicating ion rates found in natural levels.
- AtmosAir Ion Lifespan: 300 seconds
- Composite AtmosAir tubes leverage nonthermal plasmas generated by Dielectric Barrier Discharge process.



DBD BPI Benefits



- 1. Dielectric Barrier Discharge process leverages up to 75,000 ion emitters per typical Composite tube.
- 2. Ions generated using voltage and AC at very low amperage.
- 3. Verified Ozone Free Technology UL 2998/UL867A Certified.

How It Works

AtmosAir BPI breaks down the structure of known pathogens, **such as coronaviruses, molds, bacteria, and other complex contaminants**.

- Positive (+) and Negative (-) ions are introduced into the air via the AtmosAir system.
- Negative (O2-) ions surround the hemagglutinin (surface proteins that form on organisms and trigger infections) and change into highly reactive OH groups called hydroxyls (•OH)
- Hydroxyls steal hydrogen from the hemagglutinin, and return to the air as water, leaving holes in the membrane.
- lons destroy the virus surface structure, for example its envelopes and spikes, on a molecular level. As a result, the virus cannot infect even if it enters the body.

Source: Dr. John Oxford, Professor, Institute of Cell and Molecular Science at St. Bartholomew's and The Royal London Hospital. Dr. Oxford is a world respected authority on virology.





Installations – FCUs





Published Data – Coronavirus, Mold Spores, Ultrafine Particulate

Study Report – Coronavirus 229E

Test Report | Microchem Laboratory

Test Results at 30 minutes

Study Title Virucidal Efficacy of a Test Substance For Use on Inanimate, Nonporous Surfaces

Standarized Test Method

ASTM E1053

Maximum Ionization Rate

1,500 ions cm/3

		Test Results Replicate 1 30 minutes	Test Results Replicate 2 30 minutes	Test Results Replicate 3 30 minutes			
Cell Control		0000	0000	0000			
Dilution	10 ⁻¹	000+	000+	0000			
	10 ⁻²	0000	0000	0000			
	10-3	0000	0000	0000			
	10-4	0000	0000	0000			
	10-5	0000	0000	0000			
TCID ₅₀ per 0.1 ml		0.75 Log ₁₀	0.75 Log ₁₀	≤0.50 Log ₁₀			
TCID ₅₀ per Carrier		1.05 Log ₁₀	1.05 Log ₁₀	≤0.80 Log ₁₀			
Average Log_{10} Reduction		2.78 Log ₁₀					
Average Percent Reduction		99.92%					

CROCHEM





Test Result

The presence of coronavirus was reduced by 99.92% within 30 minutes of exposure to DBD BPI

Key: + = Virus recovered; 0 = Virus not recovered and/or no cytotoxicity observed;

T = Cytotoxicity observed; †Taking cytotoxicity and neutralization controls into account.

Peer Reviewed and Published Academic Research Supports DBD BPI

- a. BPI systems leveraging nonthermal plasmas generated by dielectric-barrier discharge technology, as an air disinfection strategy to control viruses, airborne microbes, and particles, have been *reviewed positively* in over 30 peer reviewed studies in the past twenty years. Many of these studies have been published in the most reputable academic journals.
- b. There is little to no published or peer reviewed research on needlepoint ionization. Needlepoint ionization has yet to have any academic institutions or journals publish third-party findings or case studies.
- c. Data on Needlepoint ionization is typically coming from a manufacturer claiming product effectiveness.
- d. In many controlled environments as well as large scale commercial air distribution systems, AtmosAir Solutions has been thoroughly tested and vetted many different needlepoint ionization systems.

Peer reviewed an	d published studies that s	upport air ionization techn	ologies to reduce								
airborne viruses, microbials, and particles.											
Efficiency of insizers in removing airborne particle in indoor environments.											
	Peer Review Publication: Journal of Electron	statica, 2017.									
lonizing air affects influenza vi	https://www.sciencedirect.com/science/article	Effect of negative air ions on the potential for	bacterial contamination of plastic medical equi	ipment.							
Peer Review Publication: Nata	Chartich.chr/s20thmber/s20thinfs/2009 Peer Review Publication: EMC Infections Dansee, 2011 https://publication:EMC Infections Dansee, 2011 https://publication:EMC Infections Dansee, 2011 https://publication.EMC Infections										
This study proved that an ionizati virus was released into the air, no	20thar, not%20ar%20teal%20tiff%20tervision This study evaluated the efficiencies of an air	This study proved that ionization systems can aid	st in charine classic natriali used in lexitali, and fair the charge or the inlationatival surface nor need batteria. Bacterialial efficien of plasma generated chatter ions.								
	effective than the ionization system in the two	Cleaning Indeor Air using Bi-Polar Ionization	Peer Review Publication: Medical & Biologic	cal Engineering & Computing	2005. https://putened.ncbs.nim.mih.gov/	16:94:909					
Evaluation of ionic air purifiers	concluded that air ionizationsystems are more also showed that ions produced by the ionizer	Link to paper: Cleaning Indoor Air using Bi-?	Are particulated by plasma-generated tose relies on a retariory newer tethnologies positive and negative ions. Plenomenological tests have already at the shown strong = verdence of their different of roots or runnings market market and the start of the shown strong market and the start of the strong								
Peer Review Publication: Indeo	from the air in these rooms in the process.	Dr. Philip M. Tierno, Jr. is a well-known microbi Dispeter of Clinical Microbiology and Dispeter	organizms and to explore possible mechanizms of horizing Exposure of Laboratory Animals to Small Air Insu: A Systematic Review of Biological and Behavioral Studies.								
This study proved that air ionizati		Microbiology and Pathology at the New York Ur	2.4 h of exposure. The destructive effect of the PCIs of Peer Review Publication: <u>Biological Engineering</u> , 2018. <u>https://publical.engineering</u> ,								
	Removal of Viable Bisaerosol Particles wit	has identified on the efficacy of Bi-Potar Ionizan	revision using a net conclusion makes provide or the second secon								
On the Ionization of Air for Re Contaminants with Nontherma	reer Keview Publication: Indoor All, 2008.	Efficacy of Bi-roby Innication on Various Par		consistent or reliable effects on measures of behavior, learning and memory, neurotransmitters, tracheal function, i reproduction and growth, carcinogenesis, orother health ends. Learning and memory interviewed with and acception are in			nization to prevent tuberrulous transmission.				
Poor Review Publication: IEEE	Citatila Caiversky in Alserana conducted its	Link to meanth: Efference of Bi Boles Ionization	Effectiveness of negative air ionization for re	emovin ficalth.							
Dr. Stacey Daniels, PhD and prof	Air instantses and calculation infaction or	Dr. John Oxford is a world authority on virology.	Peer Review Publication: The Canadian Socie	iety for E	The star Delegant A Comme	Peer Keview Publication: PLoS bledkine, 2009.	mps www.researchgate.net/publication-45280429_U	and the second			
most in-depth papers that has been	Peer Review Publication: Intensive Care Me	Mary's School of Medicine and Dentistry, Londo	This study aimed to investigate the effectivener airtight chamber. Subsequently, an air ionizatio within the chamber at oredetermined time inter	on syster rvals (5	cation: Journal of Negative Results in Bi	Koren LUD2VOIR Lagit and Negative Air Ionization to Prevent Intercuites Instantasion This study showed that using an airlonne inferition model, results demonstrated that ionizers prevented 60% of TB infection and 51% of TB daease. Conclusions: This study is the study are intercuine model, results demonstrated that ionizers prevented 60% of TB infection and 51% of TB daease. Conclusions:					
Experimental evaluation of pos	The research team studied the effect of air ion memory care unit within a hospital. Multiple Devices unre then commission for the follows:	Numerical and esperimental study on airborn	concentration of the bioaeroscie prior and after results indicated that the air ionization system s	generati This study conclude significa	d that the exposure to negative or positiv	Opper-toon UV ugits and negative an ionization e	ach prevenies non aroune 15 dansmission seecas	or of gomes pig an sampling.			
Peer Review Publication: Build	months.	Peer Reviewed Publication: Building and Envir		Evaluation of an F	lectrostatic Particle Ionization Techno	Plasma Cluster Jans Reduce the IgE-Binding Ca	pacity of House Dust Mite Allergens under a Simul	ated Indoor Environmental Condition.			
This study investigated the effect	infections.	https://www.researchgate.net/publication/320882	The bactericidal effect of an ionizer under lo	ow conc Poor Review Publi	ration: Aerobiologia 2016, https://www	Poor Roview Publication: International Archives of Allergy and Immunology, 2017. https://pubmed.ncbi.nlm.nh.gov/28848159/					
disinfection efficiencies were as l electrostatic filters/precipitators.	Application of corona discharge-generated	The research team developed a mathematical mo while predicting the efficiency with which it inac airborne microorganisms in ventilation systems.	Peer Review Publication: B30C Microbiology The effect of air ions on bacterial killing was co- bacteria and ion canture dramatically reduced	er Pohlensine: Bio: Microbiology, MM the objectives of this may neve to determine the effect of use of the instances coupled of the instances of the DMU dilegress was significantly impaired due instances of the DMU dilegress and the instances of the instances							
The Marster for America	Poor Review Publication: Journal of Aeroso		ions produced were responsible for almost all th	dae bacte		infor the M2- onoting capacity of anothe PLOSE	aneigens in a sannaaren environnennai consinton.				
The effect of surface charge, he	The research team studied the effect of coron	Indoor air pollution control through ionization	mooring oppositive states and tenoring opposite	Bactericidal effoct	s of negative air isns on airborne and s	Departies Research of Monodicators and Baladi	irnenes Salumirous Basticles by a Naustica Lie Iani				
This study suprosts the position a	aerosols were captured by the filter for a cert	voteam of a medium-efficiency ar failer to rough were captured by the filter for a cent. Peer Review Publication: Air Pollution, 2004.)		Peer Review Publi	cation: Journal of Food Protection, 2001	and Protection, 201 Protection					
of bacteria attracted per unit area	filter by soncation, and their antiviral efficient exposure time and ion concentration. When the times of 15, 30, and 45 min, respectively. Wh 6 & VIO and 3 & VIO insulational constitute	This study investigated the effect of air ionization ionization was compared to the natural decay for	Peer Review Publication: Journal of Physics,	2007. ht space such as food	udy indicate that increased levels of nega 1 of the organisms. This technology, whi processing areas, medical institutions, the	This study found that an air ionizer can enhance the measurement of deposition rate.	submicron particle deposition rate up to 115-fold. Pol	ydispense coagulation considerably affects the			
	quantitative parameter for the performance ev as 5 \$x10=3. \$ 4x10=3 and 0 \$x10=3 reserve	efficiency for respirable (sub- and super-microme emission: up to 92% of E. coli was inactivated do	Electrical phenomena can act as major transpor and macro-environments can be created throug	et and re gh the de							
	treatment.		International Geour-Groundena	Effect of a comme	rcial air ionizer on dust mites Dermato	Sterilization effects of negative air ionization on	a chamber aerosolized with Salmonella enteritidis.				
		Negative Air Ions and Their Effects on Human	Aicharas sing inactivation with churter leaves	Peer Review Publi	eation: Asian Pacific Journal of Tropical	Publication: U.S. Department of Agriculture, 20	01. https://www.are.usda.gov/weearch/publications/pu	htiration/?oxqNo115=112644			
		Peer Review Publication: International Journal	Poer Review Publication: Sharn Technical Ion	This study demonst	rates the increasing mite mortalities with an be used to reduce natural mite popula	This study tested whether ion-enriched air exerted a	bacteriocidal effect on aerosolized Salmonella Enteri	idis. In a <u>3 hour</u> test, agar plates			
		Experimental data showed that air ionization syst	Researchers investigated the effects of air ions	mites inside stuffed	materials as in mattresses and furniture.	Salmonella. The ionized plates had less than 20 cell	sonization. The plates were then incurated for 24 hour is plate, while the un-ionized plates had more than 100	s to ortermine growth rates of the 0 cells/plate.			
	of influenza vinues in the MDCK cells were that cluster ions inactivate influenza vinues		ar. Othe	violet light and negative air ionization							
			viruses or constachie viruses.	Peer Review Publi	cation: PLoS Medicine, 2009. https://ww	Air Ion Behavior in Ventilated Rooms.					
				Room Ultraviolet	Light and Negative Air Ionization to	Peer Reviewed Publication: Indoor and Built Envi	ronment, 2008. https://journale.sagespub.com/doi/abs/1	0.1177/14205253200089622			
				This study showed Upper-room UV Is	that using an airbome infection model, re fits and negative air ionization each prev	This study presents experimental data and a theoret demonstrate how, with an ionizer in operation, the i having a minimal influence.	ical model to examine the factors that influence the co- on concentration is governed by ion—ion interactions	ncentration of sons in a ventilated room. The results and electrical deposition at the walls, with the ventilation rate			
						-					

Solution Agnostic Leadership

Clean Air Group manufacturers many IAQ solutions including Dielectric Barrier (DBD) Bi-Polar Ionization Systems and Needlepoint Ionization Systems

Clean Air Group has been manufacturing air ionization systems, and other IAQ control systems, for over 30 years.

- Solution agnostic leadership in IAQ industry.
- BPI solutions for ALL air distribution and air handling configurations.

Robust Product Design

AtmosAir systems are built to be robust and withstand harsh commercial environments.

- An AtmosAir FC tube uses a 21-inch tube (electrode) to treat approximately 2,000 square feet or 2,000 CFM.
- A most critical difference with AtmosAir's technology is that the electrode is inside of the AtmosAir ion tube. The electrode/cathode is not exposed to ambient conditions.
- AtmosAir BPI Systems are UL2998 Compliant or Verified Zero Ozone Technology.
- The design of the AtmosAir tube prevents the electrode/cathode from acting as an electrostatic precipitator. An exposed design will attract particles to the 'needlepoints' wearing them out over time.
- AtmosAir's unexposed electrode design prevents oxidation from occurring as quickly as an exposed design. As electrodes/ion emitters are exposed to ambient conditions, while being subjected to relatively high voltage, they oxidize and eventually wear out. Very similar to how a spark plug operates.
- An AtmosAir 508FC has (8) 21" tubes per system. Each tube has 75,000 ion discharge sites. A 45,000 CFM air handler would require (24) 21" tubes or 1,800,000 ion discharge sites.

AtmosAir 508FC

Each AtmosAir 508FC system has (8) 21" AtmosAir tubes. Each tube has a 21" electrode in the core of the tube. The electrode is not exposed to ambient conditions.



AtmosAir Dielectric Barrier Discharge BPI generates precisely controlled Nonthermal Plasma (NTP). Needlepoint Ionization does not.

- a. University of Michigan has proven that Non-Thermal Plasma (Cold plasma) can kill 99.9% of airborne viruses. <u>https://news.umich.edu/cold-plasma-can-kill-99-9-of-airborne-viruses-u-m-study-shows/</u>
- b. Non-Thermal Plasma is very similar to a flame it just does not have the high temperature.
- c. Needlepoint ionization does not create Nonthermal Plasma. It leverages a corona discharge or 'spark' effect to generate reactive charged species.



University of Michigan NTP Study



Example Dielectric Barrier Nonthermal Plasma Discharge

Real-Time Indoor Air Quality Measurement, Verification and Controls

AtmosAir has been awarded for being an intelligent air purification system with demand-controlled capabilities (AtmosSmart, AtmosAware).

- a. AtmosSmart is an integrated in duct air monitoring system, that connects to the AtmosAir bi-polar ion unit and will adjust Bi-Polar Ion levels based on feedback from the IAQ readings it is measuring. This is to provide optimal ion levels.
- b. AtmosSmart and AtmosAware measures and controls around 8 parameters of IAQ: TVOC, particulate matter (PM2.5), formaldehyde, ozone, carbon dioxide, carbon monoxide, relative humidity and temperature.
- c. All AtmosAir systems have various control settings they can be run at. All AtmosAir systems have various BMS integration controls including continuous Indoor Air Quality monitoring.
- d. Needlepoint ionization manufacturers typically do very little when it comes to commissioning, measurement, and verification of actual air cleaning performance.
- e. Needlepoint systems can not be adjusted. They run on (1) ionization setting out of the box.





AtmosAir with an Impact

•Real-World Performance Test data

- · Over 100 proof of concept projects with testing and third-party data.
- Proof of concepts accomplished across major verticals. Everything from a 1-year pilot at the Staples Center to testing at many hospitals.

AtmosAir Laboratory Test Data

- Microchem Laboratory, a leading lab for testing EPA- and FDA-approved products, tested AtmosAir's virucidal efficacy on Human Coronavirus, Strain 229E. The test, completed to a standardized ASTM E1053 protocol, demonstrated greater than 99.9% efficacy in reducing the presence of the virus under simulated real-world conditions.
- AtmosAir has performance data vs. influenza, MS2, MRSA, Staph.

Peer-Reviewed Studies

- There are over 30-peer reviewed studies that support our technology, air ionization with nonthermal plasmas generated by dielectric-barrier discharge.
- Strong reference list of published studies in respected academic journals.

·IAQ Controls and Monitoring.

 Thanks to public grants and many years of work and dedication, AtmosSmart is the only air treatment solution with intelligent controls and continuous measurement and verification.

•Whitepapers/Presentations by Respected Third Parties and Consulting Engineering Firms

90% of the top 30 MEP consultants by revenue are specifying AtmosAir in new designs.

AtmosAir Case studies, Testimonials, Videos

- · Portfolio adoption with many high profile and Fortune 500 companies.
- Filmed and published case studies.
- AtmosAir Intro video: <u>https://www.youtube.com/watch?v=SIsYA0OjCJU</u>